Measuring the End of the Eurozone Crisis:

A Test for Financial Integration

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Abstract

In June 2013 French president François Hollande declared, "the eurozone crisis is over." However, in fact, the series of financial crises since 2008 may have interrupted the process of EMU enlargement, which in turn triggered a crisis of confidence in the euro. In this paper we extend the sigma-convergence test (or log *t* test) by Phillips & Sul (2007) to provide a more precise understanding of real interest rate parity (RIP) convergence and to predict the timing of a steady regional financial integration that would be helpful in eliminating the cost of economic asymmetric shocks. Our estimation indicates the RIP among EMU members and accessions were still valid after the interruptions of the 2008 financial crisis. However, the situation has been even worse since the 2010 European sovereign debt crisis. If ceteris paribus, convergence cannot be achieved without further policy actions. This implies the EMU authority must do its best to use its time more effectively, strengthen regional financial integration to solidify the EMU, and then be better able to re-start the process of enlargement.

JEL Codes: F33, F34, F37

Keywords: European sovereign debt crisis, financial integration, sigma-convergence test

1. Introduction

During his state visit to Japan in June 2013, French president François Hollande declared, "the eurozone crisis is over," because "now we have all the instruments of stability and solidarity, an improvement in the economic governance of the eurozone, a banking union, rules on budgetary matters that allow us to be better coordinated and have a form of convergence." (BBC News 2013). However, his declaration may not be persuasive. In addition to current economic performance, it can be seen that most of the Central and Eastern European countries (CEEs) have not been aggressive about becoming the members of the European Monetary Union (EMU) since 2010. The European sovereign debt problem triggered by the U.S. sub-prime crisis not only revealed the EMU's fiscal coordination failings, but also weakened regional financial integration, thus making members more vulnerable to asymmetric shocks despite the great success of monetary policy at the level of the euro area. Lithuania's adoption of the euro in 2015 reveals the EMU will continue to grow, but the main focus is still on the five crisis-hit EMU economies (PIIGS),[1] the "big three" of the CEEs,[2] and the three

[1] Portugal, Ireland, Italy, Greece, and Spain. Note that in December 2013 Ireland regained its financial sovereignty after three years under the thumb of the EU-IMF Troika. However, it is still not safe because of the binding constraints under Europe's Fiscal Compact Treaty.

[2] Czech Republic, Poland, and Hungary.

old "outs."[3] For instance, Poland and the Czech Republic planned to join the euro area in 2012 and 2010, respectively (Yeh 2007). But Poland has now claimed it will not launch the euro before 2015, while the entry of Hungary has been postponed to 2020. The Czech Republic even refused to sign the Fiscal Compact Treaty, which was agreed to by other 25 EU members in March 2012. Furthermore, although the situations of PIIGS have been improving they are still not yet stable, while the three old "outs" have never changed their attitude toward the EMU.

Economic and financial integration will decrease the possibility of economic asymmetric shocks between the EMU and the accessions, so the next EMU enlargement may therefore be at a lower cost. But in contrast, the stagnation of financial integration will increase the cost of sustaining a monetary union, which in turn slows EMU enlargement and thereby degrades the reputation of the euro. The debt ratios of most EMU members were steady or gradually declining before 2010. However, the problem of the banking sectors triggered by the US sub-prime crisis forced the governments to make bailouts that were financed by issuing more public debt. As Figure 1 indicates, the spreads of the government bonds since the launch of the euro have become divergent since 2009-10, which implies divergence of the long

[3] U.K., Denmark and Sweden.

term real interest rates and failure of regional financial integration. Nevertheless, this figure does not enable us to precisely measure the real interest rate convergence and the negative impact from the recent crises on financial integration between the EMU members and the accession candidates.

