

Interest rate convergence, sovereign credit risk and the European debt crisis: a survey

Mario Gruppe

Norddeutsche Landesbank Girozentrale, Hannover, Germany

Tobias Basse

Credit Risk/Risk Management, Norddeutsche Landesbank Girozentrale, Hannover, Germany and Touro College, Berlin, Germany

Meik Friedrich

Department of Banking, HSW Hameln, Hameln, Germany, and

Carsten Lange

Department of Economics, California State Polytechnic University Pomona, Pomona, California, USA

Abstract

Purpose – This paper aims to briefly review the literature on interest rate convergence and the European debt crisis with a special focus on the current fiscal problems of some governments in Europe.

Design/methodology/approach – Relevant empirical papers are identified and reviewed focusing on time series analysis techniques.

Findings – The introduction of the euro has caused interest rate convergence among European Monetary Union (EMU) government bond yields. However, now sovereign credit risk and possibly even redenomination risk have caused divergences in European bond markets.

Research limitations/implications – A major limitation is that a relatively new field of the literature is surveyed. However, there are enough papers of relevance. This review paper could therefore be helpful in finding new approaches for additional empirical research examining the EMU bond market.

Originality/value – The results of empirical studies in a relatively new field of the literature are summarized. There meanwhile are some relevant papers. A brief survey of the results of these papers is provided. Important empirical findings with regard to interest rate convergence, sovereign credit risk and redenomination risk in the EMU are discussed and evaluated. The review is especially helpful for researchers and practitioners in the field of managerial finance and risk managers in the financial services industry.

Keywords European debt crisis, Interest rate convergence, Sovereign credit risk

Paper type Literature review



1. Introduction

In the current crisis, government bond yields in some European countries have been rising strongly due to fears about increased sovereign credit risk. The credit event that was a consequence of the Greek debt swap in 2012 clearly has increased the awareness of bond investors, showing that government bonds issued by industrialized European countries are not free of default risk. Moreover, all of a sudden there were fears about a possible breakdown of the euro. These concerns caused redenomination risk – which is a special type of exchange rate risk and describes a scenario where a country leaves a currency union and

introduces a depreciating currency (Klose and Weigert, 2014; Sibbertsen *et al.*, 2014). Given that government bond yields are of high importance for financial markets, the experiences with the European debt crisis have become an attractive research topic in different fields of financial economics. With regard to managerial finance, there is, for example, a special relevance of government bond yields projecting the weighted average cost of capital for capital budgeting. Sovereign credit risk definitively could matter in this context. In fact, the hopes that a solution to the Argentine debt crisis in July and August 2014 led to higher share prices of companies in this country, because market participants thought that the end of the dispute not only would increase economic activity (and therefore corporate earnings) but also could lead to lower weighted average cost of capital for firms in Argentina. Moreover, the low oil price recently has been a starting point for discussions about sovereign credit risk in oil producing countries (Wegener *et al.*, 2016a). The implications of sovereign credit risk for equity markets with a special focus on emerging markets have, for example, been discussed by Erb *et al.* (1995).

Quite clearly, the European debt crisis and its effects on government bond yields obviously are of high relevance for financial markets. The return of exchange rate risk also could play a major role in this context. A breakdown of the EMU would have numerous economic and political consequences. It could, for example, have important negative effects for the possibility of companies to finance new investment opportunities in Europe. In fact, Holder *et al.* (2001) have argued that the introduction of the euro has led to a larger capital market, improving the ability of companies to raise additional funds. After years of negotiations and political bargaining, the euro was introduced in January 1999. It became the new currency of a number of European countries. These countries now form the EMU. The European Central Bank (ECB) has taken over the responsibility for monetary policy in the EMU (Kool, 2000; Pollard, 2003). The exchange rates among the currencies of the member states at first were irrevocably fixed; the new banknotes and coins then were put in circulation in 2002 (Geigant, 2002; Vuchelen and van Hove, 2002). The creation of the common currency in Europe and the establishment of a new supranational institution – the ECB – is often seen as an extremely important milestone in the process of European economic integration. Most importantly, the introduction of the common currency in Europe has eliminated exchange rate risk among those countries that have joined the EMU (Capstaff *et al.*, 2007; Nguyen *et al.*, 2007). This fact is important for international trade. Additionally, the elimination of exchange rate risk also has had significant consequences for financial markets (Kool, 2000; Haselmann and Herwartz, 2010). Holder (1999), for example, has discussed the implications of the introduction of the euro for equity markets. Moreover, Lund (1999) has argued convincingly that the advent of the euro has eliminated the exchange rate risk for investors planning to buy fixed income securities issued by other EMU countries and that the new currency already ought to have affected the relationship among interest rates before 1999 because a binding time table for the introduction of the euro was presented much earlier. Therefore, the EMU should have led to interest rate convergence – and this process should have started before the introduction of the euro. Amongst other factors this is a consequence of the expectation of the future existence of only one central bank (which, of course, also means one policy rate) for all countries joining the monetary union (Frömmel and Kruse, 2015). Meanwhile, the European government debt crisis has raised some concerns about sovereign credit risk and possibly even redenomination risk. These two kinds of risk have the potential to end the tendencies towards interest convergence among the EMU members (Basse *et al.*, 2012; Sibbertsen *et al.*, 2014). Therefore, this paper will review the relevant literature examining the issue of interest

