The "Confidence Fairy" in the Eurozone: A Panel Threshold Analysis*†

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Abstract

In response to the economic crisis of 2007-2008, the Eurozone invoked the "confidence fairy" and chose austerity. We put the confidence fairy hypothesis to an empirical test. We estimate a heterogeneous dynamic panel-threshold model using quarterly data on 22 countries (grouped into countries in and outside the Euro area) over the period 2000-2018. We provide evidence for the presence of a common sovereign spread-threshold effect on output growth in the Eurozone. For Eurozone countries who experienced a change in the sovereign spread greater than a threshold (in times of financial stress), growth is shown to have lowered significantly. This is evidence of the extant influence of the "confidence fairy" effect engendered by "bond vigilantes". It is moreover evidence of the financial fragility of the Eurozone. This highlights the need for a strong European Central Bank to counterbalance the influence of "bond vigilantes". For non-Eurozone countries, no panel threshold effect is found. This does not support the policy of implementing an austerity program to lower the sovereign spread and hasten recovery from crisis since no "confidence fairy" effect is generated.

Keywords: sovereign spread, output growth, confidence fairy, austerity, and panel threshold

JEL: F36, F43, F45, C33, E44

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1 Introduction: Rationale of the Study

A recent controversy in International Finance is Paul Krugman's "confidence fairy" argument against the justification for implementing an austerity program. Krugman introduced this concept in a series of articles in the New York Times, from 2010 to 2012, to criticize the US Republican party's conservative approach to implementing an austerity program. His argument focuses on attacking the supposedly fallacious fear of conservatives about an impending sovereign debt crisis that would arise if the US congress fails to control the government's deficit spending, which may lead to an unsustainable debt accumulation path. He further lambasted the Republicans for their resolute belief on the all-embracing influence of the "bond vigilantes" who call for austerity to calm investors and the market as a whole and keep the sovereign spread low.

The neo-classical argument supported by the US Republican party is formulated as follows. The economy faces an unsustainable path of debt accumulation (Reinhart and Rogoff, 2010), then to thwart the imminent crisis foreboding, there arises the need to implement an austerity program to calm worries among investors. Otherwise, the "bond vigilantes" (i.e., investors and creditors) would panic and this would lead to a sudden increase in the borrowing cost as reflected in the sovereign spread (i.e. the rate at which the economy borrows funds from abroad). This would require to trigger the "confidence fairy" by implementing an austerity program to counteract the panic effect. Krugman (2018) categorically insists that the "confidence fairy" is a myth and does not exist and taunts the neo-classical conservatives not to heed the demand of "bond vigilantes" for the immediate implementation of an austerity program.

The supposed existence of the "confidence fairy" begs two main questions. Can the sovereign spread significantly affect output or any other real variable for that matter? And if so, can succumbing to the demand of "bond vigilantes" to implement an austerity program lead to a supposed increase in "confidence" among consumers and investors, and thus lay the groundwork for a speedy recovery from recession? While the first question focuses on the capability of financial variables to influence real ones, the second question regards the transmission mechanism.

These issues are not new. Otmar Issing (2008), first President of the European Central Bank (ECB), early on during his first years in office, raised the issue of whether the ECB should allow the market (i.e., meaning the "bond vigilantes") to unduly influence the pricing of sovereign bonds (i.e., the sovereign spread). If the market has indeed shown an influence, then current available data would be able to reveal a significant effect of the sovereign spread on growth in output. And if the effect is significantly negative, then this may mean that the "bond vigilantes" effect work through a "confidence fairy" mechanism. The lowering of the sovereign spread would immediately translate to an increase in growth in output. Our analysis of the data should be able to clarify these issues.

In the state-of-the-art review of the literature, there is a significant dearth of materials on the "confidence fairy" to provide empirical evidence. One exception is Hassan and Wu (2015) that estimates the negative effect of the credit rating of sovereign debt on the economy's business cycle (defined as deviation of actual growth of per capita Gross Domestic Product (GDP) from the trend for monthly panel data of 76 emerging and developed countries from Jan 1996 to May 2010). Moreover, they emphasize the transitional effect of credit ratings of sovereign debt on the business cycle rather than directly on the permanent real effect via the growth trend[1]. There is however a recent salvo of important

[1]They however cite Ramey and Ramey (1995), which shows that economies with higher

theoretical studies (Arellano, 2008; Mendoza and Yue, 2012; Corsetti et al., 2013; among others), mostly spurred on by the 2009 Greek debt crisis. Before, the focus was traditionally tailored for emerging economies. These studies detail the specific mechanism with which the sovereign spread exerts a direct pass-through effect on investment and thus on output.

The current lack of interest of studying the real effects of the sovereign spread (or any financial variable in general) is deeply rooted in the neo-classical dichotomy that supports the real business cycle agenda of the predominant neoclassical school in Macroeconomics. The neo-classical dichotomy insists that only real variables (e.g., technological shocks or real changes in demand) can affect real variables like growth in output.

Operationally, a spread represents the difference between the interest rate offered by a fixed-income asset (in general, bonds as an asset class include corporate, municipal and sovereign bonds which is the focus of our study) and the interest rate offered by a risk-free asset of similar duration (usually the US T-bill). Fama (1986) showed that the spread can be decomposed into the term structure and the risk premium. The term structure represents the risk involved in holding short vs. long-term maturity bonds. It usually represents the change in the expected inflation, which might create a wedge in the profit gains for holding short as against longer-term bonds. The risk premium, on the other hand, represents the premium needed to compensate bond-holders in case the issuer defaults. There is general agreement that the credit spread, which includes the sovereign spread, relates negatively to the business cycle (Fama, 1986; Stock and Watson, 1989). A sudden increase in the spread is generally seen as a leading indicator of a recession or a slowing-down of economic growth.

Specifically, the sovereign spread represents the ease or difficulty of an economy to borrow funds from abroad. It also represents the risk that investors face by holding the bonds issued by borrowing economies. Its importance in the international finance literature has been emphasized particularly as it affects the business cycle of emerging economies (Neumeyer and Perri, 2005) as well as some advanced developed ones; particularly those that pertain to a currency union like the European Monetary Union (EMU) (Dell'Erba, Hausman and Panizza, 2013). The particular importance of the sovereign spread relates to the concept of "original sin" in International Finance. That is, countries cannot issue bonds in domestic currency and thereby they have no option but to issue sovereign bonds in foreign currency (usually in US dollars). This makes them more vulnerable to external shocks, particularly those that affect the sovereign spread. In most developed economies, the domestic bond market is large enough to make sovereign bonds relatively unimportant. However, Dell'Erba, Hausman and Panizza (2013) showed that countries pertaining to a currency union behave just like emerging economies in terms of debt composition, which makes them more vulnerable to sovereign spread shocks than stand-alone countries. Also, a recent study by Delatte et al. (2016) documents the importance of the ECB in getting member-countries out of a crisis zone affected by shocks in the sovereign spread using a smooth transition regression model.

But the Great Recession of 2007-2010 provided an impetus for the emergence of a macro-financial research agenda that sought to seriously incorporate financial variables such as the sovereign spread on business cycle modelling (Jorda et al., 2017)[2]. To quote

fluctuations in business cycle, in terms of large deviations from the trend, also tend to have lower growth rates in output on average.

[2]Earlier studies include Bernanke et al. (1999) on the financial accelerator as well as some related studies cited therein.

Blanchard et al. (2014, p.12): " ... The crisis brought to light ... the risk of multiple equilibria associated with high debt. If investors, worried about a higher risk of default, require higher risk premiums and thus higher interest rates, they make it more difficult for governments to service debt, thereby increasing the risk of default and potentially making their worries self-fulfilling."

The focus of our study is limited to advanced economies because data on the sovereign spread is more complete. Also, these advanced economies have not received any concessionary lending from the International Monetary Found (IMF) or World Bank that would distort measurement of the sovereign spread (IMF, 2017). Advanced economies are grouped into those belonging to the Eurozone and those that do not. We want to explore deeper whether there is a significant difference among Eurozone and non-Eurozone stand-alone countries with regard to the effect of the sovereign spread on output growth. It is hypothesized that a threshold effect exists among Eurozone countries in the way how the sovereign spread affects growth in output. Being advanced economies, Eurozone countries would still enjoy being "flight-to-quality" destinations where the increase in the sovereign spread can lead to higher output. This means that a higher influx of capital would aid in the growth of the economy — for instance, because the marginal productivity of capital together with an increase in the in-flow of funds would benefit the investment sector. But, this would only be up to a certain threshold, after which a negative effect starts to seep in. At a higher spread, investors would rather choose to flock to non-Eurozone stand-alone economies where the pull factors (e.g., being capable to independently implement their own monetary and fiscal policies and thus trigger the "confidence fairy") become even more important.

