# How the Euro-Area Sovereign-Debt Crisis Led to a Collapse in Bank Equity Prices

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ABSTRACT

We quantify the linkages among banks' equity performance and indicators of sovereign stress by using panel GMM to estimate a three-equation system that examines the impact of sovereign stress, as reflected in both sovereign spreads and sovereign ratings, on bank share prices. We use data for a panel of five euro-area stressed countries. Our findings indicate that a long-run recursive relationship between sovereigns and banks operated during the euro-area crisis. Specifically, for the five crisis countries considered shocks to sovereign spreads fed-through to sovereign ratings, which affected commercial banks. Our results also point to the importance of using levels of equity prices -- rather than rates of return -- in measuring banks' performance. The use of levels allows us to derive the determinants of long-run equity prices.

Keywords: euro-area financial crisis, sovereign-bank linkages, banks' performance, banking stability
*JEL* Classification: E3, G01, G14, G21

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*1. Introduction*

A major characteristic of the euro-area financial crisis, especially in the stressed countries has been the strong linkages between banks' performance and sovereign stress (Pisani-Ferry, 2014, pp. 101-02) as downward revisions of markets' assessments of sovereigns impacted negatively on banks' financial conditions. Deteriorations in sovereign creditworthiness during the crisis affected banks' equity performance through several channels (BIS, 2011): (i) the direct effects of banks' holdings of sovereign debt on banks' balance sheets and profitability; (ii) the reduction in the value of collateral available to banks to obtain wholesale funding and/or central-bank financing; and (iii) the reduced benefits from the implicit guarantee that, should the need arise, the state would step in to help honour banks' financial commitments.

The above linkages played-out in a number of advanced economies -- both within and outside the euro area -- during the global financial crisis that erupted in 2007-08. However, the strength of these linkages was especially pronounced in the euro area beginning in 2009-10. Several factors account for this circumstance. First, national banking systems tend to be especially large in the euro area. In 2012, for example, total bank assets as a share of euro-area GDP was almost 360 per cent, compared with less than 80 per cent in the United States (Shambaugh, 2012). Second, firms in the euro area are much more reliant on the banking system for finance than are U.S. firms; banks account for about three-quarters of total credit intermediation in the euro area, compared with about one-quarter in the United States. Third, domestic euro-area banks typically hold relatively-large shares of debt issued by their respective *national* governments in their portfolios, leaving banks' balance sheets vulnerable to doubts about sovereign solvency. In contrast, U.S. banks typically hold small amounts of local and state debt on their balance sheets; U.S. banks mainly hold U.S. government debt as their safe liquid assets (O' Rourke and Taylor, 2013, p. 181). Consequently, defaults by U.S. state and local governments have not involved financial-stability concerns for the U.S. financial system, in marked contrast to the concerns about euro-area financial stability raised by the restructuring of Greek sovereign debt in 2012.

In what follows, we investigate the impact of the euro-area sovereign debt crisis on the price of bank equity for a group of five euro-area stressed countries -- Greece, Ireland, Italy, Portugal and Spain. Using monthly data, we cover the period from October 1998 through July 2014. Although a considerable number of previous empirical studies have studied the determinants of banks' equity performance, the focus of those studies has largely been on the bank-specific determinants of excess returns on bank stocks. Some studies have included variables reflecting macroeconomic conditions that could affect banks' expected future returns or the systematic component of bank equity returns, but only several papers (to which we refer in the next section) have dealt with the impact of the crisis. However, none of these studies (to our knowledge) has dealt in a comprehensive way with the linkages between banks' equity performance and sovereign stress indicators.

In this paper, we aim to contribute to the literature on banks' equity performance. Specifically, we quantify the linkages among banks' equity performance and indicators of sovereign stress by using panel GMM to estimate a three-equation system that examines the impact of sovereign stress, as reflected in both sovereign spreads and sovereign ratings, on bank share prices. Moreover, for reasons that we explain below -- and unlike previous studies -- we do not focus on bank performance as measured by equity returns (*i.e.,* the change in equity prices). Instead, we focus on (the log of) the level of equity prices.

The remainder of the paper consists of four sections. Section 2 provides a brief literature review. Section 3 describes our data and empirical model. Section 4 presents the results. Section 5 concludes.

## *2. Literature Review*

### *2.1 Bank performance*

Prior to the outbreak of the 2007-08 global financial crisis, the empirical literature on bank performance mainly focused on the determinants of bank profitability and bank stock returns. Among the factors that were found to influence bank performance were the following: (1) measures of market characteristics, including economies of scale,

management efficiency, and bank size; (2) bank characteristics, including capital positions, loan-to-deposit ratios, and equity-to-total assets ratios; and (3) indicators of macroeconomic performance, including economic growth and the state of the business cycle. Recent studies that take into account the crisis period (beginning in 2007) include Yang and Tsatsaronis (2012), who found that the returns on bank stocks rise and fall with the business cycle, making bank equity financing cheaper during booms and more costly during contractions, and Chan-Lau, Liu and Schmittmann (2014), who found that macroeconomic factors, including growth, are more important than bank characteristics, such as capital ratios and loan-to-deposit ratios, in explaining equity returns. In an earlier (*i.e.,* prior to 2007) study, which contained implications for bank performance during crisis episodes and is, therefore, relevant for the 2007-08 global crisis, Castrén, Fitzpatrick and Sydow (2006) found that large European banks are more sensitive to market-wide news and events than small banks, possibly because large banks are more diversified across geographical regions than smaller banks, making the former more sensitive to market-wide developments.[1]