rate convergence in Europe before and after the government debt crisis. Our focus clearly lies on the empirical evidence from time series models.

The paper is structured as follows: [Section 2](#) provides a short historical overview and especially discusses some relevant consequences of the European debt crisis. The third section then reviews the literature analysing the convergence of interest rates in the Eurozone. Before concluding in [Section 5](#), the fourth section discusses the rather new literature examining the effects of the crisis.

2. Monetary union, financial markets and the European debt crisis

Even before the introduction of the common currency in Europe, there has been controversial discussions about the future of the EMU (especially from the perspective of the optimum currency area theory). Already long before the current crisis, some observers noted that there are potential core and peripheral EMU member countries. However, there always seem to have been quite different opinions with regard to the question which countries should be classified as “peripheral”. While [Beine and Hecq \(1997\)](#) have suggested Spain and Portugal, [Kouparitsas \(1999\)](#) has named Ireland and Finland. Moreover, [Goodhart \(1998\)](#) has questioned whether the theory of optimum currency areas is a good starting point trying to analyse and predict how EMU will (or should) work. In spite of the current crisis, the euro can be regarded as a success story – as can be seen by simply examining the number of countries that have introduced this currency. As already mentioned, the Euro started in 1999 with 11 member states, and Greece became the 12th member in 2001 ([Geigant, 2002](#); [Pollard, 2003](#)). Slovenia joined in 2007, Cyprus and Malta in 2008, Slovakia in 2009, Estonia in 2011 and Latvia in 2014. [Table I](#) summarizes the developments. With the creation of the ECB, this supranational institution now controls monetary policy in the whole EMU ([Pollard, 2003](#); [Hardouvelis et al., 2006](#)).

One of the most important instruments of this central bank is the ability to change the main refinancing rate. This interest rate for the ECB’s regular open market operations is identical in all EMU countries. Thus, the introduction of the euro clearly should have led to convergence among money market interest rates in the Eurozone ([Gaspar et al., 2001](#); [Holder, 1999](#)). This statement more or less is true by definition. The new common currency also ought to have affected the relationship between long-term interest rates in the EMU. In fact, it is quite common to argue that (as already indicated) the advent of the euro has eliminated the exchange rate risk for investors in bonds issued by other EMU countries ([Lund, 1999](#); [Hardouvelis et al., 2006](#)). More specifically, [Sibbertsen et al. \(2014\)](#) have argued convincingly that without fears about the breakdown of a currency union or other systems of fixed exchange rates, the expected change of the exchange rate has to be zero. Thus, assuming the absence of credit risk and differences in the liquidity of bonds, the uncovered