Following Chudik et al. (2017), we use a heterogeneous dynamic panel threshold model, which allows to correct for cross-sectional dependence and simultaneity bias, to model the threshold-type nonlinear effect of sovereign spread on output growth. This model provides a framework for addressing the "confidence fairy" hypothesis. Using Monte Carlo simulation, they did not find a significant threshold effect of public debt on growth in ouput after cross-sectional dependence is corrected for. Their study has a panel of forty countries (both advanced and emerging) for a period of 45 years. They focus on the nonlinear panel threshold effect of public debt on growth in output, our present study focuses on the sovereign spread and its nonlinear threshold effect on growth in output.

The contribution of this present paper is threefold. Firstly, we fill the gap in the empirical econometric literature and show that the "confidence fairy" does exist but only in periods of financial stress and in the Eurozone. Secondly, we provide empirical evidence about the negative influence of bond vigilantes on macroeconomic variables. Lastly, our results support the financial fragility hypothesis in the membership of a currency union.

In what follows, Section 2 discusses a review of the current literature on both theory and empirics. Section 3 presents the econometric issues on panel threshold modelling. This is followed by Section 4 where we present our panel threshold model in the analysis of the effect of the sovereign spread on growth. This section also describes our data set. In Section 5, the results are presented and discussed. Section 6 provides the summary and conclusion. And finally, Section 7 discusses some policy implications.

2 Review of the Literature

2.1 The Effect of the Sovereign Spread on Output: Theory

The dominance of the neoclassical real business cycle agenda in macroeconomics (which has strictly emphasized the neoclassical dichotomy) extends to International Finance, also known as open-economy macroeconomics. This, in general, has led researchers to shy away from analyzing the real effect of the sovereign spread on growth in output. Overall, there is a current dearth of studies analyzing the real effect of the sovereign spread (or of financial variables in general) on growth in output.

Fortuitously, the recent 2009 Greek debt crisis has re-ignited current interest on this topic. This has led to a blossoming of theoretical work on the relational effect of financial variables (with particular interest on the sovereign spread) on growth in output. One study specifically motivated by the Greek crisis is Corsetti et al. (2013), which extends an earlier model by Curdia and Woodford (2009) by introducing a sovereign risk channel through which sovereign default risk raises borrowing costs in the private sector and thereby has a real effect on output. The main transmission mechanism by which the sovereign spread can have real effects on output is through the strong link between the sovereign spread and the borrowing costs of the private sector. There is strong evidence (Aguiar and Amador, 2013) that a direct pass-through effect occurs when changes in the sovereign spread are immediately reflected in the corporate sector and hence on the borrowing costs faced by firms. Thus, an austerity program makes sense to reduce worries among investors of an upcoming possible default overhang if monetary authorities face a zero-limit bound. In other words, an austerity program is needed to engender a "confidence fairy" effect among investors. This should lead to a lowering (or at least not increasing) of the sovereign spread that would allow the economy to avoid a bad equilibrium (e.g., a self-fulfilling debt crisis).

Most previous studies focused on emerging economies. The seminal paper of Mendoza and Yue (2012) propose the existence of a transmission mechanism (that is, a direct link) between the sovereign spread and fluctuations in output (i.e., the real business cycle) among emerging economies. Their model concentrates on the tendency of local firms during crisis periods to substitute lower-quality, in terms of productivity, of locally-available capital inputs in the aggregate production in lieu of higher-quality and more productive imported capital inputs. They further show that their model performs well in explaining the fluctuations in the growth of output as it relates to the sovereign spread (or to the default premium of the spread).

As to be discussed later on, the problem of simultaneity bias is an important issue in the econometric modelling of the effect of the sovereign spread on growth in output. This is the focus of some studies. One example is an earlier paper by Arellano (2008) that also deals on emerging economies and attempts to explain the relationship between the default premium of the sovereign spread and the business cycle. The paper discusses some empirical anomalies in the literature such as the low explanatory power of the sovereign spread in explaining variation in output. Uribe and Yue (2006) as well as Neumeyer and Perri (2005) point to the need to address and correct the simultaneity bias which may be present in the analysis of the relationship between financial variables and real growth in output.

Overall, the theoretical literature points to a solid foundation for formulating a hypothesized causal relationship between the sovereign spread and growth in output and

the need to address the simultaneity bias. We aim to provide empirical testing of this relationship.

2.2 The Effect of the Sovereign Spread on Output: Empirics

Krugman (2018)'s main criticism against the existence of a "confidence fairy" effect has an inherent issue, the transmission mechanism with which investors in the bond market do actually affect the sovereign spread. This argument is in relation to the "bond vigilantes" issue as to whether there exists a group of investors that is big and powerful enough to be able to influence the bond market. There is scant discussion of this issue in the literature.

To the best of our knowledge, Hassan and Wu (2015) is the only real attempt to undertake an empirical test to check whether credit ratings agencies (from which the "bond vigilantes" takes most of its information) would have a real effect on an economy. Their result show that the bond market, through the indirect influence of credit rating agencies, may have some influence on the business cycle of an economy.

Whether "bond vigilantes" would exert a significant direct influence on real growth of an economy is debatable. An economy implementing a fiscal consolidation program (e.g., austerity) would be rewarded with lower sovereign spread and thus would allow the economy to escape a bad equilibrium "crisis zone", that is the "confidence fairy" effect. In like manner, an economy who refuses to undertake fiscal consolidation when called for by the "bond vigilantes" would be punished by a higher sovereign spread. This would push the economy toward a bad equilibrium "crisis zone" even if macro fundamentals are good.

In this regard, we highlight two studies to clarify Krugman's criticism against the implementation of austerity and the "bond vigilantes" issue. IMF (2010) focuses on the effect of austerity on economic activity as the result of applying fiscal consolidation with some additional specific analysis on the sovereign spread. The study is largely based on a historical analysis of fiscal consolidation among advanced economies and on the use of a simulation results of the IMF's Global Integrated Monetary and Fiscal Model (GIMF). Results suggest that the immediate short-term increase in output after the implementation of an austerity program is not representative of the normal output response among countries with initial poor credit risk ratings. Furthermore, they indicate that the short-term negative relationship between growth in output and sovereign credit risk is significantly smaller than expected.

In a related study, Perotti (2014) presents four detailed case studies on the effect of austerity on output growth. Two cases focus on countries where the economy is an anchored-base exchange rate regime, Denmark (1982-1986) and Ireland (1987-1990). The other 2 cases are on Finland (1982-1998) and Sweden (1993-1998), which have a free-floating exchange rate regime. All 4 cases are associated with an expansionary fiscal contraction experience but it is only in Denmark where the driver of growth during an austerity program was the presence of an increased "confidence fairy" effect in the consumer sector. Perotti (2014) concludes that it is more likely that there were other causes of output growth during austerity (like exchange rate stabilization and export boom) rather than a "confidence fairy" effect. This study indicates that the "confidence fairy" effect is generated in some countries and not in others and not always constantly at all times. Hence, there must be some kind of nonlinear regime shifts at work in the way how the sovereign spread affects output.

Overall, there is conflicting evidence on the "confidence fairy" effect to support or

contradict Krugman's counter-arguments. At times a "confidence fairy" effect is observed and other times no. Empirical testing using a nonlinear threshold approach is deemed necessary to further clarify the issue and is the main focus of this present paper.

2.3 Addressing the issue of Simultaneity Bias and Reverse Causality

While a dearth of literature exists on the real effect of the sovereign spread on output growth, analyzing the effect of growth (and other macroeconomic variables such as trade openness, financial repression, strict regulation of the financial sector, etc.) on the sovereign spread is certainly popular for both emerging and developed economies, especially after the 2009 Greek debt crisis (Bhanot et al. 2014, and Gibson et al. 2014 among others).

Despite most of the literature (Afonso and Jales (2019), Chen et al. (2016), as well as Eichengreen and Mody, 2000 among others) still maintains that causality runs from real (e.g., growth in output, debt-to-GDP, etc.) to financial variables, we do not exclude reverse causality from our analysis. Indeed, it is our aim to determine the direction of causality. If the effect is in both directions, simultaneity bias arises leading to inconsistent estimators (Singh, 2008; Romero-Avila, 2007; and Beck et al., 2000).

Longstaff and Schwartz (1995) is regarded as one of the first studies analyzing how to measure the sovereign spread. Later, Longstaff, Mithal and Neis (2005) introduced the use of the Credit Default Swap (CDS) to explain the default portion of the sovereign spread, and showed that 57% of the variation in spreads could be explained by a default premium component.

A more recent study is Longstaff et al. (2011), which highlighted the importance of global push factors in the pricing of sovereign debt. They specifically pointed out to the important effect of the global volatility index (e.g., the VIX) and the movements in the US stock market as factors reflecting the increase or decrease in the global appetite for risk and/or liquidity. They both affect the variation in the sovereign spreads among emerging and less developed economies. One important reason for this is the dominance of large international investors who participate in the market for sovereign bonds. When global appetite for risk increases, the emerging market as a whole serves as a vehicle for diversifying the high-risk high-earnings profile of their portfolios. However, when global appetite for risk declines (for instance, when the VIX suddenly increases), there is a sudden "flight-to-quality" movement toward safer bonds in advanced economies.