The effects of sovereign risk on bank performance have been less researched than the factors (*i.e.,* bank characteristics and indicators of macroeconomic performance) mentioned above. The BIS (2011) found that the rise in sovereign risk after 2009 pushed up the cost, and adversely affected the composition of some euro area banks' funding, with the extent of the impact broadly related to the deterioration in the credit worthiness of the home sovereign. Demirgüç-Kunt, Detragiache and Merrouche (2013) found that increases in bank CDS premia during the crisis were significantly related to deterioration in bank capital positions as well as public finances. Chan-Lau, Liu and Schmittmann (2014) examined the impact of sovereign risk, measured as the arithmetic average of the five-year CDS spreads of Belgium, Greece, Ireland, Italy, Portugal, and Spain, on equity returns of euro-area (and other banks); the authors found that, for the period 2008-10, equity returns in excess of a risk-free rate of return were driven mainly by the economic-growth outlook (as measured by the Purchasing Managers' Indices of both the euro area and the United States) and sovereign risk.

[1] Chan-Lau, Liu and Schmittmann (2014) provide a thorough review of the earlier literature on the determinants of banks' performance.

*2.2 Indicators of sovereign stress*

As mentioned, in this paper we use a three-equation system to estimate, in addition to the determinants of banks' performance, the determinants of sovereign ratings and sovereign spreads. Here, we briefly refer to the empirical literature on the determination of sovereign stress in euro-are countries.

The recent macro-international finance literature has focused on two presumably separate measures of sovereign stress or risk -- (1) spreads on government bond yields, and (2) CDS spreads. As Aizenman, Hutchison and Lothian (2013, p. 41) pointed out, however, recent studies suggest that both reference measures have common underlying determinants, rather than being entirely separate measures.[2]

Studies focusing on euro-area countries have found that macroeconomic fundamentals played an important role in determining sovereign bond spreads or CDS spreads (e.g., Dötz and Fischer, 2010; Gibson, Hall, and Tavlas, 2012; Aizenman, Hutchison, and Jinjarak, 2013; Beirne and Fratzscher, 2013; De Grauwe and Ji, 2013).[3] Typical determinants have been found to include indicators reflecting fiscal imbalances, current account imbalances and growth.[4] Gerlach, Schulz and Wolff (2010) assessed the impact of the size and structure of a country's banking sector on euro-area sovereign spreads, and found that the size of the banking sector is a positive determinant of a country's spread; as of early 2009, almost one percentage point of euro-area sovereign spreads could be explained by this factor. In a study of the determinants of Greek sovereign spreads, Gibson, Hall, and Tavlas (2014) found that sovereign ratings' downgrades and political uncertainty were the main drivers of spreads from 2008-09 onwards, over-and-above the impact of the economic fundamentals.

*3. Data and empirical model*

To examine the links between sovereign stress indicators and bank performance, we estimate a three-equation panel system in which bank equity prices, sovereign bond

[2] See, also, Ammer and Cai (2007) and Fontana and Scheicher (2010).
[3] Typically, the literature has found roles for other factors, including measures of international market volatility and capital flows into government bond markets, as drivers of sovereign risk.
[4] Gibson, Hall, and Tavlas (2012) provide a more-thorough review of the literature.

spreads and sovereign ratings are endogenous variables. This system framework allows us to fully explore the impact that sovereign stress can have on bank equity prices. As the sovereign becomes more stressed, sovereign spreads rise and ratings fall. This circumstance would be expected to impact on banks' market values. Market values fall as confidence in the ability of the state to meet potential obligations to banks – either direct obligations resulting from banks' holdings of sovereign assets, or indirect obligations through state guarantees – comes into question. Thus, in addition to bank-specific variables, we include sovereign spreads and sovereign ratings as determinants of bank performance.

We focus on the *level* of bank equity prices, and not equity *returns*. The reason is as follows. As mentioned above, if sovereign spreads rise and sovereign ratings fall, then we expect bank equity prices to fall. Initially, this fall in the level of equity prices will be associated with negative equity returns. If spreads and ratings stabilize at new levels (higher levels for spreads and lower levels for ratings), equity returns will go back to zero -- that is, returns will improve from a negative number to a number that approaches (or equals) zero, even though spreads may remain high and rating may remain low. This situation would give the (paradoxical) result that equity returns improve while sovereign stress indicators remain at extreme levels. Consequently, the appropriate relationship involves sovereign spreads, sovereign ratings and the *level* of equity prices (and not the rate of *change* of equity prices). A similar argument can be made with respect to the bank-specific variables. For example, if the capital ratio falls and then stabilises at a lower level, we would expect the value of banks equities to fall and then stabilize at a lower level. Returns would be highly negative but then go back to more-normal levels even though the capital ratio remained low.