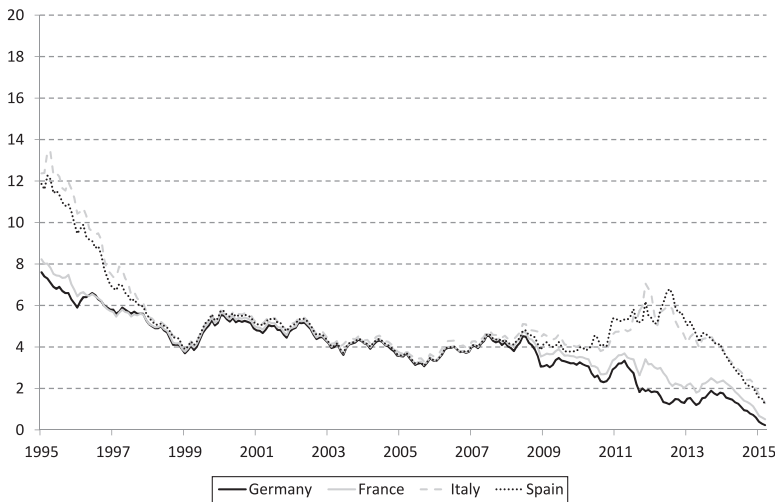
Initial members	New members
Austria, Belgium, Finland, France, Germany, Ireland, Italy, Luxembourg, Netherlands, Portugal, and Spain	Greece (12th member, January 2001), Slovenia (13th member, January 2007), Cyprus and Malta, (14th and 15th member, January 2008), Slovakia (16th member, January 2009), Estonia (17th member, January 2011), Latvia (18th member, January 2014), and Lithuania (19th member, January 2014)

Table I.
EMU member states **Source:** European Central Bank

interest rate parity also predicts the existence of a very close relationship among long-term bond yields (Sibbertsen *et al.*, 2014; Basse, 2014). Phrased somewhat differently, the introduction of the euro should have caused convergence among bond yields in the Eurozone.

As already noted, the introduction of the euro already should have affected the relationship among interest rates before 1999, because a binding time table for the introduction of the new currency was already presented much earlier (Lund, 1999; Basse *et al.*, 2012). More recently, the European debt crisis has raised some concerns among investors. Figure 1 illustrates the developments of interest rates in selected EMU countries (10-year government bond yields). The rolling correlations among German 10-year government bond yields and the interest rates in France, Italy and Spain (in differences, 60 data points) also show signs of convergence of government bond yields until 2008 (see Figure 2).

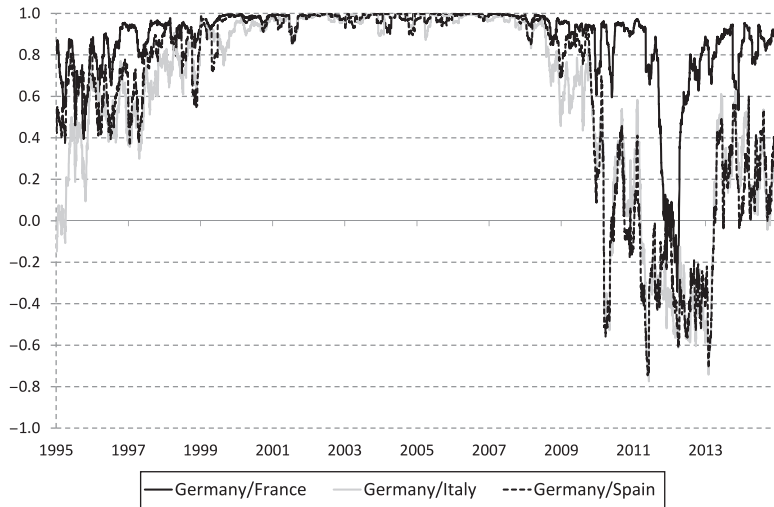
Sibbertsen *et al.* (2014) have argued that in this new environment, sovereign credit risk and probably even redenomination risk have become of special importance for European bond markets. While there are not that many papers discussing the exits from currency unions, Rose (2007) has documented a number of cases after World War II. Additionally, quite a number of studies have examined the end of currency system based on fixed exchange rates in general. Most importantly, there are numerous studies examining the breakdown of the Bretton Woods system (Geigant, 2002; Basse, 2006). Moreover, Kang (2013) has discussed the consequences of the abandonment of the fixed exchange rate regime in South Korea during the crisis in East Asia. Meanwhile, the European debt crisis and its implications for EMU have attracted some attention. Given that Moro (2014) recently has published an excellent survey examining this crisis, we will not focus on details here. Our main objective is to discuss the relevant empirical evidence on interest rate convergence documented in the literature.