Traditionally, advanced economies are viewed as safe destinations for "flight-to-quality" investors who wish to reduce the riskiness of their portfolios. Thus, individual country-specific pull factors such as forecasted potential growth, sustainable debt statistics, monetary policy and interest rates become important in analyzing and discriminating among the sovereign spread of advanced economies. In this regard, a controversial finding shows that the formation of the European Monetary Union reinforced the financial fragility of member-countries as "flight-to-quality" destinations. De Grauwe (2011) and De Grauwe and Ji (2013) explained that the membership to a currency union such as the European Monetary Union (EMU) weakened the effect of country-specific pull factors and hence resulted into a complete de-coupling of macroeconomic variables (such as growth in output and monetary policy related variables including the exchange rate) and the sovereign spread. This means that Eurozone member-countries are now more prone to be affected by the capriciousness and whimsical movements of global push factors such as increased

volatility and the increase or decrease in global appetite for risk.

Discussions on the above-cited literature reflect the serious need to focus on the simultaneity bias which may arise in testing the relationship between the sovereign spread and growth in output. In like manner, Chudik et al. (2017) focus on correcting for the simultaneity bias in their analysis of the panel threshold effect of debt on growth in output. They indicate that careless disregard of the correction of simultaneity bias (together with cross-sectional dependence) would render empirical results inconsistent and inefficient.

We likewise put emphasis on a careful analysis of the simultaneity bias as well as for testing the presence and correction of cross-sectional dependence. Furthermore, the "financial fragility" hypothesis in the formation of currency union is to be incorporated in the study of the relationship between the sovereign spread and growth. These will be the emphases in this present paper.

3 Panel-Threshold Modelling

A threshold represents a structural break in a time series data. It means a significant regime shift at a specific point in time, as for instance when a global crisis period starts or ends. In panel data settings, it is usually assumed that countries share a common threshold τ, due to the difficulties of estimating reliable country-specific thresholds if there is no sufficient time variation.

To test the nonlinear effect of sovereign spread (s) on growth (y) , we follow Chudik et al. (2017) and consider a heterogeneous dynamic panel-threshold model with two threshold variables:

$$\Delta y_{it} = \begin{cases} \alpha_{1i} + \phi_1 I_1(\Delta s_{it} > \tau) + \phi_2 I_2(max\{0, \Delta s_{it}\}) + \beta_{1i}\Delta\, y_{i,t-1} + \beta_{2i}\Delta\, s_{it-1} + e_{1it}, \\ \alpha_{1i} \;+\; \beta_{1i}\,\Delta\, y_{i,t-1} \;\; + \; \beta_{2i}\,\Delta\, s_{it-1} \;+\; e_{1it}, \end{cases} \tag{1}$$

$$\Delta s_{it} = \alpha_{2i} \;+\; \beta_{3i}\,\Delta\, y_{it} \;+\; e_{2it}, \tag{2}$$

where I_1 and I_2 are indicator functions representing panel threshold variables, i refers to country and t is time. τ is a threshold value to be estimated from the data.

Equations (1) and (2) can be combined and the simultaneity bias can be corrected by adding lags such that the econometric model is formulated as a reduced form panel threshold Auto-regression Distributed Lag (ARDL) equation which is written as follows:

$$\begin{aligned} \Delta y_{it} = \alpha_i^* \;+\; \phi_1\, I_1(\Delta s_{it} > \tau) \;+\; \phi_2\, I_2(max\{0, \Delta s_{it}\}) \;+\; \beta_{1i}\,\Delta\, y_{i,t-1} \;+\; \beta_{2i}\,\Delta\, s_{it} \\ + \sum_{2}^{p} \beta_{3ip}\,\Delta y_{i,t-p} \;+\; \sum_{1}^{p} \beta_{4ip}\,\Delta s_{i,t-p} \;+\; e_{it}^* \end{aligned} \tag{3}$$

where e_{it}^* is the error term assumed to be homoskedastic and free from cross-sectional dependence.

In the estimation of the model, Pesaran's (2004 and 2006) test for the presence of cross-sectional dependence is undertaken. Consequently, to correct for cross-sectional dependence, Pesaran's (2006) method of adding cross-sectional averages and their lags allows equation (3) to be re-written as follows:

$$\Delta y_{it} = \alpha_i^* \; + \; \phi_1 \, I_1(\Delta s_{it} > \tau) \; + \; \phi_2 \, I_2(max\{0, \Delta s_{it}\}) \; + \; \beta_{1i} \, \Delta \, y_{i,t-1} \; + \; \beta_{2i} \, \Delta \, s_{it}$$
$$+ \sum_{2}^{p} \beta_{3ip} \, \Delta y_{i,t-p} \; + \; \sum_{1}^{p} \beta_{4ip} \, \Delta s_{i,t-p} \; + \; \sum_{1}^{p} \beta_{5ij} \, \overline{\Delta \, y_{i,t-p}} \; + \; \sum_{1}^{p} \beta_{6ip} \, \overline{\Delta \, s_{i,t-p}} \; + \; e_{it}^* \tag{4}$$

where *t-p* is a time lag from 1 to p, and $\overline{\Delta \, y_{i,t-p}}$ and $\overline{\Delta \, s_{i,t-p}}$ are cross-sectional averages and their lags (Pesaran, 2006).

In this framework, we want to test the null hypothesis of a linear model versus a nonlinear alternative, that is $H_0 : \phi_1 \neq \phi_2 \neq 0$ in equation 4. If the H_0 is rejected, then we give evidence of the existence of a panel threshold model. In our empirical analysis, we consider equation (3) as the ARDL model and equation (4) as the CS-ARDL. We also include a reduced form with only one panel threshold variable.

To implement the estimation of equation (4), Chudik et al. (2017)'s procedure was used using Monte Carlo simulation to test the threshold effect of the sovereign spread on growth for Eurozone as well as non-Eurozone and combined panel data sets. They develop a set of statistical tests for estimating the significance of a threshold effect in a panel setting - following the ideas proposed and developed in Davies (1977), Andrews and Ploberger (1994) and Hansen (1999). This requires the simulation of the level of significance of the threshold variable through the *SupF* and *AveF* statistics. This type of hypothesis testing requires non-standard distribution owing to the nuisance parameter problem. Under the null hypothesis, the nuisance parameter $\phi_i = 0$ is unobserved. Hence, a bootstrap procedure is used. Another important feature of Chudik et al. (2017) is the testing and correction of cross-sectional dependence for an unbalaned panel data set following Pesaran (2006). The results are discussed in the next section.

4 Empirical Evidence

Our panel is composed of Eurozone and non-Eurozone countries. For Eurozone countries (which use the euro as an official currency), the original 11 members (Austria, Belgium, Germany, Spain, Finland, France, Holland, Ireland, Italy, Luxembourg,and Portugal) are included plus Greece (which later joined officially in 2001). Smaller and new members (Malta, Latvia, Lithuania, Slovakia, Slovinia, Andorra, Monaco, San Marino and the Vatican) were not included in the panel because of incomplete data. For non-Eurozone countries, data on the following advanced countries are included: Australia, Canada, Switzerland, Denmark, Iceland, Japan, Norway, New Zeland, and Sweden.

The economic series employed in this study are the quarterly data (1999:1 to 2018:1) of GDP per capita (y) in constant US$, base=2010 seasonally adjusted and in natural logs, as well as the sovereign spread (s), defined as the difference in the yield spread calculated as the interest rate offered by a one-year bond issued by a country's finance ministry *minus* the equivalent rate offered by a similar US T-bill. The short-term duration of our calculation of the sovereign spread is deemed ideal as it is complementary to the short-term target of a central bank's monetary policy. In addition, an outstanding characteristic of short-term debt is that it is almost entirely free of default risk. Hence, any significant real effect of the spread on output would most likely be due to "liquidity risk" or the difficulty to roll-over short-term debt, the most common form of sovereign debt crisis (DeGrauwe, 2011; Arellano and Ramanarayanan, 2012 as well as the literature cited therein).

An additional variable on government consumption is also included in the robustness check. This variable is defined as government consumption as percentage of GDP. It is also in natural log. This aims to measure how large the government sector is in an economy, and the first difference will state whether an expansionary fiscal or an austerity program was implemented.

4.1 Descriptive findings

Figure 1 shows a scatterplot of the two variables (s and y). It shows a noticeable negative relationship for both Eurozone and non-Eurozone countries alike.