This circumstance suggests that, in focusing on equity returns, previous studies have been mis-specifying the relationship since they have overlooked the effect on the level of equity prices. The figures presented in Appendix I drive home this point. They show the level of the equity index and equity returns for each of the countries examined here for the period October 1998 until July 2014. It is clear from these figures that equity *returns* move around zero throughout the period and that the crisis period (beginning in 2007) is associated with a rise in volatility rather than a particular trend. By contrast, as

also shown in Appendix I, the *level* of the equity price index appears to be a more appropriate measure of bank health; that index exhibited a steady decline as sovereign spreads and sovereign ratings increased. (As we discuss below, our measure of sovereign ratings is constructed in such a way that a rise in our measure is associated with a downgrade of the sovereign).

As noted, we focus on five stressed euro area countries – Spain, Greece, Ireland, Italy and Portugal. Figures 1-5 plot the three dependent variables for each country. The bank equity index is the FTSE index for the banking sector for each country[5]. Sovereign bond spreads are the yield on the 10-year benchmark bond in each country relative to that of Germany. Sovereign ratings are those assigned to the sovereigns by the three main ratings agencies, Moody's, Standard and Poor's (S&P) and Fitch. We convert the ordinal series to a cardinal series by assigning values of 1-22 to different possible ratings – the higher the value, the lower the rating. The rating assigned in each period depends on which of the three agencies moved first. In this way, we capture what might be termed "important" rating downgrades or upgrades.

Looking across Figures 1 to 5, a number of stylized facts can be identified. First, bank equity prices, which had been rising relatively steeply in all five countries before the failure of Lehman Brothers (in September 2008), fell sharply thereafter. This decline was then following by a small recovery – the size of which is closely related to banks' involvement in the type of assets which sparked Lehman's failure – before the outbreak of the euro area sovereign debt crisis (in late 2009 and early 2010) sent bank equity prices falling again (in some countries, *e.g.*, Greece and Ireland, bank equity prices remained at low levels through the end of our sample period). Second, spreads rose slightly in light of the turmoil associated with the failure of Lehman Brothers; it was not, however, until the sovereign crisis (beginning in late 2009 and 2010) that they underwent sharp rises. Third, sovereign ratings started deteriorating in 2009 in Ireland (associated with concerns about the fiscal cost of the banking crisis), Greece, and Portugal (concerns about the level of public debt in the former country and the total of public and private debt in the latter country) and, then, in 2011 in Spain (reflecting the

[5] For data sources, see Appendix II. Note, also, that data are scaled to facilitate their presentation in one figure. Thus, spreads are presented in basis points and sovereign ratings, which range between 1 and 22 in the original data, are multiplied by 10 for display in the figures.

fiscal consequences of the banking crisis following the collapse of the housing boom), and Italy (related to concerns about size of public debt). The final stylized fact is the close interconnection between movements in equity prices, spreads and ratings. Indeed, there appears to be a strong negative correlation between equity prices and sovereign spreads and, to a lesser extent, between sovereign ratings and banks' equity prices.

These stylized facts motivate our three-equation system, which is estimated as a panel GMM system which is robust to autocorrelation and heteroskedasticity (HAC). We are interested in a three equation simultaneous system for a group of n countries, estimated over T periods. Our baseline model can be expressed as:

$$S_{it} = \alpha_{0i} + \alpha_1 SR_{it} + \alpha_2 BR_{it} + \sum_{k=1}^{K} \alpha_{2+k} X_{itk} + \varepsilon_{it} \quad (1)$$

$$SR_{it} = \beta_{0i} + \beta_1 SR_{it} + \beta_2 BR_{it} + \sum_{k=1}^{K} \beta_{2+k} X_{itk} + \varpi_{it} \quad (2)$$

$$BE_{it} = \chi_{0i} + \chi_1 SR_{it} + \chi_2 SR_{it} + \sum_{k=1}^{K} \chi_{2+k} X_{itk} + \upsilon_{it} \quad (3)$$

where i=1…N, t=1…T and K is the number of exogenous regressors. $S_{it}$ is the interest rate spread between country i and Germany, $SR_{it}$ is the sovereign rating for country i, $BE_{it}$ is the (log of the) equity price for commercial banks in country i and $\varepsilon_{it}$, $\omega_{it}$ $and$ $\upsilon$ are error terms and $\alpha_{0i}$ $\beta_{0i}$ $and$ $\chi_{0i}$ are fixed effects in each equation. We assume there are suitable exclusion restrictions on $\alpha$ $\beta$ $and$ $\chi$ to either exactly or over-identify the system.

GMM estimation requires the specification of a set of theoretical moment conditions that the parameters of interest $\varphi$ should satisfy. Thus,

$$E(m(y,\varphi)) = 0 \quad (4)$$

where y is a vector of variables relevant for the specific moment conditions being specified , m is the moment function (e.g. mean, covariance etc), and the method of moments estimator is defined by replacing these with their sample analog.

$$\sum_t m(y_t, \varphi)/T = 0 \qquad (5)$$

In the case of the specific GMM estimator we are using here, the moments conditions are specified in terms of orthogonality conditions between the residuals of each equation and a set of instruments ($Z_t$), that is $\varepsilon_{it}$ $\varpi_{it}$ $and$ $\upsilon_{it}$ are assumed to be orthogonal to the vector of instrumental variables Z.