Source: National Central Banks

Figure 1. Interest rate convergence: 10-year government bond yields in selected EMU countries

Figure 2.
Rolling correlations
among EMU
government bond
yields (in first
differences)



Source: National Central Banks

3. Before the crisis

As already noted, the introduction of the euro has been very important for interest rates in the EMU. [Kim *et al.* \(2006\)](#), for example, have documented that the euro has caused structural change in the bond market. Additionally, [Laopodis \(2008\)](#) has examined data from 10 EMU countries and has documented an increase in the correlation of the returns on Euro government bonds after the introduction of the new currency. Moreover, by using techniques of cointegration analysis, he has identified two groups of EMU countries – a core group (including Germany and France) and some peripheral countries (including Italy and Ireland). [Jenkins and Madzharova \(2008\)](#) have been able to find cointegration among nominal government bond yields in the Euro area after the introduction of the euro. This empirical finding does indicate that interest rates in EMU countries have converged.

It has also been argued ([Basse *et al.*, 2012](#); [Sibbertsen *et al.*, 2014](#)) that it could be interesting to examine data before 1990, because the Exchange Rate Mechanism (ERM) of the European Monetary System (EMS) already could have caused convergence of interest rates in Europe. Quite clearly, the EMS helped to reduce exchange rate risk for investors. German government bond yields should have played a special role for the European bond markets, thereby “causing” interest rate movements in other member states of the EMS. This assumption is called German Dominance Hypothesis. Testing this hypothesis has produced mixed empirical findings. [Hassapis *et al.* \(1999\)](#), for example, have argued that the ERM did not strongly increase the linkages between interest rates in Germany and the rates of other ERM countries with one exception – The Netherlands (where monetary policymakers were trying to imitate the Deutsche Bundesbank). However, there also is empirical evidence supporting the German Dominance Hypothesis. Most importantly, [Baum and Barkoulas \(2006\)](#) have documented some results that speak for this theory using techniques of fractional cointegration. Additionally, [Fountas and Wu \(1998\)](#) have noted that there is clear empirical evidence for interest rate convergence in the EMS period controlling for structural change. Additionally, [Siklos and Wohar \(1997\)](#) have presented empirical

evidence for interest rate convergence among the EMS members during some periods of time.

4. After the crisis

As already discussed, the European debt crisis has caused some concerns about sovereign credit risk and redenomination risk among investors buying EMU government bonds. While this is a relatively new literature, there meanwhile are some relevant studies. [Gruppe and Basse \(2012\)](#) have examined German and Greek government bond yields and have shown that information about fiscal problems in Greece seems to have led to structural change among government bond yields issued by the two countries. [Apergis et al. \(2011\)](#) have estimated a threshold vector error correction model and have reported that the spreads of Greek over German government bond yields and CDSs are cointegrated and that two regimes (a typical and an extreme one) can be identified. They have shown that the error-correction effects are not significant in the extreme regime. Moreover, [Basse et al. \(2012\)](#) have examined 10-year government bond yields in Germany and Italy and have reported that there is empirical evidence for cointegration with two structural breaks. The different patterns that can be observed examining the two interest rate time series can be explained by a higher risk premium demanded by investors in Italian government bonds and by German interest rates falling due to the financial crisis (flight to quality). They have argued that the first breakpoint seems to be a consequence of the US subprime crisis and the second break might be a result of the increase of Italian sovereign credit risk, and probably even redenomination risk caused by the current crisis in Europe. [Gruppe and Lange \(2014\)](#) have used an identical approach and have shown that higher sovereign credit risk has caused structural change among government bond yields in Germany and Spain. Moreover, [Basse \(2014\)](#) has argued that Austria, Belgium, Finland and The Netherlands seem to belong to the group of EMU core member states that have not been hit that hard by the European debt crisis, because interest rates in these countries are cointegrated with German government bond yields and there has been no sign for structural change caused by the current crisis, increasing the risk premia market participants demand for holding government bonds from these four countries. For France, there are quite different results.

Examining the cross-sectional structure of default risk from 2008 to 2011 [Ang and Longstaff \(2013\)](#) have even reported that there are three groups of EMU countries (one cluster consists of Greece, Ireland, Italy, Portugal and Spain; the second cluster is formed by Austria, Finland and The Netherlands; and France and Belgium are the members of the third cluster). More recently, [Gómez-Puig and Sosvilla-Rivero \(2014\)](#) have searched for structural change among EMU government bond yields and have argued that more than half of the detected breakpoints (60 out of 110) are directly connected to the Euro sovereign debt crisis. Moreover, they have tested for Granger causality between EMU government bond yields. After having endogenously determined the breakpoints in the evolution of the relationships among interest rates, they have argued that the number and intensity of causal relationships seem to have increased after endogenous shocks. These results could be interpreted as clear evidence for contagion in the aftermath of the European debt crisis. Moreover, examining the integration of the European bond markets, [Christiansen \(2014\)](#) has concluded that the countries that experienced problems because the sovereign debt crisis has less integrated bond markets than the other countries.