[Figure 1]

The real interest rate parity (RIP) convergence, which in this paper is measured by using the long term government yield minus the expected inflation rate, can be an indicator to judge the degree of regional financial integration. Most articles examine the above issue by testing the validity of the RIP. This conventional approach applies single-equation-based unit-root tests to examine the hold of RIP and takes the rejection of the unit-root hypothesis as supporting evidence for financial integration (Obstfeld & Taylor, 2002; Goldberg et al., 2003; Ferreira & León-Ledesma, 2007). Due to the low power of single equation unit-root tests, many researchers have applied panel unit-root tests to examine the unit-root hypothesis of real interest differentials, but found mixed results. Wu & Chen (1998), Kim (2006), Holmes (2002), support RIP, but Camarero et al. (2009) fails to support it. In short, rejecting the unit-root hypothesis of the conventional approach implies neither that real interest rates across countries converge to a common interest rate nor that the dispersion of real interest rates decreases over time. Thus the existing evidence of financial integration is open to discussion.

If real interest rates can be decomposed to the multiplication of a common and idiosyncratic component, then an alternative strategy for testing real interest-rate convergence is to examine if the idiosyncratic component, such as risk premium, converges. Phillips & Sul (2007) show that testing the above hypothesis is equivalent to testing the convergence of the cross-sectional variance of real interest rates over time, and so it is termed the sigma-convergence test (or log *t* test). This provides a more precise answer for RIP convergence than the traditional unit root test. There are several advantages of the test by Phillips & Sul (2007). First, the test examines the convergence of each country's real interest rate to the world interest rate. In addition, the test is not subject to the choice of a reference country. Second, the test investigates whether the idiosyncratic component converges to the same long-run equilibrium for each real interest rate in the portfolio. Third, it allows heterogeneous and nonlinear transitions among subgroups. Fourth, the test does not rely on any particular assumptions concerning trend stationarity or stochastic non-stationarity in real interest rates. Finally, when the speed of divergence of the common factor is faster than that of the convergence of the idiosyncratic components, the real interest differentials may retain non-stationary characteristics. The log *t* test will have higher power to detect the asymptotic co-movement relative to conventional unit root tests. In the case with the heterogeneous time-varying risk premium across countries, applying the log *t* test to

examine financial integration across countries would be more appropriate (Lin, 2011).

Note that some papers use a different method but focus on EMU enlargement as well. But their results need to be updated after the crisis. Bussière et al. (2008), García-Solanes & María-Dolores (2008), and Kutan & Zhou (2008) assess the timing of the newest members to enter into the EMU by looking at trade integration, economic symmetry and the persistence of real exchange rate shocks, respectively. Arghyrou et al. (2009) demonstrate evidence of convergence towards the EMU average for major EU countries, when accounting for the structural breaks on real interest rate differentials.

On the basis of Lin & Yeh (2014), the purpose of this paper is to measure the damage to financial integration between the EMU and its main accession candidates caused by the European sovereign debt crisis since 2010. Doing so may be able to point out a means to finally resolve the Eurozone crisis. We use the log t test by Phillips & Sul (2007) to provide a more precise answer on convergence of the RIP than the traditional unit root test. Further, we extend Lin & Yeh (2014) to predict the timing of a steady RIP convergence, which measures the cost of time to achieve financial integration caused by the sovereign debt crisis between the EMU and its main accession candidates. We expect that the convergent speed could be slower than the prediction by Lin & Yeh (2014), which includes only the 2008 global financial crisis.

This paper is structured as follows. Section 2 presents and explains our modeling.

Section 3 uses the log *t* test to show RIP convergence between Germany and other 11 important "ins" and "outs" of the EMU mentioned above. Section 4 concludes the findings of this paper and provides policy suggestions.

2. The Model

2.1 Real Interest Parity

The model of this paper is based mainly on Phillips & Sul (2007) and on Wu & Lin (2011). RIP is implied by purchasing power parity (PPP) and uncovered interest parity (UIP). If PPP holds, nominal exchange rates should equal the deviation in domestic and foreign prices:

$$s_t = p_t - p_t^*, \tag{1}$$

where s_t is the log of the nominal exchange rate (domestic currencies per foreign currency); and p_t and p_t^* denote the log of domestic and foreign price levels, respectively.