If the number of parameters of interest is exactly equal to the number of moment conditions, then we can exactly satisfy these moment conditions and we obtain the method of moment's estimator. However, when the number of moment conditions is greater than the number of parameters of interest then we cannot meet all the moment conditions at the same time and, instead, we minimize the following function, which gives rise to the Generalised Method of Moments (GMM):

$$\sum_t m(y_t, \varphi) A(y_t, \varphi) m(y_t, \varphi) \qquad (6)$$

where A is a weighting matrix. While any positive definite symmetric matrix will give rise to a consistent estimator, the optimal A is given by the inverse of the covariance matrix of the moment conditions. When the number of endogenous variables exactly equals the number of instruments, the model is exactly identified. When there are less instruments than endogenous variables the model is underidentified, and cannot be estimated. When there are more instruments than endogenous variables the model is over identified. In the case of our estimates below the model is overidentified.

Our explanatory variables include (1) bank-specific fundamentals, (2) macroeconomic fundamentals and (3) an index of political stability.

The bank-specific variables are constructed for each country based on data at the individual-bank level. In each case, individual country data are aggregated into a "country bank" and ratios calculated for this (fictitious) entity (see Appendix III for more details). They cover various aspects of bank performance. Profitability is measured as *pre-tax operating income as a percentage of total assets*. Asset quality is calculated as *loan loss reserves as a percentage of impaired loans*. The capital adequacy of the banks is *equity as a percentage of total assets*. Finally, the liquidity condition of the banks is

captured by the *interbank ratio*, that is, funds lent in the interbank market to other banks divided by funds borrowed; if the ratio takes the value of 100, then banks have a zero net interbank exposure – they lend as much as they borrow. A value higher than 100 implies that the bank is a net lender to the interbank market and, vice versa, for a value lower than 100. For all four bank-specific variables, a rise in the ratio indicates a stronger financial situation; hence, we would anticipate that a rise in the ratio produces a rise in the bank equity indices.

We use the following variables to capture macroeconomic fundamentals. (1) Our fiscal variable is the *general government consolidated gross debt-to-GDP ratio*. Other things equal, the higher the debt-to-GDP ratio, the higher we would expect sovereign spreads to be and the lower a sovereign's rating (which, in our cardinal series, translates into a higher value). (2) Competitiveness is captured by including *relative price levels* (defined as each country's Harmonised Index of Consumer Prices -- HICP, all items index -- relative to that of Germany). A higher ratio of relative prices indicates a deterioration in competitiveness. (3) Growth is an important determinant of a country's ability to meet its obligations and hence we include the percentage *change in real GDP as an explanatory variable*.

As mentioned, we include an index of *political stability;*[6] we use the IFO World Economic Survey index of political stability. A rise in the index indicates greater stability. Finally, in order to bring banks' ratings into our framework, we constructed a variable that measures banks' rating relative to sovereign rating for each country, and we include this variable in the bank equity index equation. (See Appendix III for details.)

Our data comprise an unbalanced panel covering, at its maximum, the period October 1998 until July 2014, and the data are monthly; where they are quarterly or annual (bank-specific data), we interpolate them to a monthly frequency.

*4. Results*

In order to provide a basis of comparison of our findings with the results of the conventional single-equation approach typically used in the previous literature, we begin

[6] We follow Gibson, Hall, and Tavlas (2014), who found that an index of political stability helped explain sovereign spreads in Greece.

by estimating a single equation in which movements in the bank equity price index are explained by bank-specific variables. Table 1 provides the results of a panel estimated using least squares with fixed effects. With the exception of the capital ratio (*i.e.,* the ratio of equity to total assets), which has a negative sign, the bank specific variables are correctly signed; we would have expected the sign on the capital ratio to be positive since a higher level of capital typically signals a healthier bank. Profitability (*i.e.,* profits over total assets) appears to be the strongest determinant of bank equity prices, while the two variables, the interbank ratio and the ratio of loan loss reserves to non-performing loans, are significant at the 10 per cent level.

Next, we estimate the system of equations, which includes the three endogenous variables -- the level of bank equity prices, sovereign spreads, and sovereign ratings. Our estimation approach is as follows. For the equation in which bank equity prices is the dependent variable, we again use the four specific bank-related variables, along with the simultaneous effects from sovereign spreads and sovereign ratings. We also capture inter-reactions through the variable incorporating the difference between bank ratings and sovereign ratings. For the equations in which sovereign spreads and sovereign ratings are the dependent variables, respectively, we use the three macroeconomic variables and the variable that captures political uncertainty as explanatory variables; we also use the simultaneous effects of the other equations. In the final specification of the system, we include those variables that are correctly signed and significant (at the five per cent level).

The results are displayed in Table 2[7]. The following findings merit comment.