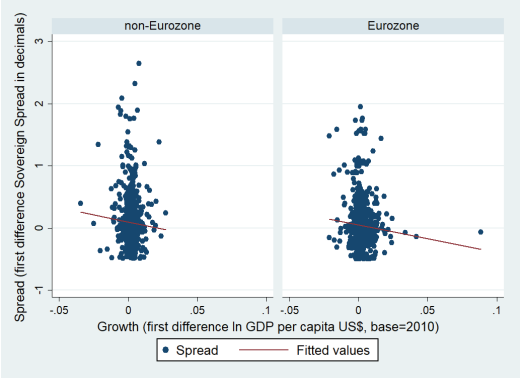

Figure 1: Scatterplot - Sovereign Spread vs. Growth in Output (real GDP per capita) non-Eurozone vs. Eurozone

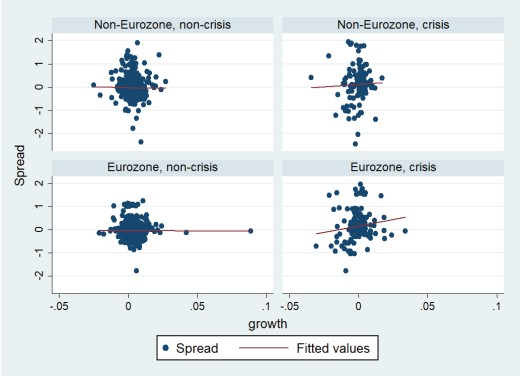

Figure 2: Scatterplot - Sovereign Spread vs. Growth in Output (real GDP per capita) non-Eurozone vs. Eurozone during crisis and non-crisis years

However, if the same data is analyzed during crisis vs. non-crisis years, a significant result appears. Figure 2 shows scatterplot of the data but differentiated between crisis (2007:q4 to 2010:q4)[3] and non-crisis years. In this Figure, there seems to be a substantial shift in the relationship between the spread and growth variables during crisis vs.non-crisis years for both Eurozone and non-Eurozone countries alike. During non-crisis years, there seems to be no significant relationship. However, if the scatterplot is focused on crisis years (during the time of the Great Recession), there appears to be a significant positive relationship between the 2 variables for both Eurozone and non-Eurozone countries alike - with the relationship even more significantly positive for the Eurozone. This shows that there is a need to focus on the shifting effect of the spread variable on growth for different regimes, that is, during crisis and non-crisis years. As such, a nonlinear panel threshold model is presented as a suitable approach for analyzing the relationship between the Sovereign Spread and Growth in output for Eurozone and non-Eurozone countries separately. More descriptive statistics and graphical displays are included in the appendix.

4.2 The Nonlinear Effect of the Sovereign Spread on Growth: The Case of Eurozone countries

This section discusses the results of the nonlinear panel threshold estimation of the dynamic effect of the sovereign spread on growth for non-Eurozone and Eurozone countries.[4]. The first step is to test for panel unit-roots to justify taking the first-difference in the estimation of equation (3). Pesaran's (2004 and 2006) tests for cross-sectional dependence were undertaken for both the growth (y_{it}) and the sovereign spread (s_{it}) variables to test whether a second-generation panel unit-root testing is necessary. Detailed results are shown in Appendix.

We also tested for the presence of simultaneity bias with the Granger causality test for heterogeneous panels (Dumitrescu and Hurlin, 2012). Results show significant simultaneity bias between the variables $\Delta \boldsymbol{GDP}$ (growth) and $\Delta \boldsymbol{spread}$ (spread) for both Eurozone and non-Eurozone countries. This simultaneity bias needs to be seriously addressed in equations (1) and (2).

In the analysis of the panel threshold, we follow Chudik et al. (2017) who developed a procedure using bootstap method. In the analysis, the *SupF* and *AveF* statistics are used to test the presence of a panel threshold. Additionally, their procedure includes diagnostic testing and correction of cross-sectional dependence based on Pesaran (2004 and 2007). Table 1 summarizes the results of the estimation of the panel threshold model for Eurozone countries. Results show significant cross-sectional dependence (*CD* statistics) in the panel data. This is to be expected since Eurozone countries as a group experience common shocks given that a unique central bank (the European Central Bank) administers a common monetary policy for these countries.

Table 1 is divided into the ARDL (estimation of equation 3) and the CS-ARDL (estimation of equation 4). When cross-sectional dependence is corrected for, the results show

[3]The date represents the Great Recession as dated by the NBER business cycle dating for the US.

[4]The econometric estimation and testing were undertaken using Stata software version 14.2 and Chudik et al. (2017)'s Matlab program. The authors are thankful for the permission granted by Prof. K. Mohaddes in using their Matlab program which was downloaded from Prof. Mohaddes's webpage hosted by the University of Cambridge.

the existence of a robust significant nonlinear panel threshold effect. This documents how the effect of sovereign spread on real growth in output undergoes a significant regime shift for Eurozone countries. Figures in Table 1 show that the threshold statistics (e.g., the *SupF* and the *AveF*) are both significant. These results do not depend on either the specification of the threshold variable or the number of lags considered.

In addition, results likewise indicate that, in general, the hypothesized negative effect of the sovereign spread on growth is rejected for Eurozone countries. This can be seen in the estimated values of the β_2 parameter which came out insignificant when the CS-ARDL model is used. This puts into serious question the existence of the "confidence fairy" effect associated with the implementation of an austerity program (Perotti, 2014; Alesina and Ardagna, 1998).

However, when a Eurozone country's change in the sovereign spread surpasses a threshold value, the market (i.e., the "bond vigilantes") would in general discriminate against them with an associated lowering of growth in output as indicated by the negative significant value of ϕ_1 in Table 1. And in times of financial stress, the Eurozone country would experience an even greater lowering of growth in output as indicated by the significant negative value of ϕ_2.

Given the effect of the sovereign spread on growth in output is shown to be insignificant (the β_2 parameter in the CS-ARDL model), then one may surmise that, in general, the hypothesized "bond vigilante" effect on growth in output may turn out to be false for the Eurozone. This vindicates the claim of Krugman (2018) on the myth of the "bond vigilante" and the "confidence fairy" transmission mechanism and of his criticism of the conservatives' austerity agenda as a solution to a recession.

However, in times of financial stress the market (e.g., the "bond vigilante") may manifest its presence and influence. This may be taken as supporting the financial fragility hypothesis of a currency union (De Grauwe, 2011 and De Grauwe and Ji, 2013). If a Eurozone country faces a looming financial crisis, then it should be careful not to exceed a threshold in terms of the change in its sovereign spread. This may be one case when an austerity program may be helpful to prevent a self-fulfilling debt crisis. Moreover, there arises the need for a strong ECB to help member-countries achieve an orderly lowering of the spread and avoid a bad equilibrium (Roubini, 2014).

Table 1: Panel Threshold Estimation for Eurozone countries

	ARDL			CS-ARDL		
	p =1	p =2	p =3	p =1	p =2	p =3
A. Model with 2 threshold variables $I_1(\Delta s_{it} > \hat{\tau})$ and $I_2(max\{0, \Delta s_{it}\})$						
β_2	.0004	-.0015***	-.0042***	.0014	.0008	-.0046
	(.0007)	(.0006)	(.0006)	(.0022)	(.0026)	(.0054)
ϕ_1	-.0085	-.0082	-.0098	-.0008	-.0009	-.0076
ϕ_2	-.0095	-.0089	-.0090	-.0024	-.0032	-.0059
τ	.0700	.0500	.0500	.0250	.0600	.0700
SupF	27.56***	13.41**	9.14	12.06*	8.35	2.58
AveF	18.23***	7.98***	3.79***	5.99***	3.75***	1.49***
CD	18.78***	16.26***	15.25***	1.17	1.86	1.39
B. Model with 1 threshold variable $I_1(\Delta s_{it} > \hat{\tau})$						
β_2	.0002	-.0018***	-.0042***	.0012	.0005	-.0046
	(.0007)	(.0006)	(.0006)	(.0023)	(.0035)	(.0054)
ϕ_1	-.0079	-.0072	-.0091	-.0015	-.0028	-.0068
τ	.0500	.0800	.0500	.0250	.0700	.0700
SupF	4.87***	3.20**	2.63	3.04**	2.64	1.53
AveF	3.63***	2.21***	1.08***	2.09***	1.59***	1.06***
CD	20.32***	18.15***	15.74***	.74	1.43	1.37
C. Model with 1 threshold variable $I_2(max\{0, \Delta s_{it}\})$						
β_2	.0004	-.0019***	-.0046***	.0015	.0024	-.0039
	(.0007)	(.0006)	(.0006)	(.0023)	(.0031)	(.0056)
ϕ_2	-.0083	-.0077	-.0092	-.0014	-.0016	-.0042
τ	.0500	.0700	.0500	.0250	.0175	.0175
SupF	3.74***	2.43	2.01	2.88*	1.84	.85
AveF	2.43***	1.25***	.96***	1.61***	1.12***	.45***
CD	20.30***	16.26***	15.13***	.96	1.09	.85

Cross-sectional dependence is diagnosed and corrected using Pesaran(2004).
Figures in parentheses are standard errors. Significant at 1% (***), 5% (**), 10% (*)

4.3 The Effect of the Sovereign Spread on Growth: The Case of non-Eurozone countries

The next Table 2 shows the results for the non-Eurozone countries. Even if there is substantial heterogeneity among the non-Eurozone countries, results still show the presence of significant cross-sectional dependence in the panel data set. This means that Pesaran's (2004 and 2006) method for correcting cross-sectional dependence restores the *BLUE* properties of the estimators.

