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Banking sector fragility linkages in the euro area: Evidence for crisis years 2007–2010

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HIGHLIGHTS

- We analyze Eurozone banking sector fragility linkages in the period 2007–2010.
- We use rolling Granger causality tests to examine their time-varying behavior.
- We observe a significant increase in fragility linkages during the recent crisis.
- The epicenter of spillover risk shifted from periphery towards the core countries.

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ABSTRACT

We investigate fragility linkages among national banking sectors in the euro area during the crisis years 2007–2010. We find that their number increased sharply with the outbreak of the subprime crisis in the US in the first half of 2007 and then remained at a relatively constant and high level until the Greek bailout and the creation of the Eurozone-wide bailout funds in mid-2010. The epicenter of spillover risk shifted from banking sectors in the euro area periphery towards banking sectors in the core countries during the period.

1. Introduction

The existing research on the systemic character of the recent financial crisis in the euro area mostly examines sovereign risk linkages between its member countries using yields or CDS spreads on sovereign bonds as sovereign fragility indicators. Potential fragility linkages between national banking sectors in the Eurozone, whose solvency problems have brought many member states to the verge of bankruptcy and led to the first steps towards a banking union, have not yet been analyzed. To the best of our knowledge, this paper presents the first attempt to fill this gap.

2. Data and methodology

We study the existence and the direction of bilateral banking sector fragility linkages among eight Eurozone member countries (GIIPS, Belgium, France, and Germany) focusing on the crisis years 2007–2010. For this purpose modified Granger causality tests as proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996) are applied to daily values of Average Distance to Default (ADtD). The ADtD is an equity market-based banking sector fragility indicator, which measures the asset-weighted average of individual Distance to Defaults (DtD) of a country's listed banks (see Appendix for details on the derivation of ADtD). The individual DtD assesses the number of standard deviations of banking assets the bank is expected to be away from the default barrier (the value of debt payment in one year). The DtD was shown to have high power in predicting individual bank failures in the EU (Gropp

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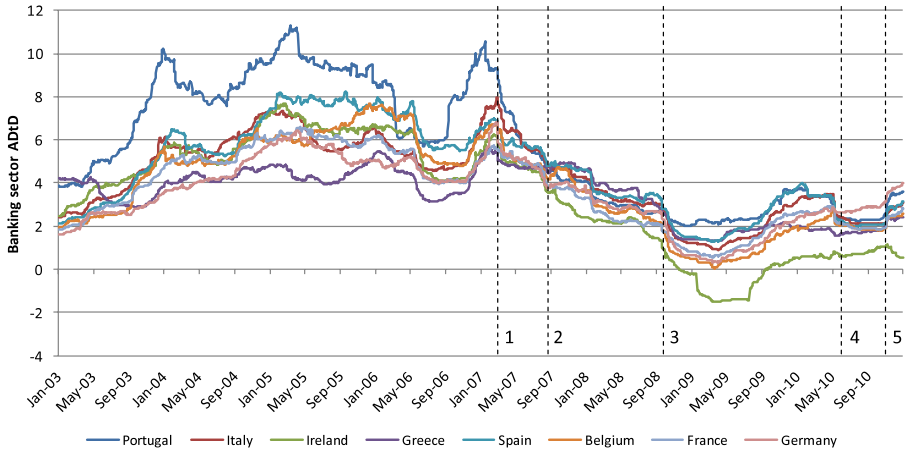

Fig. 1. Banking sector ADtDs by euro area member country. 1: outbreak of US subprime crisis (Mar-07), 2: first ECB liquidity injections (Aug-07), 3: default of Lehman Brothers (Sep-08), 4: Greek bailout & foundation of EFSF (May-10), 5: Irish bailout & announcement of ESM (Nov-10).

et al., 2006). The ADtD performed well as a banking sector fragility indicator during the recent financial crisis in the euro area (Eichler and Sobański, 2012).