With risk-averse investors, the hold of UIP implies that interest-rate differentials equal the sum of the expected depreciation rate of domestic currency and a time-varying risk premium:

$$i_t - i_t^* = E_t(s_{t+1} - s_t) + \omega_{t+1}, \tag{2}$$

where i_t and i_t^* denote domestic and foreign interest rates, respectively; $E_t(.)$ denotes a conditional expectation based on the information set at time *t*; and ω_t is the time-varying risk premium. Flood & Marion (2000) point out the time-varying risk premium ω_t depends on the measure of investors' risk aversion, expected currency risk,

and worldwide relative holdings of domestic and foreign bonds. In other words, risk premium reflects the relative risk of holding domestic and foreign assets.

Based on equations (1) and (2), this work derives the RIP as follows:

$$r_t^e = r_t^{*,e} + \omega_{t+1}, \tag{3}$$

where $r_t^e = i_t - E_t \Delta p_{t+1}$ and $r_t^{*,e} = i_t^* - E_t \Delta p_{t+1}^*$, in which Δ is the first difference operator. If investors are risk neutral, and the risk premium is zero, then equation (3) degenerates to the standard UIP model in the expectation form: $r_t^e = r_t^{*,e}$. The realization of RIP implies that international trade barriers are removed, and therefore the asset market and goods market are integrated.

2.2 Log t Test

Conventional literature evaluates RIP validity by testing the stationarity of real interest differentials given that real interest rates are I (1) and the risk premium is stationary. Obviously, rejecting the unit-root hypothesis with an ADF statistic implies neither that real interest rates converge to the same level in the long run nor that real interest differentials converge to a common mean. Moreover, rejecting the joint unit-root hypothesis with a panel unit-root test implies the series under investigation could mix with the I (1) and I (0) series. An alternative strategy to examine the convergence of real interest rates is to test their sigma convergence. That is equivalent to testing whether the dispersion of real interest rates across countries declines over time (Phillips & Sul, 2007). This is a rigorous test for real interest convergence, and hence rejecting the hypothesis that unit root does not imply sigma-convergence (Pesaran, 2007). This paper applies the sigma-convergence test of Phillips & Sul (2007) to examine RIP convergence.

Assume the real interest rate is decomposed into a time-varying return of systematic risk, $\lambda_{jt}\mu_t$, and the return of idiosyncratic risk, a_{jt}, so

$$r_{jt} = a_{jt} + \lambda_{jt}\mu_t, \tag{4}$$

where μ_t is the systematic risk factor for real interest rates, and λ_{jt} is time varying factor loading coefficients that capture the individual effects on systematic risk. The systematic risk factor can be measured by the cross-sectional mean of real interest rates, $\overline{r_t}$, which is an I (1) process based on our data. Hence, the systematic risk factor also is an $\mathrm{I}(1)$ process. To separate the common component from idiosyncratic components, the real interest rate is re-written as:

$$r_{jt} = \left(\frac{a_{jt}}{\mu_t} + \lambda_{jt} \right) \mu_t, \tag{5}$$

Since μ_t follows an $\mathrm{I}(1)$ process, the term a_{jt}/μ_t converges to zero in the long run. According to equation (5), this paper decomposes a real interest rate into two components:

$$r_{jt} = b_{jt}\mu_t, \tag{6}$$

where $b_{jt} \equiv \left(\frac{a_{jt}}{\mu_t} + \lambda_{jt} \right)$ is an idiosyncratic component, depending on the currency-specific risk premium, intertemporal marginal rate of substitution or financial regulations of country *j*. Based on equation (6), real interest differentials are given as follows:

$$r_{it} - r_{jt} = (b_{it} - b_{jt})\mu_t, \tag{7}$$

where $b_{it} - b_{jt}$ is the relative risk premium between country *i* and *j*. Financial integration implies that the idiosyncratic risk in different assets converges