- First, focusing on the equation for the bank equity index, two of the four bank-specific balance-sheet variables are significant and correctly signed; (1) a rise in reserves held to meet potential defaults on non-performing loans ensures that banks are healthier -- a rise in the ratio reserves-to-

[7] It can be noted that we use all available observations for each of the estimations in Tables 1 and 2. However, samples differ since the interbank ratio is available only from 2004 in 4 out of the 5 countries. At the same time, the loan loss reserves to NPL ratio is only available in Greece from 2004. The system estimates, which do not contain the interbank ratio (since it was found to be insignificant), allow a larger sample to be used. It should be noted that dropping the interbank ratio from Table 1 does not change qualitatively the results.

non-performing loans is associated with a rise in the bank equity index; (2) higher profitability has a positive impact on the bank equity index.

- Second, sovereign ratings play a substantial role in the determination of banks' equity, beyond the effects of the banking fundamentals. A deterioration in sovereign ratings (an increase) causes the bank equity index to fall. This effect most likely reflects concerns about the ability of the country to meet the potential fiscal costs associated with its explicit or implicit banking system support (deposit guarantee schemes, possible capital injections, etc).
- Third, it appears that changes in sovereign ratings have larger effects than changes in the bank-specific variables. Our findings indicate that a one-notch sovereign downgrade results in a fall in bank equity prices of almost 13 per cent. With the exception of Italy (which experiencd a fall in sovereign ratings of 4 notches beginning in 2008), the other countries at the end of the period (mid-2014) were some 7-8 notches below their 2008 levels. Thus sovereign rating downgrades explain a large amount of the sharp falls in bank equity indices displayed in Figures 1-5. Bank-specific variables have much smaller effects. A 10 per cent fall in the loan-loss-reserves-to-nonperforming-loans ratio causes a 3 per cent fall in equity prices; a 10 per cent fall in profitability causes equity prices to decline by 4.4 per cent.
- Fourth, there are significant spillover effects of sovereign ratings on banks' equity prices -- both directly, through the two variables measuring sovereign ratings and the difference between bank rating and sovereign rating, and indirectly, through the effect of sovereign spreads on sovereign rating. However, it should be noted that in the case of Spain and Italy, bank ratings deteriorated at a slower rate than that of the sovereign. This behavior implies that the differential between bank and sovereign rating had a positive effect on bank equity prices in these countries.

- Fifth, if banks are downgraded at the same pace as the sovereign -- that is, there is no change in the variable representing the difference between bank ratings and sovereign ratings -- there is no effect on the bank equity prices apart from the effect of downgrades of the sovereign, which has a negative effect (with a coefficient of -0.13). However, if banks are downgraded at a faster pace than the sovereign -- indicating more of a banking crisis rather than a sovereign crisis -- the total effect of the two downgrades on bank equity prices is about three times larger than if sovereign downgrades occur at the same pace as bank downgrades; that is, the combined effect is -0.35 instead of -0.13.
- Sixth, our results point to the importance of using levels of equity prices -- rather than rates of return -- in measuring banks' performance. The use of levels allows us to derive the determinants of long-run equity prices. Moreover, our focus on levels indicates that if sovereign ratings deteriorate, bank equity prices go down and stay down until sovereign ratings improve.
- Finally, sovereign spreads are determined mainly by economic fundamentals, as reflected in real growth and relative prices, and sovereign ratings, while sovereign ratings are determined primarily by the sovereign's debt ratio, political uncertainty, and the simultaneous effect of sovereign spreads.

To summarize, our findings indicate that a long-run recursive relationship between sovereigns and banks operated during the euro-area crisis. Specifically, for the five crisis countries considered shocks to sovereign spreads fed-through to sovereign ratings, which affected the equity performance of commercial banks. Indeed, our results suggest that during the euro-area crisis, a predominant part of the decline in banks' share prices reflected direct and indirect impacts from the sovereign sector. The combined effect of the average change in sovereign ratings across countries, along with the average change in the differential between bank and sovereign ratings, explains just over half of the actual fall in bank equity prices. In three programme countries (Greece, Ireland and Portugal) this combined effect explains over 90 per cent of the fall in bank

equity prices. The cases of Spain and Italy, where bank ratings deteriorated by less than those of the sovereign between 2008 and 2014, highlight the importance of further work examining the impact of banks on sovereigns, and not just the impact of sovereigns on bank equity prices as done in this study.

*5. Conclusions*

During the course of 2014, several important actions have been taken toward the creation of a banking union in the euro area.[8] These actions will go a long way in reducing the strength of the linkages between sovereigns and banks, linkages that played out during the recent crisis, deepening on the intensity of the crisis. Our results, however, suggest that a banking union may be a necessary, but not a sufficient, condition for financial stability. As long as domestic euro-area banks hold relatively-large shares of debt issued by their respective *national* sovereigns in their portfolios -- and in the absence of a mechanism that ensures some form of debt mutualization -- the potential will exist for a re-emergence of the interactions between sovereign spreads and sovereign ratings, on the one hand, and banks' performance, on the other.

[8] These include the establishment of a Single Supervisory Mechanism in November 2014. A Single Resolution Mechanism will be fully operational on January 1, 2016.