[Sibbertsen et al. \(2014\)](#) have tested for a break in the persistence of EMU government bond yield spreads by examining data from France, Italy and Spain using Germany as a benchmark. Their results do indicate that structural breaks exist in yield spreads. The persistence of the examined time series seems to have increased significantly in the crisis.

This could be a sign of higher sovereign credit risk (and possibly even redenomination risk). [Ludwig \(2014\)](#) also has applied cointegration tests to analyse the validity of the assumption that sovereign debt of European Union member states is risk-free. The author has investigated the cointegration relationship between Germany (as a kind of risk-free benchmark) and the other EU countries. Using a test for multiple structural breaks, he has found convergence in the case of Greece, Ireland, Italy and Spain before and divergence after the beginning of the global financial crisis. [Table II](#) summarizes the results reported above. There is some related literature. [Ludwig and Sobański \(2014\)](#), for example, have used rolling Granger causality tests to show that with the fiscal problems of Greece risk shifted from financial institutions in the periphery towards the banking sector in the core countries of the Euro area. Moreover, [Ejsing and Lemke \(2011\)](#) have detected structural change in the relationship between bank and sovereign CDS premia after the bailouts of banks in the EMU. [Albertazzi et al. \(2014\)](#) have discussed the impact of the crisis on the activity of Italian banks. These empirical findings are of special importance for risk managers in the financial services industry. Additionally, [Kunze and Gruppe \(2014\)](#) as well as [Kunze \(2014\)](#) have analysed interest rate predictions from professional forecasters. In fact, both empirical studies seem to suggest that the financial crisis has caused structural change among interest rates and interest rate forecasts.

To summarize the results documented in the literature, there is a lot of empirical evidence indicating that the European debt crisis has resulted in structural change affecting the relationship between the yields of government bonds issued by Germany and a number of other EMU member countries. Thus, the crisis seems to have, at least temporarily, ended a general tendency towards convergence among interest rates in the currency union that is a

Study	Breakpoint/regime shift test used	Main results
Apergis et al. (2011)	Hansen and Seo (2002)	Spreads of Greek over German government bond yields and CDSs are cointegrated and two regimes (typical/extreme one) can be identified
Gruppe and Basse (2012)	Quandt (1960) and Andrews (1993)	Information about fiscal problems in Greece led to structural change among German and Greek government bond yields
Basse et al. (2012)	Hansen and Johansen (1999)	The crisis seems to have caused structural change among German and Italian government bond yields
Basse (2014)	Hansen and Johansen (1999)	Structural change caused by the crisis seems to show that sovereign credit risk in France has increased
Gruppe and Lange (2014)	Hansen and Johansen (1999)	Increased sovereign credit risk has caused structural change among government bond yields in Germany and Spain
Gómez-Puig and Sosvilla-Rivero (2014)	Quandt (1960) and Andrews (1993) , as well as Bai and Perron (1998)	More than half of the detected breakpoints (60 out of 110) among government bond yields are directly connected to the Euro sovereign debt crisis
Sibbertsen et al. (2014)	Sibbertsen and Kruse (2009)	Evidence for a break in the persistence in yield spreads of France, Italy and Spain using Germany as benchmark
Ludwig (2014)	Kejriwal and Perron (2010)	Structural change in the relationship between bond yields in Greece, Ireland, Italy and Spain relative to Germany

Table II.
Time series evidence on interest rate convergence and the crisis

direct consequence of the introduction of the euro in the year 1999. This empirical finding reported by numerous researchers can be explained by the fact that the crisis has forced investors and risk managers to think about sovereign credit risk and probably even about redenomination risk. These worries among bond buyers have led to increased risk premia compensating investors for both types of risk. The timing of structural change also is interesting. In fact, the breakpoint dates reported in a number of studies are quite early. This could be a result of the subprime mortgage crisis in the US that has increased risk aversion among investors in general and might have caused some concerns about costly bank rescue programmes having negative effects on the solidity of public finances in some EMU member states. Moreover, [Basse et al. \(2012\)](#) have argued that the bond market seems to have anticipated at least some problems with Italy's government budget at an early stage. This finding could be interpreted as supportive empirical evidence for the efficient market hypothesis, because German and Italian government bond yields have reflected new information about sovereign credit risk in a very timely manner.