asymptotically. That is, the idiosyncratic components b_{it} and b_{jt} converge to some common b as $t \to \infty$, implying financial integration holds. However, the common factor μ_t is non-stationary. When the speed of divergence of common factor is faster than that of the convergence of the idiosyncratic components, the real interest differentials may retain non-stationary characteristics. Conventional co-integration tests will have low power to detect the asymptotic co-movement of the idiosyncratic components. Therefore, it is interesting to examine if convergence holds for the idiosyncratic component (b_{jt}) instead of the mixture of idiosyncratic and common components (r_{jt}). Phillips & Sul (2007) provide the log *t* test to examine the convergence of b_{jt}.

The convergence of real interest rates holds if $b_{it} \to b$ for $i = 1, ..., N$, which means there is a common trend in real interest rates and the common trend, $b\mu_t$, can be either stochastic or deterministic. Further, to examine the joint hypothesis of real interest-rate convergence, $H_0 : b_{it} \to b$ for all *i*, against the alternative hypothesis of no real interest-rate convergence in at least one country, $H_A : b_{it} \not\to b$ for some *i*.

The common factor μ_t is unknown and could not be detected, but it may be removed by dividing the cross-section mean of real interest rates.

$h_{it} = r_{it} / N^{-1} \sum_{i=1}^{N} r_{it} = b_{it} / N^{-1} \sum_{i=1}^{N} b_{it}$. h_{it} is called the relative transition coefficient and converge to unity under the null of convergence. A log *t* test regresses the following log *t* regression model:

$$\log \frac{H_1}{H_t} - 2\log(\log t) = \xi_0 + \xi_1 \log t + u_t \quad , \tag{8}$$

for $t = T_0, ..., T$, where $H_t = N^{-1}\sum_{i=1}^{N}\left(h_{it} - 1\right)^2$. The long-run convergence of real interest rates is rejected if ξ_1 is significantly negative. Data for this regression starts at $T_0 = \left[cT\right]$ for some $c > 0$. Phillips & Sul (2007) suggest $c \in [0.2, 0.3]$ is a satisfactory choice in terms of both size and power.

The method to derive equation (8) is as follows. By dividing the cross-sectional mean of r_{it}, the relative transition coefficient, h_{it}, is derived, which removes the systemic components. Since h_{it} converges to unity for the null convergence, it is expected that the cross-sectional variance of h_{it} decreases over time, if the null is true. The cross-sectional variance of h_{it}, H_t, is derived by $H_t=N^{-1}\Sigma_{i=1}^{N}(h_{it}-1)^2$. The log t regression model is constructed by regressing log H_t and some corrected term, such as log (log t) or log H_1, on log t. The log t regression model of Phillips & Sul (2007) is shown as equation (8).

Under the null hypothesis of convergence, the cross-sectional variance of variables under investigation decreases over time. Therefore, the convergence test is also called the sigma-convergence test. Phillips & Sul (2007) also demonstrate that removing cyclical components from the data improves the finite sample size and power of the tests. The Hodrick-Prescott filter is widely used in macroeconomics to separate the cyclical component of a time series from raw data. It is used to obtain a smoothed non-linear representation of a time series that is more sensitive to long-term than to short-term fluctuations. This work also adopts the Hodrick-Prescott (1997) trend of r_{it} in order to construct h_t . The parameter λ in HP filter is set to 1600, since the frequency

of our data is monthly.

3. Empirical Results

To examine whether the markets integrate, we take 12 important "ins" and "outs" of the EMU as our sample due to data availability. The log *t* model combines all the individual series into one cross-sectional variance and determines the convergence of the variance. Therefore the number of the sample countries does not affect the power of the test. This study examines whether and when the real interest rates of the 12 economies can be converged, both before and after the 2010 European sovereign debt problem. Monthly data for long-term government bond yields and the consumer price index (CPI) are downloaded from the International Financial Statistics (IFS) database, and we apply the balanced panel data. The CPIs are the most frequently used indicators of inflation and reflect changes in the cost of acquiring a fixed basket of goods and services by the average consumer, while the data of the producer price is limited to domestic and industrial sectors. Therefore, the CPI is adopted to calculate the inflation rate in this study. The expected inflation rates by actual inflation rates are constructed from the CPI: $\pi_t = p_{t+12} - p_t$. Due to the construction of inflation rates, the sample period of real interest rates is from 2001M1 to 2012M8. Note that this paper focuses on the impact of the European sovereign debt problem on the stability and enlargement

of the EMU, and the Greek crisis has been an issue since April 2010 (2010M4). So we choose April 2010 to divide our data.