## References


Aizenman, A, Hutchison, M and Jinjarak, Y (2013) 'What is the risk of European sovereign debt defaults? Fiscal space, CDS spreads and market pricing of risk' *Journal of International Money and Finance*, 34, 37-59.

Aizenman, A, Hutchison, M and Lothian, J (2013) 'The European sovereign debt crisis: background and perspectives' *Journal of International Money and Finance*, 34, 1-5.

Ammer, J, and Cai, F (2007) 'Sovereign CDS and bond pricing dynamics in emerging markets: does the cheapest-to-deliver option matter?' International Finance Discussion Papers 912, Board of Governors of the Federal Reserve System (U.S.).

Beirne, J and Fratzscher, M (2013) 'The pricing of sovereign risk and contagion during the European sovereign debt crisis', *Journal of International Money and Finance*, 34, 60-82.

BIS (2011) 'The impact of sovereign credit risk on bank funding conditions', Committee on the Global Financial System, CGFS Papers, no. 43.

Castrén, O, Fitzpatrick, T and Sydow, M (2006) 'What drives EU banks' stock returns? Bank level evidence using the dynamic dividend-discount model', ECB Working Paper, no. 677.

Chan-Lau, J A, Liu, E X and Schmittmann, J M (2014) 'Equity returns in the banking sector in the wake of the Great Recession and the European sovereign debt crisis', *Journal of Financial Stability*, forthcoming.

De Grauwe, P and Ji, Y (2013) 'Self-fulfilling crises in the euro zone: an empirical test', *Journal of International Money and Finance*, 34, 15-36.

Demirgüç-Kunt, A, Detragiache, E and Merrouche O(2013) 'Bank capital: lessons from the financial crisis', *Journal of Money, Credit and Banking*, 45, 1147-64.

Dötz, N and Fischer, C (2010) 'What can EMU countries' sovereign bond spreads tell us about market perceptions of default probabilities during the recent financial crisis?' Deutsche Bundesbank, Discussion Papers, Series 1: Economic Studies, no. 11.

Fontana, A and Scheicher, M (2010) 'An analysis of euro area sovereign CDS and their relation with government bonds', ECB Working Paper, no. 1271.

Gerlach, S, Schulz, A and Wolff, G B (2010) 'Banking and sovereign risk in the euro area', CEPR Discussion Paper, no. 7833.

Gibson, H D, Hall, S G and Tavlas, G S (2012) 'The Greek financial crisis: growing imbalances and sovereign spreads', *Journal of International Money and Finance*, 31, 498-516.

Gibson, H D, Hall, S G and Tavlas, G S (2014) 'Fundamentally wrong? Market pricing of sovereigns and the Greek financial crisis', *Journal of Macroeconomics*, 39b, 405-419.

O' Rourke, K, and Taylor, A, (2013) 'Cross of Euros' *Journal of Economic Perspectives* 27 (3), 167-192.

Pisani-Ferry, J (2014) *'The Euro Crisis and its Aftermath'*, Oxford University Press, Oxford, U.K.

Shambaugh, (2012) '*The euro's three crises',* Brookings Pap. Econ. Act. 44 (1), 157-231.

Yang, J and Tsasaronis, K (2012) 'Bank stock returns, leverage and the business cycle', *BIS Quarterly Review*, March, 45-59.

**Table 1: Single equation model for bank equity price index**

Dependent Variable: Log of bank equity price index
Method: Panel Least Squares
Sample: 1/01/2004 1/08/2014
Periods included: 128
Cross-sections included: 5
Total panel (unbalanced) observations: 628

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| Constant | 5.676893 | 0.138470 | 40.99720 | 0.0000 |
| Interbank ratio | 0.002319 | 0.001337 | 1.734958 | 0.0832 |
| Loan-loss reserves to non-performing loans | 0.001762 | 0.000963 | 1.830858 | 0.0676 |
| Profits/total assets | 1.129165 | 0.029092 | 38.81332 | 0.0000 |
| Equity/total assets | -0.181094 | 0.014926 | -12.13240 | 0.0000 |

Effects Specification

Cross-section fixed (dummy variables)

| | | | |
|---|---|---|---|
| R-squared | 0.793919 | Mean dependent var | 5.214657 |
| Adjusted R-squared | 0.791256 | S.D. dependent var | 1.432158 |
| S.E. of regression | 0.654332 | Akaike info criterion | 2.003824 |
| Sum squared resid | 265.0252 | Schwarz criterion | 2.067491 |
| Log likelihood | -620.2008 | Hannan-Quinn criter. | 2.028558 |
| F-statistic | 298.0841 | Durbin-Watson stat | 0.081679 |
| Prob(F-statistic) | 0.000000 | | |