5. Conclusion

This paper has surveyed the literature on interest rate convergence in the EMU countries. While there are a number of different points of view, there seems to be a broad consensus among researchers that the introduction of the euro has eliminated exchange rate risk for financial transactions among those countries that have decided to join the EMU. In the period before the current crisis – where sovereign credit risk was not of major importance – the currency union has caused interest rate convergence among government bond yields issued by EMU countries. However, now investors seem to fear sovereign credit risk and probably even redenomination risk. Thus, interest rate convergence among EMU government bond yields could be a phenomenon of happier times ([Sibbertsen et al., 2014](#)). The breakpoint dates reported in the literature are quite early. There are a number of different interpretations of this empirical finding. [Basse et al. \(2012\)](#), for example, have noted that investors seem to have anticipated at least some problems with the solidity of public finances in Italy at an early stage – a result that could be seen as supportive for the efficient market hypothesis. Meanwhile, there are new tendencies for interest rate convergence in the EMU. The lower government bond yields in Italy, Spain and other EMU member countries are a result of the ECB's monetary policy. Further empirical research clearly should focus on the interaction of sovereign credit risk and monetary policy measures. Moreover, there are some interesting concepts to combine the use of cointegration analysis with other techniques of quantitative data analysis – namely artificial neural networks – that can help to improve the understanding of the crisis ([Wegener et al., 2016b](#)). Additional empirical evidence using this approach could be interesting.

References

- Albertazzi, U., Ropele, T., Sene, G. and Signoretti, F.M. (2014), "The impact of the sovereign debt crisis on the activity of Italian banks", *Journal of Banking and Finance*, Vol. 46, pp. 387-402.
- Andrews, D.W.K. (1993), "Tests for parameter instability and structural change with unknown change point", *Econometrica*, Vol. 61 No. 4, pp. 821-856.
- Ang, A. and Longstaff, F.A. (2013), "Systemic sovereign credit risk: lessons from the US and Europe", *Journal of Monetary Economics*, Vol. 60 No. 5, pp. 493-510.
- Apergis, N., Mamatzakis, E. and Staikouras, C. (2011), "Testing for regime changes in Greek sovereign debt crisis", *International Advances in Economic Research*, Vol. 17 No. 3, pp. 258-273.