In this paper we use 10-year bond yields as Figure 1. Note that as the facts we show in Figures 1, RIP convergence of the EMU members and accessions was expected to be demonstrated because of the benefits of the elimination of exchange rate risk. However, the effects of the crisis in 2010 spread to Europe, which led to high debt-GDP ratios in some euro countries, such as Greece, Italy and Ireland. The crisis might have postponed RIP convergence or caused the real interest rates of "ins" and "outs" to diverge from that of Germany. Therefore, we can first discuss what financial integration would have been like if there had been no 2010 debt crisis by separating our sample into two sub-samples: 2001M1-2010M4 and 2001M1-2012M8. To do so we can see what the situation would have been if the 2010 European sovereign debt crisis had not occurred, and therefore determine the impacts of the 2008 and the 2010 crises on the EMU. Note that it would not be a problem to expand this research by revising the data.

3.1 Test for the Full Sample Countries

Table 1 reports the slope coefficient of equation (8), ξ_1, and its t-statistics for different sample periods. Parameter *c*, indicating the fraction of the sample to be removed in

regression, is repeatedly adjusted from 0.2 to 0.3 at intervals of 0.01. The results from the second column indicate that the estimates of ξ_1 are significantly negative, rejecting the convergence hypothesis before the onset of the 2010 sovereign debt crisis. Therefore, it could be expected that the RIP will also be rejected over the entire period, including the period after 2010M4.

[Table 1]

In Table 1, the values of ξ_1 are significantly negative in the second and third columns, respectively. ξ_1 ranges from -0.16 to -0.42 from 2001M1-2010M4 and ranges from -1.56 to -1.90 from 2001M1-2012M8. Since ξ_1 can also represent the speed of the changes in H_t, the speed of divergence is higher in the full sample than in the period of 2001M1-2010M4. This indicates that the 2010 debt crisis caused the RIP to be more divergent.

3.2 Club Convergence

Although the real interest convergence is rejected among the full sample countries, there might be club convergence among them. That is, some of the 12 countries might be convergent according to the idea of sigma-convergence. Thus we adopt the clustering algorithm, which was also provided by Phillips & Sul (2007), to investigate whether there is club convergence in 2001M1-2010M4 or 2010M1-2012M8. The

algorithm for club convergence and clustering, shown on pp. 1798-1803 of Phillips & Sul (2007), is used consistently. The results are shown in Table 2.

[Table 2]

The first part of 2001M1-2010M4 in Table 2 indicates that the U.K. is the main factor for rejecting the convergence hypothesis in the second column of Table 1, since all countries except the U.K. are in Club X. That is, most EMU members and accessions still keep converging to Germany even if they were affected by the 2007-08 U.S. sub-prime crisis.

However, the second part of 2001M1-2012M8 in Table 2 shows how the situation changed dramatically after the 2010 debt crisis. The 12 countries are separated into five groups: In addition to the independence of the U.K. and Denmark, most EMU crisis-hit economies (Portugal, Ireland, Greece, and Spain) are in one group (Club Y), and the Czech Republic, Sweden and Italy are in another (Club Z). The most striking change is that the real interest rate of Germany is as independent as those of the U.K. and Denmark, which means the path of financial integration of the selected "ins" and "outs" towards Germany was no longer convergent.