To analyze the time-dependent behavior of fragility linkages during the crisis period, we run Granger causality tests on all possible pairs of the ADtD series considered using a rolling window of four years with an increment of 20 trading days between two successive windows. The first (benchmark) windows before March 2007 cover the period of economic and financial stability in the euro area. Comparing the number of fragility linkages in these windows with those from subsequent four-year windows that include continuously increasing observations from the crisis period enables us to examine the changes in the general level of spillover risk. Moreover, we are able to detect potential changes of the epicenter of spillover risk, meaning the country with the highest number of out-going fragility linkages relative to all existing fragility linkages in the euro area banking sector.

We use Granger causality tests as they allow examining not only the existence but also the direction of banking sector fragility linkages in the Eurozone. This is the main advantage of our method in comparison to standard approaches used in the literature on contagion/spillover risk such as (dynamic) correlation analysis. We apply Granger causality tests in the modified vector autoregressive (VAR) model as proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). This framework addresses the problem of incorrect identification of the integration order, which may occur in the case of ADtD series. From a theoretical point of view, ADtD series should be stationary since, at least in the long-run, distressed banking sectors should again reach pre-crisis stability levels as represented by a certain positive value of ADtD. This theoretical argument would support the use of Granger causality tests in a standard VAR model in levels. However, empirical evidence from the ADF-GLS test[1] (Elliott et al., 1996) shows the existence of a unit-root in the ADtD series in most of the considered four-year windows suggesting the applicability of cointegration analysis and/or Granger causality tests in a standard VAR model with first differences of ADtD in our study. In order to address this discrepancy we use the Granger causality test proposed by Toda and Yamamoto (1995) and Dolado and Lütkepohl (1996). It has good power and size properties independent of the order of integration and of the presence of cointegration and hence avoids pretesting biases (Dolado and Lütkepohl, 1996).[2]

3. Results

Fig. 1 illustrates the evolution of country-specific Average Distance to Defaults (ADtD) in the euro area for the years 2003–2010, measured on a daily basis. Lower ADtD indicates higher fragility (probability of default) of the banking sector in perception of equity market investors.

We observe three simultaneous sharp drops in considered ADtD series: after the outbreak of the subprime crisis in the US (March 2007), the Lehman collapse (September 2008) and the Greek quasi-default (May 2010). Moreover, Fig. 1 shows a strong increase in co-movements as well as convergence in levels of the ADtD series after the outbreak of the US subprime crisis. This suggests growing fragility interconnectedness in the euro area banking sector during the crisis years.

Fig. 2 illustrates the changes in the level of spillover risk, i.e. the overall number of fragility linkages (the number of Granger causalities detected between considered ADtDs series at the 10% significance level) in the euro area banking sector.

In benchmark windows covering the tranquil period before March 2007 we detect the existence of about 40% of all possible fragility linkages. Between the outbreak of the subprime crisis in the US in March 2007 and first ECB liquidity injections in reaction to the disrupted Eurozone inter-bank lending market in August 2007, this number grew rapidly and doubled relative to the pre-crisis period. Afterwards, it stabilized at about 65%. First the Greek bailout and the creation of the euro area-wide bailout funds (the European Financial Stability Facility) in mid-2010 caused the spillover risk in the euro area banking sector to start decreasing. After the bailout of Ireland and the agreement of the Eurozone member states to establish the permanent common stability fund (the European Stability Mechanism) in November 2010, the number of banking sector fragility linkages again reached its pre-crisis level. Thus, our results demonstrate that the spillover risk in the Eurozone banking sector was very high long before the Lehman collapse in September 2008. This may explain why the fragility shock following this event spread so fast across all banking sectors in the euro area causing a systemic banking crisis.

Fig. 3 presents the evolution of the relative importance of the single national banking sectors as an epicenter of spillover risk. We measure this using the share of outgoing fragility linkages of each national banking sector in relation to all fragility linkages detected in the euro area banking sector as a whole.

[1] Results are available upon request.

[2] This approach contains an additional lag in addition to the optimal number p of lags in the VAR model. This augmentation guarantees that a test for the significance of the p lagged values of the potentially Granger-causing variable has a standard asymptotic distribution.