- Bai, J. and Perron, P. (1998), "Estimating and testing linear models with multiple structural changes", *Econometrica*, Vol. 66 No. 1, pp. 47-78.
- Basse, T. (2006), "Floating exchange rates and inflation in Germany: are external shocks really irrelevant?", *Economics Letters*, Vol. 93 No. 3, pp. 393-397.
- Basse, T. (2014), "Searching for the EMU core member countries", *European Journal of Political Economy*, Vol. 34, pp. S32-S39.
- Basse, T., Friedrich, M. and Kleffner, A. (2012), "Italian government debt and sovereign credit risk: an empirical exploration and some thoughts about consequences for European insurers", *Zeitschrift für die gesamte Versicherungswissenschaft*, Vol. 101 No. 5, pp. 571-579.
- Baum, C. and Barkoulas, J. (2006), "Dynamics of intra-EMS interest rate linkages", *Journal of Money, Credit, and Banking*, Vol. 38 No. 2, pp. 469-482.
- Beine, M. and Hecq, A. (1997), "Asymmetric shocks inside future EMU", *Journal of Economic Integration*, Vol. 12 No. 2, pp. 131-140.
- Capstaff, J., Marshall, A. and Hutton, J. (2007), "The introduction of the Euro and derivative use in French firms", *Journal of International Financial Management & Accounting*, Vol. 18 No. 1, pp. 1-17.
- Christiansen, C. (2014), "Integration of European bond markets", *Journal of Banking and Finance*, Vol. 42, pp. 191-198.
- Ejsing, J. and Lemke, W. (2011), "The Janus-headed salvation: sovereign and bank credit risk premia during 2008-2009", *Economics Letters*, Vol. 110 No. 1, pp. 28-31.
- Erb, C.B., Harvey, C.R. and Viskanta, T.E. (1995), "Country risk and global equity selection", *The Journal of Portfolio Management*, Vol. 21 No. 2, pp. 74-83.
- Fountas, S. and Wu, J. (1998), "Tests for interest rate convergence and structural breaks in the EMS", *Applied Financial Economics*, Vol. 8 No. 2, pp. 127-132.
- Frömmel, M. and Kruse, R. (2015), "Interest rate convergence in the EMS prior to European monetary union", *Journal of Policy Modeling*, Vol. 37 No. 6, pp. 990-1004.
- Gaspar, V., Perez, Quiros, G. and Sicilia, J. (2001), "The ECB monetary policy strategy and the money market", *International Journal of Finance & Economics*, Vol. 6 No. 4, pp. 325-342.
- Geigant, F. (2002), *Stationen und Strukturen: Europas Weg zum Euro*, in Cunz, R. (ed.): *Währungsunionen*, Hamburg, pp. 337-410.
- Gómez-Puig, M. and Sosvilla-Rivero, S. (2014), "Causality and contagion in EMU sovereign debt markets", *International Review of Economics and Finance*, Vol. 33, pp. 12-27.
- Goodhart, C.A. (1998), "The two concepts of money: implications for the analysis of optimal currency areas", *European Journal of Political Economy*, Vol. 14 No. 3, pp. 407-432.
- Gruppe, M. and Basse, T. (2012), "Die Griechenlandkrise: credit risk Jetzt Auch am Europäischen staatsanleihenmarkt?", in Schwarzbach, C. and Rudschuck, N. (eds), *Die Folgen der Finanzkrise für Regulierung und Eigenkapital – Evolution oder Revolution in der Versicherungsbranche?*, Verlag Versicherungswirtschaft, Karlsruhe, pp. 61-77.
- Gruppe, M. and Lange, C. (2014), "Spain and the European sovereign debt crisis", *European Journal of Political Economy*, Vol. 34, pp. S3-S8.
- Hansen, B.E. and Seo, B. (2002), "Testing for two-regime threshold cointegration in vector error-correction models", *Journal of Econometrics*, Vol. 110 No. 2, pp. 293-318.
- Hansen, H. and Johansen, S. (1999), "Some tests for parameter constancy in cointegrated VAR-models", *The Econometrics Journal*, Vol. 2 No. 2, pp. 306-333.
- Hardouvelis, G.A., Malliaropulos, D. and Priestley, R. (2006), "EMU and European stock market integration", *The Journal of Business*, Vol. 79 No. 1, pp. 365-392.
- Haselmann, R. and Herwartz, H. (2010), "The introduction of the Euro and its effects on portfolio decisions", *Journal of International Money and Finance*, Vol. 29 No. 1, pp. 94-110.