In sum, the real interest rate "levels" between the EMU and its accession candidates may not be the same. The answer, however, may differ if we look at the same thing according to the idea of "variances" instead of "levels." Nevertheless, from

the above test we can observe the destructive effect of the 2010 sovereign debt crisis on EMU financial integration.

3.3 Cost of the 2010 Debt crisis

Club X of Table 2 shows that most of the selected "ins" and "outs" still converged to Germany even with the financial turmoil in 2007-08. However, it can be observed that the financial crisis changed the mind of the three CEEs and their plans to join the Eurozone were postponed. This paper uses Club X of Table 2 to simulate H_t of equation (8), which implies a steady RIP convergence and therefore predicts an appropriate timing for a candidate to enter the EMU for a higher degree of financial integration. H_t in Figure 2 indicates the timing has been postponed assuming there are no further disturbances.

[Figure 2]

Nevertheless, from the upper panel of Figure 2 the time point that real interest rate convergence will be achieved cannot be seen. However, this model implies that when the forecasted cross-sectional variance is in a steady state, it is the time when the real interest rates of the countries in Club X converge to Germany, which makes complete financial integration feasible. The growth rate of the forecasted cross-sectional variance, $d\ln(H_t) = \ln(H_t) - \ln(H_{t-1})$, is plotted in the bottom panel of Figure 2. The

growth rate of the forecasted cross-sectional variance is negative. The speed of its growth rate decreases and gradually converges after 2030, assuming there are no further disturbances.

Note that the monthly data of Club X are from 2001M1 to 2010M4, which covers the 2008 financial crisis. If ceteris paribus, our simulation indicates convergence of the variance cannot be achieved until about 2030-2040. In an economic sense, it will take 20 years more to achieve complete financial integration, with the goal of lowering the operating costs of the EMU.

The situation becomes even worse taking the 2010 debt crisis into account, because the real interest rates of Club Y, Club Z and Germany are totally divergent. Thus in theory it is not possible to predict the timing for a recovery of EMU financial integration. The only thing we could say is that the EMU authority must do its best to use its time more effectively, strengthen regional financial integration to solidify the EMU, and then be able to re-start the process of enlargement.

4. Concluding Remarks

Lithuania's adoption of the euro in 2015 shows that the energy of EMU expansion still exists. But in fact the series of financial crises since 2008 may have interrupted the process of EMU enlargement, which in turn triggered a crisis of confidence in the euro.

A sigma-convergence (or log *t*) test is used to provide a more precise answer about RIP convergence than the traditional unit root test. Further, we extend the model to predict the timing of a steady RIP convergence, which measures the degree of regional financial integration helpful in reducing the cost of economic asymmetric shocks.

Our estimation indicates that, according to variances instead of levels, RIP among EMU members and accessions were still valid after the interruptions of the 2008 financial crisis. However, the situation has been even worse since the 2010 European sovereign debt crisis. If ceteris paribus, convergence of the variance cannot be achieved without further action. This implies the EMU authority must do its best to use its time more effectively, strengthen regional financial integration to solidify the EMU, and then be able to re-start the process of enlargement.

This research could be improved in several ways. Firstly, the data ends at 2012 M8, but the factor of the European sovereign debt crises could be included in the study by updating the information. Then the RIP convergence would be achieved more quickly after more institutional reforms. Secondly, a formal comparison of the conventional methods and the new model would constitute a robust test and an econometric application.

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Table 1. Results of the Log *t* Test: Before and After the 2010 Debt Crisis

	2001M1-2010M4		2001M1-2012M8	
c	ξ_1	t-stat.	ξ_1	t-stat.
0.20	**-0.42**	**(-16.20)**	**-1.56**	**(-17.97)**
0.21	**-0.40**	**(-15.16)**	**-1.58**	**(-17.96)**
0.22	**-0.39**	**(-14.05)**	**-1.60**	**(-17.99)**
0.23	**-0.37**	**(-12.90)**	**-1.63**	**(-18.24)**
0.24	**-0.35**	**(-11.70)**	**-1.65**	**(-18.48)**
0.25	**-0.30**	**(-9.26)**	**-1.69**	**(-19.27)**
0.26	**-0.28**	**(-8.04)**	**-1.72**	**(-19.88)**
0.27	**-0.25**	**(-6.85)**	**-1.74**	**(-20.68)**
0.28	**-0.22**	**(-5.69)**	**-1.79**	**(-23.07)**
0.29	**-0.19**	**(-4.59)**	**-1.82**	**(-24.81)**
0.30	**-0.16**	**(-3.56)**	**-1.90**	**(-29.91)**