As we focus on results in the CS-ARDL block, one can see that there is no significant evidence to support the hypothesis that a panel threshold effect exists for non-Eurozone countries. This can be deduced from the results of the *AveF* tests, except for model B with one and 2 lags.

One can further conclude that the hypothesized significant influence of "bond vigilantes" on growth in output through the sovereign spread is proven to be false even among non-Eurozone countries. Table 2 shows that if the cross-sectional dependence is not cor-

rected for - then the supposed highly significant negative effect of the sovereign spread (the β_2 parameter which represents the hypothesized power of the "bond vigilantes" as taunted by the conservatives in their call for austerity) is shown to be incorrect. Perhaps, Krugman is right in his call for an end to austerity program as this is based on a fallacious belief on the power of the "bond vigilantes" and the supposed "confidence fairy" effect.

Table 2: Panel Threshold Estimation for non-Eurozone countries

	ARDL			CS-ARDL		
	p =1	p =2	p =3	p =1	p =2	p =3
A. Model with 2 threshold variables $I_1(\Delta s_{it} > \hat{\tau})$ and $I_2(max\{0, \Delta s_{it}\})$						
β_2	-.0000	-.0008**	-.0015**	.0004	.0011	.0005
	(.0004)	(.0006)	(.0007)	(.0010)	(.0017)	(.0012)
ϕ_1	-.0007	.0023	.0014	-.0008	-.0004	-.0000
ϕ_2	-.0021	-.0047	-.0031	.0004	.0000	-.0003
τ	.0350	1.000	.0350	.0800	.0500	1.000
SupF	7.17	6.53	2.94	4.02	5.52	1.41
AveF	4.68***	4.18***	1.91	2.08	3.37	.63
CD	8.59***	8.12***	8.13***	-.48	-0.63	-.52
B. Model with 1 threshold variable $I_1(\Delta s_{it} > \hat{\tau})$						
β_2	-.0004	-.0011**	-.0021***	.0008	.0015	.0002
	(.0004)	(.0006)	(.0006)	(.0009)	(.0018)	(.0012)
ϕ_1	-.0018	-.0024	-.0028	-.0002	-.0003	-.0001
τ	.0350	.0350	.0350	.0800	.0500	.0350
SupF	2.68*	2.43**	1.51	2.35	2.68	1.37
AveF	1.97***	1.75***	1.02	1.43***	1.78***	.77
CD	8.80***	8.24***	8.11***	-0.79	-.84	-.20
C. Model with 1 threshold variable $I_2(max\{0, \Delta s_{it}\})$						
β_2	-.0002	-.0008*	-.0017***	-.0000	.0007	.0000
	(.0004)	(.0006)	(.0007)	(.0008)	(.0012)	(.0012)
ϕ_2	-.0029	-.0063	-.0070	.0004	.0004	.0005
τ	1.000	1.150	1.150	.0175	.0500	.0175
SupF	1.71	1.86	1.44	.62	.54	.85
AveF	1.36***	1.53***	1.21**	.24	.31	.48
CD	8.83***	8.25***	7.92***	-1.09	-.82	-.59
D. Model without threshold variable						
β_2	.00024	.0002	.0001	-.0005	-.0004	.1497**
	(.0006)	(.0006)	(.0005)	(.0012)	(.0012)	(.075)
CD	8.89***	8.16***	8.04***	1.66	.33	.77

Figures in parentheses are standard errors.
Significant at 1% (***), 5% (**),10% (*)

4.4 Robustness check: adding a government variable

As a robustness check, the models were re-estimated with an additional variable - *Gov (log of government consumption as a percentage of real GDP)*, but only for Eurozone countries where the panel threshold effect is found to exist. The additional variable (*Gov*) is in

first difference. This means that a negative value of the variable would have indicated the implementation of an austerity program, while a positive value would indicate that the Eurozone governments had implemented an expansionary program. In general, the results point to the robustness of the initial estimate of a significant panel threshold variable. These results do not change significantly with the addition of another variable. Results are presented in Table 3 as follows:

Table 3: CS-ARDL model with ΔGov variable for Eurozone countries

	ARDL			CS-ARDL		
	p =1	p =2	p =3	p =1	p =2	p =3
A. Model with 2 threshold variables $I_1(\Delta s_{it} > \hat{\tau})$ and $I_2(max\{0, \Delta s_{it}\})$						
β_2	.0003	-.0018***	-.0046***	.0025*	.0015	-.0055***
	(.0008)	(.0007)	(.0006)	(.0018)	(.0018)	(.0022)
γ	.1591**	.2548**	.2755**	.1726***	.1977***	.1215
	(.0804)	(.1154)	(.1303)	(.0395)	(.0792)	(.1223)
ϕ_1	-.0054	-.0055	-.0092	.0006	-.0011	-.0083
ϕ_2	-.0086	-.0105	-.0109	-.0002	-.0012	-.0054
τ	.0600	.0600	.0500	.0250	.0700	.0600
SupF	24.31***	17.77***	12.15*	9.41	8.52	9.54
AveF	13.84***	7.50**	4.69***	4.05***	3.01***	3.84***
CD	20.62***	17.45***	13.93***	1.63	2.95*	2.10
B. Model with 1 threshold variable $I_1(\Delta s_{it} > \hat{\tau})$						
β_2	-.0001	-.0022***	-.0048***	.0025	.0012	-.0043
	(.0008)	(.0007)	(.0006)	(.0020)	(.0029)	(.0044)
γ	.1618**	.2607**	.2772**	.1800***	.2022***	.1828*
	(.0860)	(.1283)	(.1332)	(.0409)	(.0476)	(.1224)
ϕ_1	-.0073	-.0085	-.0101	.0004	-.0012	-.0039
τ	.0800	.0800	.0500	.0250	.0700	.0700
SupF	4.68***	3.73***	3.37**	2.53	2.25	1.79
AveF	3.24***	2.11***	1.21***	1.70***	1.23***	.82***
CD	20.93***	18.24***	14.28	1.17	2.60*	2.08
C. Model with 1 threshold variable $I_2(max\{0, \Delta s_{it}\})$						
β_2	-.0000	-.0021***	-.0051***	.0025*	.0038	.0011
	(.0007)	(.0007)	(.0006)	(.0019)	(.0025)	(.0037)
γ	.1493**	.2540**	.2582**	.1991***	.2032***	.1411*
	(.0815)	(.1160)	(.1386)	(.0385)	(.0634)	(.0988)
ϕ_2	-.0074	-.0102	-.0100	.0004	.0034	.0037
τ	.0050	.0700	.0500	.0250	.0175	.0600
SupF	3.76***	3.70***	2.59	2.44	2.07	1.47
AveF	2.23***	1.63***	1.47***	1.24***	1.04***	.78***
CD	20.30***	16.81***	13.70***	1.45	1.57	2.54*

Figures in parentheses are standard errors.
Significant at 1% (***), 5% (**),10% (*)

The results of the robustness check presented in Table 3 show that the addition of another variable (ΔGov) does not affect the robustness of the initial results in Table 1. The results still show that Eurozone countries have a significant panel threshold effect.

Furthermore, one can see that the effect of government consumption (the γ parameter) is significant and positive. This contradicts the logic of conservatives in their admonition of austerity programs. Results in Table 3 indicate that government consumption has a significantly positive effect on growth. This squarely contradicts the austerity logic of conservatives.

5 Results and Discussions

This section presents a more detailed discussion of the results. The first step done in the analysis was to implement Pesaran's (2004 and 2006) tests for cross-sectional dependence. Results show substantial presence of cross-sectional dependence for both the weak form (e.g., spatial or geographic "neighboring" effect where the pairwise correlations of error terms cluster around some dominant unit or country[5]) and the strong form (e.g., the existence of a common correlated effect such as a common reaction to a ubiquitous shock). This would lead to the conclusion that second-generation panel data unit root testing (Bai and Ng, 2010) needs to be implemented which call for the incorporation of correcting for the presence of cross-sectional dependence in the panel data. The results are presented in Appendix Table A2 which confirm the need to take the first-difference of the variables to be included in the analysis.