- Hassapis, C., Pittis, N. and Prodrromidis, K. (1999), "Unit roots and granger causality in the EMS interest rates: the German dominance hypothesis revisited", *Journal of International Money and Finance*, Vol. 18 No. 1, pp. 47-73.
- Holder, M. (1999), "The Euro impact on European financial markets", *Managerial Finance*, Vol. 25 No. 11, pp. 27-34.
- Holder, M., Sinha, A.K. and Severiens, J.T. (2001), "The Euro and capital market integration: are we there yet?", *Managerial Finance*, Vol. 27 No. 9, pp. 32-40.
- Jenkins, M. and Madzharova, P. (2008), "Real interest rate convergence under the Euro", *Applied Economics Letters*, Vol. 15 No. 6, pp. 473-476.
- Kang, H. (2013), "Behind the scenes of abandoning a fixed exchange rate regime", *Journal of Banking and Finance*, Vol. 37 No. 8, pp. 3145-3156.
- Kejriwal, M. and Perron, P. (2010), "Testing for multiple structural changes in cointegrated regression models", *Journal of Business & Economic Statistics*, Vol. 28 No. 4, pp. 503-522.
- Kim, S.J., Moshirian, F. and Wu, E. (2006), "Evolution of international stock and bond market integration: influence of the European monetary union", *Journal of Banking and Finance*, Vol. 30 No. 5, pp. 1507-1534.
- Klose, J. and Weigert, B. (2014), "Sovereign yield spreads during the Euro crisis: fundamental factors versus redenomination risk", *International Finance*, Vol. 17 No. 1, pp. 25-50.
- Kool, C.J. (2000), "International bond markets and the introduction of the Euro", *Federal Reserve Bank of St. Louis Review*, Vol. 82 No. 5, pp. 41-56.
- Kouparitsas, M.A. (1999), "Is the EMU a viable common currency area? A VAR analysis of regional business cycles", *Federal Reserve Bank of Chicago Economic Perspectives*, Vol. 23 No. 4, pp. 2-20.
- Kunze, F. (2014), "The European financial crisis – a challenge for ten-year German government bond yield forecasts?", *International Journal of Bonds and Derivatives*, Vol. 1 No. 2, pp. 171-185.
- Kunze, F. and Gruppe, M. (2014), "Performance of survey forecasts by professional analysts: did the European debt crisis make it harder or perhaps even easier?", *Social Sciences*, Vol. 3 No. 1, pp. 128-139.
- Laopodis, N. (2008), "Government bond market integration within European union", *International Research Journal of Finance and Economics*, Vol. 19, pp. 56-76.
- Ludwig, A. (2014), "Credit risk-free sovereign bonds under Solvency II: a cointegration analysis with consistently estimated structural breaks", *Applied Financial Economics*, Vol. 24 No. 12, pp. 811-823.
- Ludwig, A. and Sobański, K. (2014), "Banking sector fragility linkages in the Euro area: evidence for crisis years 2007–2010", *Economics Letters*, Vol. 125 No. 3, pp. 451-454.
- Lund, J. (1999), "A model for studying the effect of EMU on European yield curves", *European Finance Review*, Vol. 2 No. 3, pp. 321-363.
- Moro, B. (2014), "Lessons from the European economic and financial great crisis: a survey", *European Journal of Political Economy*, Vol. 34, pp. S9-S24.
- Nguyen, H., Faff, R. and Marshall, A. (2007), "Exchange rate exposure, foreign currency derivatives and the introduction of the Euro: French evidence", *International Review of Economics and Finance*, Vol. 16 No. 4, pp. 563-577.
- Pollard, P. (2003), "A look inside two central banks: the European central bank and the federal reserve", *Federal Reserve Bank of St. Louis Review*, Vol. 85 No. 1, pp. 11-30.
- Quandt, R.E. (1960), "Tests of the hypothesis that a linear regression system obeys two separate regimes", *Journal of the American Statistical Association*, Vol. 55 No. 290, pp. 324-330.
- Rose, A. (2007), "Checking out: exits from currency unions", *Journal of Financial Transformation*, Vol. 19, pp. 121-128.

- Sibbertsen, P. and Kruse, R. (2009), "Testing for a break in persistence under long-range dependencies", *Journal of Time Series Analysis*, Vol. 30 No. 3, pp. 263-285.
- Sibbertsen, P., Wegener, C. and Basse, T. (2014), "Testing for a break in the persistence in yield spreads of EMU government bonds", *Journal of Banking and Finance*, Vol. 41, pp. 109-118.
- Siklos, P. and Wohar, M. (1997), "Convergence in interest rates and inflation rates across countries and over time", *Review of International Economics*, Vol. 5 No. 1, pp. 129-141.
- Vuchelen, J. and van Hove, L. (2002), "An early evaluation of the introduction of Euro banknotes and coins", *Journal of Economic Studies*, Vol. 29 No. 6, pp. 370-387.
- Wegener, C., Basse, T., Kunze, F. and Mettenheim, H.J.V. (2016a), "Oil prices and sovereign credit risk of oil producing countries: an empirical investigation", *Quantitative Finance*, Vol. 16 No. 12, pp. 1961-1968.
- Wegener, C., Spreckelsen, C.V., Basse, T. and Mettenheim, H.J.V. (2016b), "Forecasting government bond yields with neural networks considering cointegration", *Journal of Forecasting*, Vol. 35 No. 1, pp. 86-92.

Corresponding author

Mario Gruppe can be contacted at: Email: mario.gruppe@nordlb.de

For instructions on how to order reprints of this article, please visit our website:

www.emeraldgroupublishing.com/licensing/reprints.htm

Or contact us for further details: permissions@emeraldinsight.com

Reproduced with permission of copyright owner. Further reproduction prohibited without permission.