Source: Authors' computation

Note: a. The sample includes Czech Republic, Denmark, Germany, Greece, Hungary, Ireland, Italy, Poland, Portugal, Spain, Sweden, and the U.K.

b. The log *t* regressions based on Equation (8). All results cannot accept the null hypothesis of real interest convergence.

c. Discarding some initial fraction of the time series data allows attention to be focused on the recent tendency, especially when the sample size is larger. Based on the simulation experience of Phillips & Sul (2007), *c* in the interval, 0.2 to 0.3, is a satisfactory choice, in terms of size and power.

Table 2. Results of Club Convergence: Before and After the 2010 Debt Crisis

	log *t*	t-stat.	Countries
2001M1-2010M4			
Club X	0.08	2.88	Hungary, Czech Republic, Poland, Sweden, Germany, Denmark, Portugal, Italy, Ireland, Greece, Spain
Independent			U.K.
2001M1-2012M8			
Club Y	0.17	1.54	Hungary, Poland, Portugal, Ireland, Greece, Spain
Club Z	0.12	0.95	Czech Republic, Sweden, Italy
Independent			Germany U.K. Denmark

Source: Authors' computation

Note: The convergent-club classification of real interest rates is based on Table 1.
"Independent" means its real interest rate is different from each other.

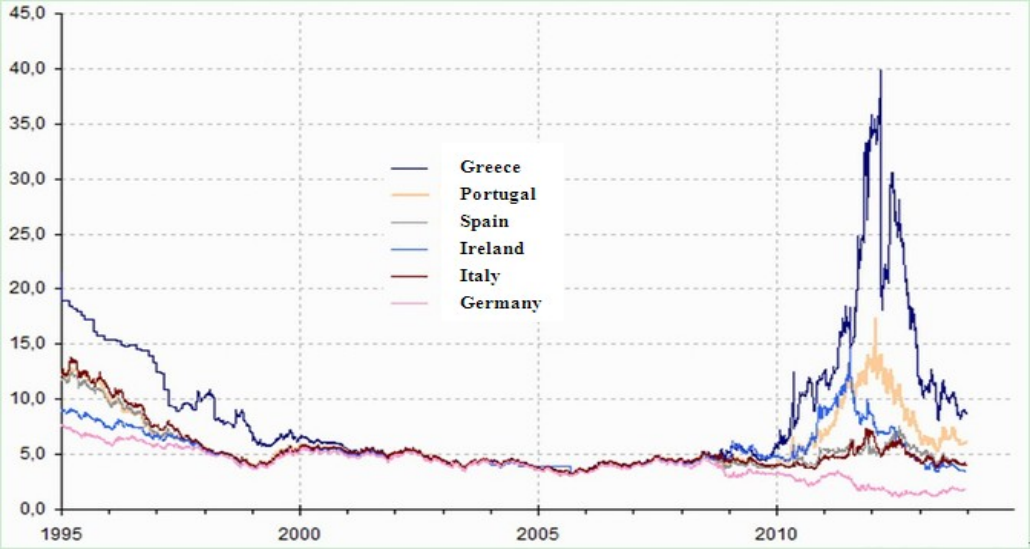

Figure 1. 10-year Government Bond Yields of the Selected EMU Members
Source: Markt-Daten.de