Subsequently, panel Granger-Causality tests confirmed the existence of simulaneity bias in the relationship between the variables growth ($\Delta\ GDP$) and the sovereign $\Delta spread$. As such, estimation of equation (4), the CS-ARDL model, requires the inclusion of lags to correct the simultaneity bias present in the panel data set. The results were presented in Table 1 for Eurozone countries and Table 2 for non-Eurozone countries.

In both Tables 1 and 2, the highly significant negative effect of the sovereign spread on growth is proven to be spurious and invalid if the model is not corrected for the presence of cross-sectional dependence. Furthermore, results show that a panel threshold effect is shown to be significant only for the Eurozone. A robustness check is presented in Table 3 which includes an additional variable (the log of government consumption as percentage of GDP). The robustness check strengthens the claim of the existence of a nonlinear panel threshold effect for Eurozone countries.

The results of the panel threshold testing are further summarized by comparing Eurozone vs. non-Eurozone as presented in Figure 3. When countries of the Eurozone experience a surpassing of the panel threshold in the sovereign spread, a negative relationship occurs between the sovereign spread and growth in output. The same cannot be said for non-Eurozone countries even if the graph indicates a change in the effect of the sovereign spread on growth in output but which is not statistically significant.

For Eurozone countries, results indicate the significance of a panel threshold effect which may lead one to conclude that there may be a basis for accepting the financial fragility hypothesis. When a Eurozone country experiences an increase in the sovereign spread pass a threshold, then the market (i.e., the "bond vigilantes") may be ready to penalize them with a lowering of growth in output. This echoes DeGrauwe (2011, p.2)'s fear that "... Members of a monetary union issue debt in a currency over which they have no control. It follows that financial markets acquire the power to force default on these countries." As such, there should be a renewed call for policymakes to strengthen

[5]This is the equivalent of coarse granularity in finance where a dominant asset affects the performance of the whole portfolio.

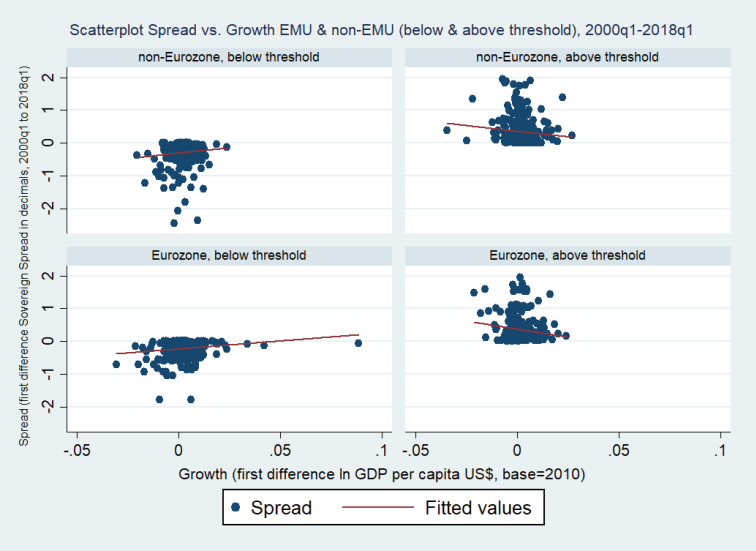

Figure 3: Scatterplots - Sovereign Spread vs. Growth in Output (real GDP per capita) non-Eurozone vs. Eurozone economies, below and above Thresholds

the ECB to counter-act the still extant and very much active influence of the bond market on economic growth.

6 Summary and Conclusions

This paper aims to show the existence of a panel threshold effect on the relationship between the sovereign spread on output growth among advanced (as well as Eurozone vs. non-Eurozone) countries. Results show that the highly significant negative effect of the sovereign spread on output growth is proven to be spurious and invalid if the presence of cross-sectional dependence in the panel data is not corrected. This study used Pesaran's (2004 and 2006) method of correcting the presence of cross-sectional dependence in a panel data. Also, using Chudik et al.'s (2017) procedure for testing the presence of a panel threshold effect, this study gave evidence that for Eurozone countries a panel threshold effect exists in the dynamic relationship between the sovereign spread and growth in output. It is shown that for Eurozone countries, the positive effect of the sovereign spread on output converts into negative when an increase in the sovereign spread exceeds a threshold. This however does not significantly hold true for non-Eurozone countries.

In conclusion, this paper states that: "YES, Paul you're right. The "confidence fairy" does ***NOT*** exist - except in times of financial stress and only for the Eurozone!" And Eurozone countries should be more aware of the extant influence of "bond vigilantes", particularly in times of financial stress.

7 Policy implications

Results of the study point to the insignificance of the "confidence fairy" effect in the way how the sovereign spread is supposed to negatively affect real growth - particularly for non-Eurozone countries. Nevertheless for Eurozone countries, a threshold effect is proven to exist. Above this estimated threshold (assumed to be common for all countries in the Eurozone), a "confidence fairy" effect may arise in the way how the sovereign spread significantly and negatively affects real growth. These findings may be of utmost interest to policy-makers in the way how they design fiscal policy to affront an impending financial crisis. Traditional Keynesian recommendation points to the use of an expansionary fiscal policy as an instrument in affronting recession. However, such indiscriminate use of Keynesian expansions should always be looked upon with wariness, specially among countries of the Eurozone. Given the "financial fragility" hypothesis, Eurozone countries should consider that "bond vigilantes" may still have extant influence in the way how they are able to impose a higher sovereign spread on an economy. And, this may have a negative effect on the growth prospects of Eurozone member-countries. Thus, Eurozone governments should seriously take note of this.

Another important point is the need to strengthen the European Central Bank (ECB) as a supervisory body to safeguard the financial sector of the European Union. Part of the ECB's role should be to advice governments as to the state of the sovereign bond market and promptly advise individual governments if they are close to the threshold. This should be able to effectively counter-act the "financial fragility" hypothesis of a currency union (De Grauwe, 2011; and De Grauwe and Ji, 2014) owing to the loss of independence in the formulation and implementation of monetary and fiscal policy (i.e., the Growth and Stability Pact). As such, some economists (Eberly, 2014) point to the need to review the role of credible fiscal policy rules governing the Eurozone countries. One specific issue is the slowness in both decision-making and implementation of fiscal policy as compared to monetary policy. Whereas monetary policy is exclusively the responsibility of an independent central bank, fiscal policy, on the other hand, has to go through parliamentary debate as well as negotiations with the European Commission. The findings in our study would provide some insightful guidelines into this concern.

A related issue is whether central bank independence should singularly focus on price stability. Given the results in this study pointing to the significant "confidence fairy" effect in the Eurozone during times of financial stress, the ECB should not just only focus on price stability but should also formally incorporate real growth objectives, such as the avoidance of possible recessionary episodes. To quote Roubini (2014, p. 214): "... the existence of a central bank that is willing to avoid a self-fulfilling bad equilibrium. This implies that a run against the public debt or the widening of the sovereign spread can be avoided ... So, the existence of a potential lender of the last resort can lead to a better equilibrium, even if the lender doesn't act." More thorough research is needed to tackle this issue.[6]

It is hoped that the significant findings of this study would be able to help policy-makers in the optimal design and implementation of fiscal rules in a monetary union, particularly to affront challenges during times of financial stress.

[6]In 2018, the European Court of Justice ruled that the European Central Bank (ECB) is within its legal framework to implement an Outright Monetary Transactions (OMT) program to intervene in secondary market bond purchases. This was earlier challenged in court by the German government in 2012 as being outside of the ECB's legal mandate.

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Appendix:

Table A1: Descriptive statistics

Variable: Δ lnGDP (ln per capita GDP US$, base=2010)									
country	**mean**	**s.d.**	**min**	**max**	**country**	**mean**	**s.d.**	**min**	**max**
AUT	.0018	.0030	-.0074	.0078	AUS	.0031	.0020	-.0023	.0076
BEL	.0016	.0023	-.0092	.0067	CAN	.0022	.0026	-.0100	.0064
DEU	.0014	.0037	-.0199	.0088	CHE	.0019	.0024	-.007	.0058
ESP	.0054	.0088	-.0158	.0338	DNK	.0012	.0039	-.0104	.0128
FIN	.0015	.0053	-.0305	.0122	GRB	.0019	.0026	-.0095	.0064
FRA	.0014	.0020	-.0072	.0046	ISL	.0033	.0113	-.0344	.0271
GRE	.0001	.0070	-.0211	.0138	JPN	.0009	.0045	-.0218	.0104
HOL	.0015	.0030	-.0158	.0064	NOR	.0017	.0045	-.0109	.0150
IRE	.0051	.0140	-.0211	.0886	NZL	.0030	.0036	-.0065	.0135
ITA	.0003	.003	-.0121	.0066	SWE	.0025	.0041	-.0165	.0102
LUX	.0030	.0069	-.018	.0243					
POR	.0005	.0033	-.0101	.0060					
Eurozone	.0020	.0063	-.0305	.0886	***non-Eurozone***	.0021	.0049	-.0344	.0271
Variable: Δ spread (first difference of sovereign spread)									
AUT	.0015	.3940	-.9362	1.5861	AUS	.0017	.5323	-2.455	2.3251
BEL	-.0004	.4338	-1.7790	1.7330	CAN	.0045	.3120	-.8194	1.1618
DEU	.0029	.3871	-.7207	1.522	CHE	.0107	.4323	-1.3822	1.7630
ESP	.0025	.3952	-.8327	1.4450	DNK	-.0050	.4205	-.8289	1.5501
FIN	.0029	.3871	-.7207	1.5208	GRB	-.0204	.3755	-1.0626	1.1520
FRA	.0015	.394	-.9362	1.5861	ISL	-.0278	1.200	-7.3206	2.6444
GRE	-.0113	.4626	-1.7859	1.7670	JPN	.0556	.4251	-.5643	1.7587
HOL	.0013	.396	-1.0499	1.5628	NOR	-.0125	.5367	-1.3631	1.8834
IRE	.0015	.394	-.9362	1.5861	NZL	.0075	.4928	-2.0622	1.7968
ITA	.0029	.3871	-.7207	1.5224	SWE	-.0055	.5083	-1.2289	1.8321
LUX	-.0464	.5115	-.8686	1.9501					
POR	.0013	.3960	-1.0499	1.5628					
Eurozone	-.0030	.4100	-1.7859	1.950	***non-Eurozone***	.0009	.5709	-7.3206	2.644
Variable: Δ lnGov (First Difference of log Government Consumption as % of GDP)									
AUT	.0036	.0626	-.1427	.1177	AUS	.0073	.0106	-.0316	.0324
BEL	.0030	.0030	-.0042	.0094	CAN	.0050	.0054	-.0096	.0216
DEU	.0034	.0064	-.0145	.0195	CHE	.0035	.0052	-.0198	.0151
ESP	.0064	.0085	-.0170	.0214	DNK	.0033	.0071	-.0200	.0173
FIN	.0029	.0753	-.1200	.1465	GRB	.0049	.0106	-.0285	.0385
FRA	.0021	.0032	-.0056	.0133	ISL	.0052	.0386	-.0782	.0664
GRE	.0004	.0260	-.0652	.0515	JPN	.0035	.0058	-.0124	.0185
HOL	.0049	.0098	-.0185	.0583	NOR	.0052	.0107	-.0340	.0397
IRE	.0054	.0246	-.0764	.0933	NZL	.0073	.0095	-.0196	.0267
ITA	.0010	.0085	-.0169	.0243	SWE	.0029	.0057	-.0172	.0296
LUX	.0077	.0093	-.0293	.0250					
POR	.0013	.0066	-.0169	.0125					
Eurozone	.0035	.0306	-.1427	.1465	***non-Eurozone***	.0048	.0144	-.0782	.0664

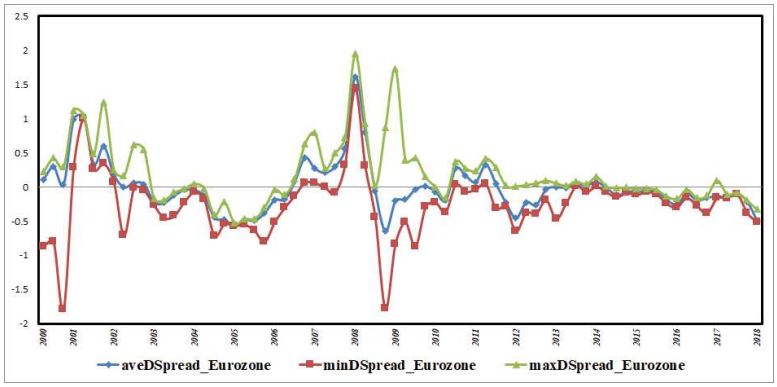

Figure A1: Scatterplot Sovereign Spread Eurozone (1999.q1-2018.q1)

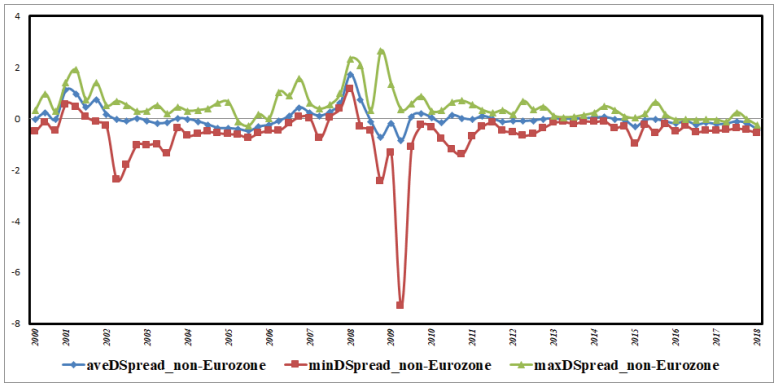

Figure A2: Scatterplot Sovereign Spread non-Eurozone (1999.q1-2018.q1)

Figures A1 and A2 show the movement across time of the average, minimum and maximum values of the sovereign spreads for Eurozone and non-Eurozone countries respectively. As can be seen in Figure A1, there was a speedy convergence in the minimum and maximum values to a common average value among Eurozone member-countries. After about one year, countries with traditionally high average sovereign spread (like Spain, Italy and Greece) immediately experienced a sudden lowering of their spread and were accused of going through a borrowing spree as their borrowing costs decreased. On the other hand, Figure A2 shows that non-Eurozone countries continued experiencing an almost a gap in the maximum and minimum values of their sovereign spread.

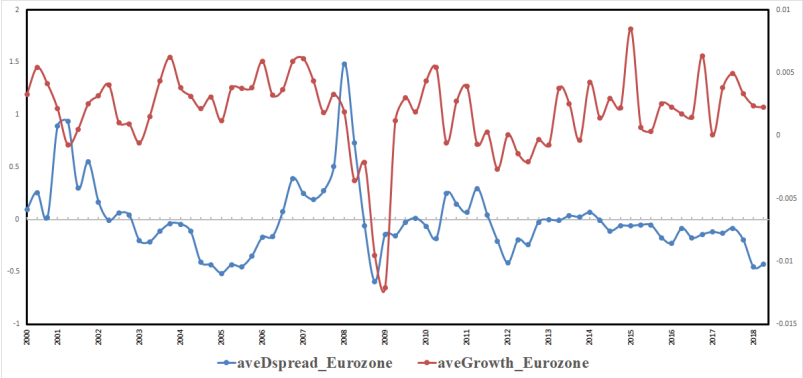

Figure A3: Scatterplot Spread vs. Output, Eurozone

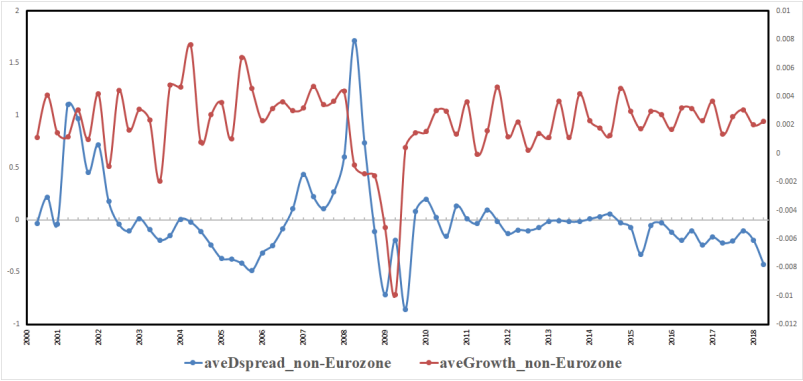

Figure A4: Scatterplot Spread vs. Output, non-Eurozone

Figures A3 and A4 show scatterplots of the co-movements of both the sovereign spread and real growth in output for both Eurozone and non-Eurozone countries. In both Figures A3 and A4, one can see that over-all there appears to be a perceptible negative relationship between the sovereign spread and growth in output for both Eurozone and non-Eurozone countries. However as shown in both figures, during times of financial stress (specifically, during the Great Recession between 2007:4 and 2010:4 dates representing the Great Recession as dated by the NBER business cycle dating for the US), there appears to be a evident shift to a positive relationship as both the sovereign spread and real growth were moving together downwards. This was the time when countries implemented auterity programs which may have caused both variables to move downwards at the same time (Perotti, 2014).