**Table 2: Results of System Estimation**

Sample: 1/10/1998 1/07/2014
Included observations: 874
Total system (unbalanced) observations 2457
Kernel: Bartlett, Bandwidth: Fixed (7), No prewhitening
Linear estimation after one-step weighting matrix

| | | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|---|
| Relative prices | **Sovereign spreads equation** | 4.812258 | 2.227517 | 2.160369 | 0.0308 |
| Growth | | -28.75429 | 12.83913 | -2.239583 | 0.0252 |
| Sovereign rating | | 0.929404 | 0.049043 | 18.95085 | 0.0000 |
| Debt-to-GDP | **Sovereign ratings equation** | 0.089411 | 0.003512 | 25.46089 | 0.0000 |
| Politics | | -0.364405 | 0.043240 | -8.427516 | 0.0000 |
| Spread | | 0.319997 | 0.015778 | 20.28173 | 0.0000 |
| LLR/NPLs | **Banks' equity price index** | 0.003412 | 0.000907 | 3.763427 | 0.0002 |
| Profits/TA | | 0.821993 | 0.061067 | 13.46055 | 0.0000 |
| Bank rating – sovereign rating | | -0.221529 | 0.044753 | -4.950047 | 0.0000 |
| Sovereign rating | | -0.126670 | 0.019880 | -6.371555 | 0.0000 |
| Determinant residual covariance | | 0.817252 | | | |
| J-statistic | | 0.051508 | | | |

**SOVEREIGN SPREADS EQUATION**

| Observations: 829 | | | |
|---|---|---|---|
| R-squared | 0.677511 | Mean dependent var | 1.712273 |
| Adjusted R-squared | 0.674761 | S.D. dependent var | 3.586643 |
| S.E. of regression | 2.045453 | Sum squared resid | 3434.964 |
| Durbin-Watson stat | 0.116437 | | |

**SOVEREIGN RATINGS EQUATION**

| Observations: 829 | | | |
|---|---|---|---|
| R-squared | 0.918250 | Mean dependent var | 4.765983 |
| Adjusted R-squared | 0.917553 | S.D. dependent var | 3.423526 |
| S.E. of regression | 0.983018 | Sum squared resid | 793.3517 |
| Durbin-Watson stat | 0.196309 | | |

**BANK EQUITY INDEX EQUATION**

| Observations: 799 | | | |
|---|---|---|---|
| R-squared | 0.816569 | Mean dependent var | 5.347119 |
| Adjusted R-squared | 0.814712 | S.D. dependent var | 1.306846 |
| S.E. of regression | 0.562534 | Sum squared resid | 249.9909 |
| Durbin-Watson stat | 0.074779 | | |