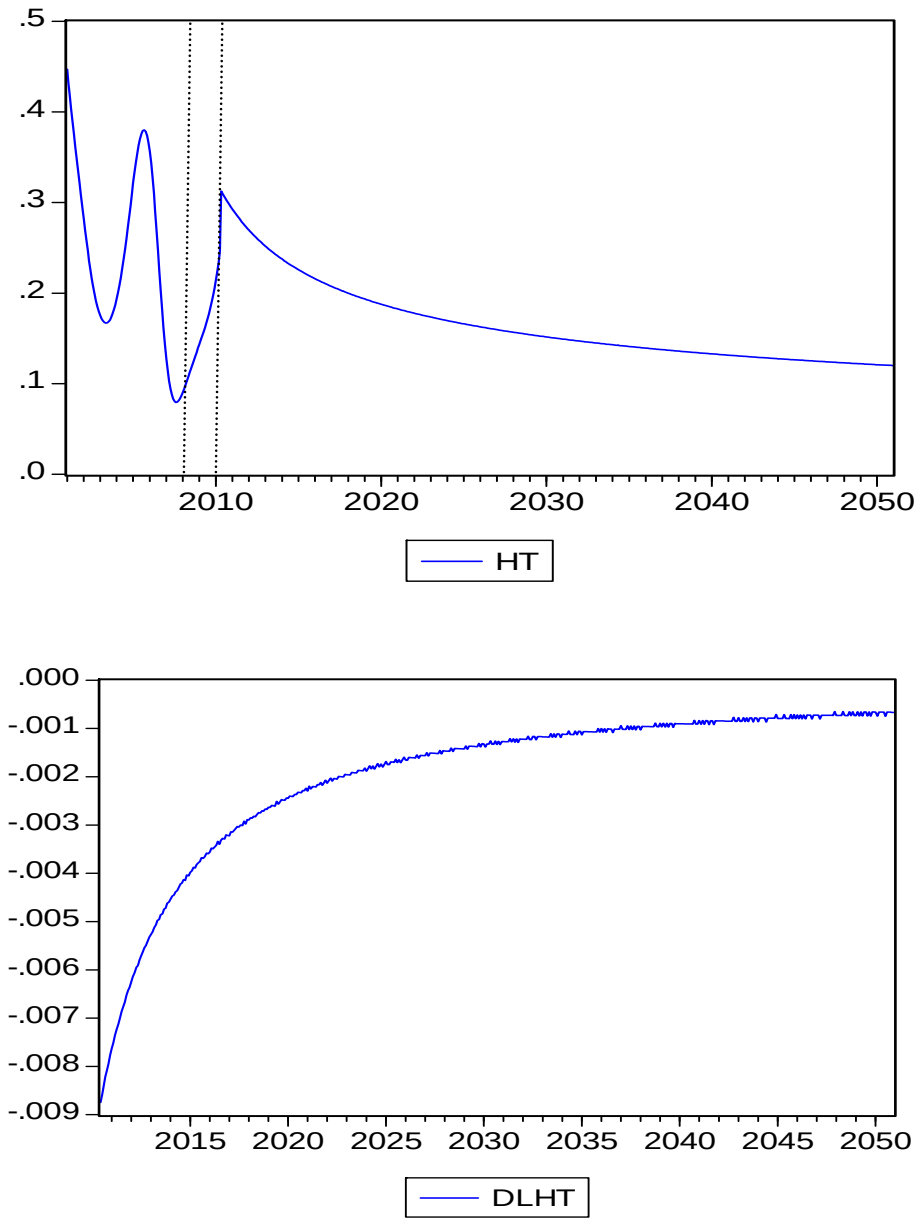

Figure 2. RIP Convergence Simulation by Club X of Table 2: What If the 2010 Debt Crisis Did Not Occur?

Source: Authors' computation

Note: a. The upper panel is forecasted cross-sectional variance (H_t) of the relative transition coefficients based on Club X of Table 2 (2001M1-2010M4). The dashed lines indicate the period between 2008 and 2010.

b. The bottom panel is growth of the forecasted cross-sectional variance ($DLHT = d\ln(H_t) = \ln(H_t) - \ln(H_{t-1})$).