Table A2: Cross-sectional Dependence Tests (Pesaran, 2006)

	Eurozone countries		non-Eurozone countries	
Variable	**CD-test**	**CD$_p$-test**	**CD-test**	**CD$_p$-test**
lnGDP	38.81***	69.41***	55.06***	57.31***
spread	60.12***	59.64***	30.67***	19.53***
Gov	93.28***	129.85***	55.06***	57.31***
Δ lnGDP	29.80***	33.27***	14.33***	23.98***
Δ spread	55.43***	54.72***	31.64***	31.56***
Δ Gov	8.51***	27.90***	0.46	13.497***

H_0: ***NO*** cross-sectional dependence
H_1(for CD-test): there is weak cross-sectional dependence
H_1(for CD$_p$-test): there is strong cross-sectional dependence
*** Significant at 1%

Table A3: Second-generation Panel Unit-Root test (Bai and Ng, 2010)

	Eurozone countries				non-Eurozone countries			
Variable	**ADF**	**P_a**	**P_b**	**PMSB**	**ADF**	**P_a**	**P_b**	**PMSB**
lnGDP	-8.54***	.46	.53	.70	-8.54***	1.8	3.68	6.68
spread	1.07	-1.58*	-1.06	-.80	8.54***	-4.5***	-2.22**	-1.16
Gov	-2.75***	1.27	3.58	13.78	-2.86***	1.65	4.79	11.28
Δ lnGDP	-6.55***	-79.67***	-13.12***	-1.89**	-7.19***	-31.9***	-7.78***	-1.84**
Δ spread	-4.97***	-21.31***	-5.4***	-1.35*	-5.68***	-50.58***	-9.71***	-1.85**
Δ Gov	-7.98***	-80.24***	-13.20***	-1.88**	-8.26***	-50.26***	-9.33***	-1.70**

Ho: PANEL unit-root exists
Significant at 1% (***), 5% (**),10% (*)

Table A4: Panel Granger Causality Test:

	x	**y**	**stat-test value**
Eurozone	Δ lnGDP	Δspread	29.6219***
	Δspread	Δ lnGDP	3.0284*
non-Eurozone	Δ lnGDP	Δspread	5.0471***
	Δspread	Δ lnGDP	4.2120**

H_0: x does not Granger-cause y.
H_1: x does Granger-cause y for at least one panel unit.
Significant at 1% (***), 5% (**),10% (*)

Table A5: Panel Threshold Estimation for ALL advanced countries

	ARDL			CS-ARDL		
	p =1	p =2	p =3	p =1	p =2	p =3
A. Model with 2 threshold variables ($I_1 \mid \Delta s_{it} > \hat{\tau}$) and ($I_2 \mid max\{0, \Delta s_{it}\}$)						
β_2	-.0006*	-.0020***	-.0045***	.0011	.0021*	-.0021
	(.0004)	(.0004)	(.0007)	(.0012)	(.0015)	(.0031)
ϕ_1	-.0037	-.0043	-.057	-.0001	-.0002	-.0023
ϕ_2	-.0034	.0038	.0044	.0001	.0009	.0020
τ	.0350	.0350	.0350	.0250	.0700	.0175
SupF	31.55***	16.7***	8.37	5.32	4.04	3.68
AveF	20.94***	10.00***	3.35*	2.90	2.42	1.64
CD	27.38***	24.66***	22.68***	-1.57	-1.23	-1.06
B. Model with 1 threshold variable ($I_1 \mid \Delta s_{it} > \hat{\tau}$)						
β_2	-.00054*	-.0017***	-.0042***	.001	.023	-.0023
	(.0004)	(.0004)	(.0007)	(.0013)	(.0021)	(.0031)
ϕ_1	-.0034	-.0038	-.0047	-.0000	.0012	-.0032
τ	.0350	.0250	.0350	.0250	.0700	.0600
SupF	5.50***	3.90***	2.79*	2.37	2.27	2.06
AveF	4.15***	2.85***	1.49***	1.59***	1.4**	1.3**
CD	27.62***	25.85***	23.30***	-1.76	-1.46	-.82
C. Model with 1 threshold variable (($I_2 \mid max\{0, \Delta s_{it}\}$)						
β_2	.0004	-.0014***	-.0034***	.0001	.0015	-.0022
	(.0004)	(.0005)	(.0006)	(.0014)	(.0017)	(.0031)
ϕ_2	-.0024	-.0045	-.0057	.0008	.0014	-.0020
τ	.0250	.0700	.0700	.0200	.0200	.0175
SupF	3.55***	2.69	2.09	1.49	.97	.84
AveF	2.67***	1.95***	1.12*	.75	.52	.54
CD	29.05***	24.73***	23.47***	-1.71	-1.11	-1.07
D. Model without threshold variable						
β_2	.0009	.0005	.0006	.0010	.0012	.0012
	(.0005)	(.0005)	(.0004)	(.0010)	(.0012)	(.0012)
CD	29.56***	25.55***	23.63***	-1.64	-.68	.90

Figures in parentheses are standard errors.
Significant at 1% (***), 5% (**),10% (*)

Table A6: Panel NO Threshold Estimation for ALL advanced countries

	p =1	p =2	p =3	p =1	p =2	p =3
D. Model without threshold variable						
β_2	.0009	.0005	.0006	.0010	.0012	.0012
	(.0005)	(.0005)	(.0004)	(.0010)	(.0012)	(.0012)
CD	29.56***	25.55***	23.63***	-1.64	-.68	.90
by country						
AUT	.0011*	0013	.0015	.0018***	.0033***	.0021***
	(.0023)	(.0024)	(.0024)	(.0075)	(.0085)	(.0091)
BEL	.0012	.0012	.0010	.0034	.0029	.0028
	(.0016)	(.0016)	(.0016)	(.0031)	(.0040)	(.0041)
DEU	.0048	.0044*	.0044	.0090	.0110	.0084
	(.0025)	(.0027)	(.0027)	(.0070)	(.0081)	(.0084)
ESP	.0051	.0044	.0043	-.0094	-.0116	-.0112
	(.0024)	(.0025)	(.0024)	(.0048)	(.0054)	(.0055)
FIN	.0015*	-.0008***	.0002***	.0101	.0017	.0105
	(.0025)	(.0027)	(.0027)	(.0070)	(.0080)	(.0081)
FRA	.0009**	.0005***	.0007***	.0026***	.0027	.0026***
	(.0023)	(.0023)	(.0023)	(.0072)	(.0081)	(.0084)
GRE	-.0041	-.0038	-.0042	-.0049	-.0063	-.0059
	(.0016)	(.0016)	(.0018)	(.0023)	(.0036)	(.0037)
HOL	.0004***	-.0009*	-.0006***	.0050	.0026***	.0024***
	(.0022)	(.0023)	(.0023)	(.0070)	(.0085)	(.0089)
IRE	.0022	.0008***	.0012*	-.0003***	.0070	.0127
	(.0022)	(.0023)	(.0023)	(.0072)	(.0082)	(.0085)
ITA	.0039	.0036	.0038	.0045	.0023***	.0021***
	(.0026)	(.0027)	(.0026)	(.0070)	(.0080)	(.0086)
LUX	-.0020	-.0025	-.0001***	-.0001***	.0040	.0024
	(.0015)	(.0016)	(.0019)	(.0019)	(.0035)	(.0035)
POR	.0016	.0003***	.0005***	.0014***	-.0024***	-.0015
	(.0022)	(.0023)	(.0023)	(.0069)	(.0083)	(.0086)
AUS	.0016	.0018	.0016	.0013	.0012**	.0014*
	(.0014)	(.0014)	(.0015)	(.0020)	(.0023)	(.0024)
CAN	-.0008***	-.0006***	-.0009***	.0001***	.0002***	-.0006***
	(.0022)	(.0022)	(.0022)	(.0029)	(.0037)	(.0037)
CHE	.0012	.0012	.0010	.0039	.0034	.0033
	(.0016)	(.0017)	(.0017)	(.0030)	(.0040)	(.0039)
DNK	-.0010*	-.0007***	.0003***	-.0040	-.0037	-.0030
	(.0018)	(.0017)	(.0020)	(.0034)	(.0039)	(.0040)
GRB	.0026	.0027	.0026	.0035	.0018***	.0021**
	(.0025)	(.0026)	(.0025)	(.0041)	(.0050)	(.0050)
ISL	.0011	.0012	.0011	.0019	.0020	.0026
	(.0006)	(.0006)	(.0006)	(.0006)	(.0070)	(.0007)
JPN	-.0040	-.0042	-.0026	-.0061	-.0064	-.0076
	(.0019)	(.0019)	(.0019)	(.0035)	(.0044)	(.0052)
NOR	-.0004***	-.0004***	-.0011*	-.0042	-.0030	-.0036
	(.0018)	(.0018)	(.0019)	(.0028)	(.0030)	(.0040)
NZL	.0001***	-.0005***	-.0005***	-.0029	-.0021	-.0011***
	(.0017)	(.0017)	(.0018)	(.0025)	(.0027)	(.0027)
SWE	.0021	.0014	.0006***	.0049	.0051	.0053
	(.0018)	(.0019)	(.0019)	(.0035)	(.0039)	(.0039)

Figures in parentheses are standard errors.
Significant at 1% (***), 5% (**),10% (*)