**Figure 1: Spain -- bank equity index, sovereign bond spreads and sovereign ratings**

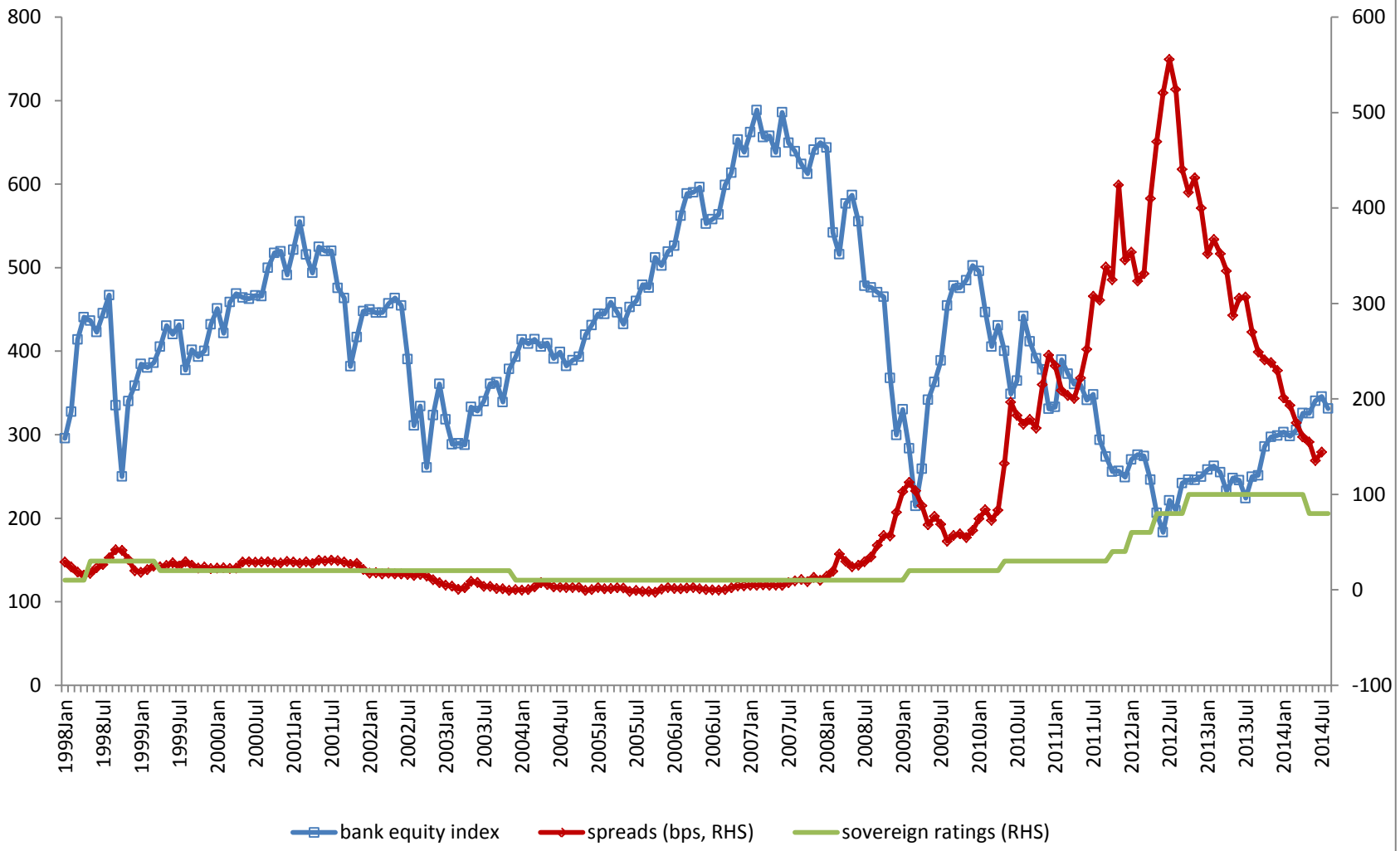


**Figure 2: Greece -- bank equity index, sovereign bond spreads and sovereign ratings**

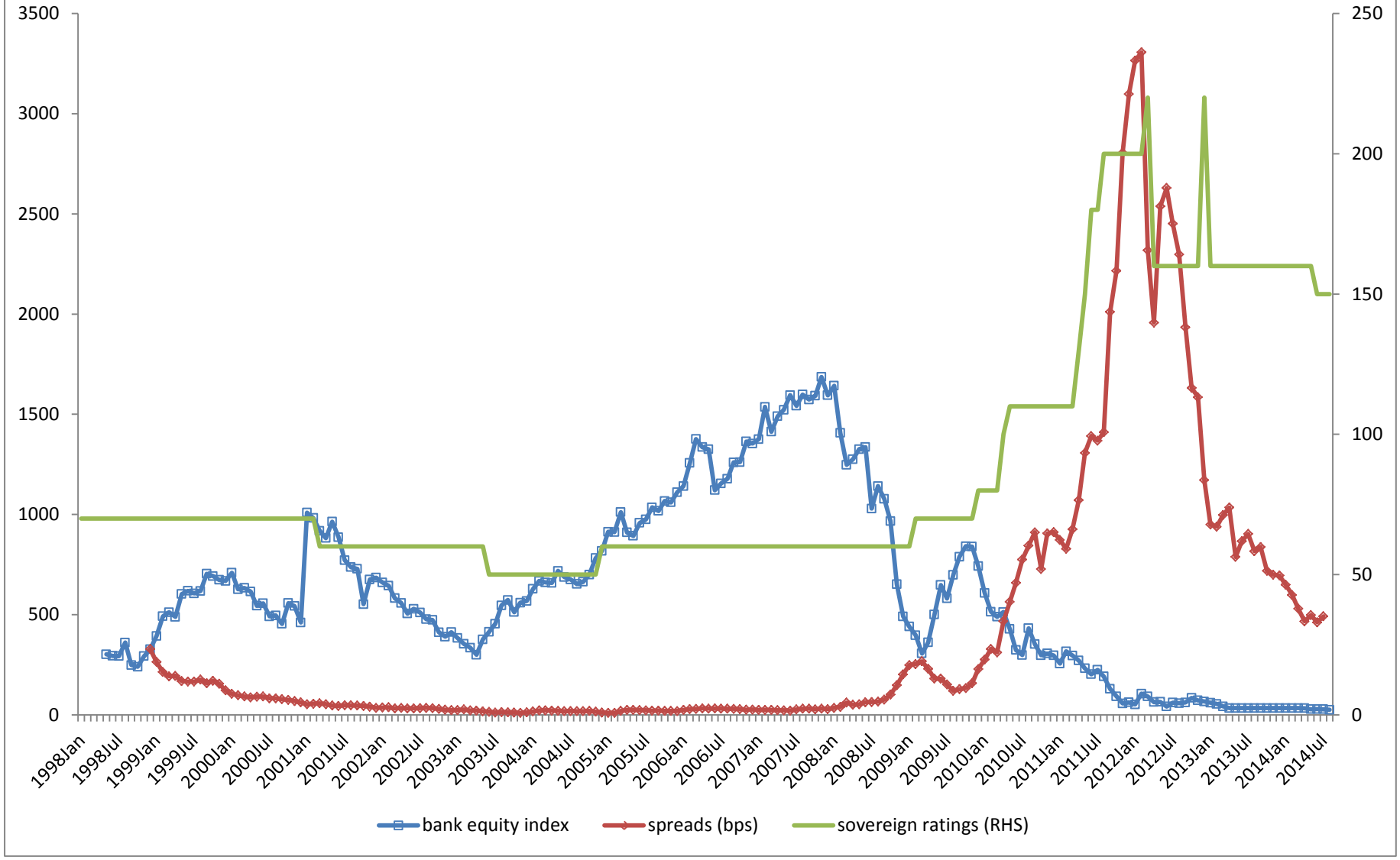


**Figure 3: Ireland - bank equity index, sovereign bond spreads and sovereign ratings**

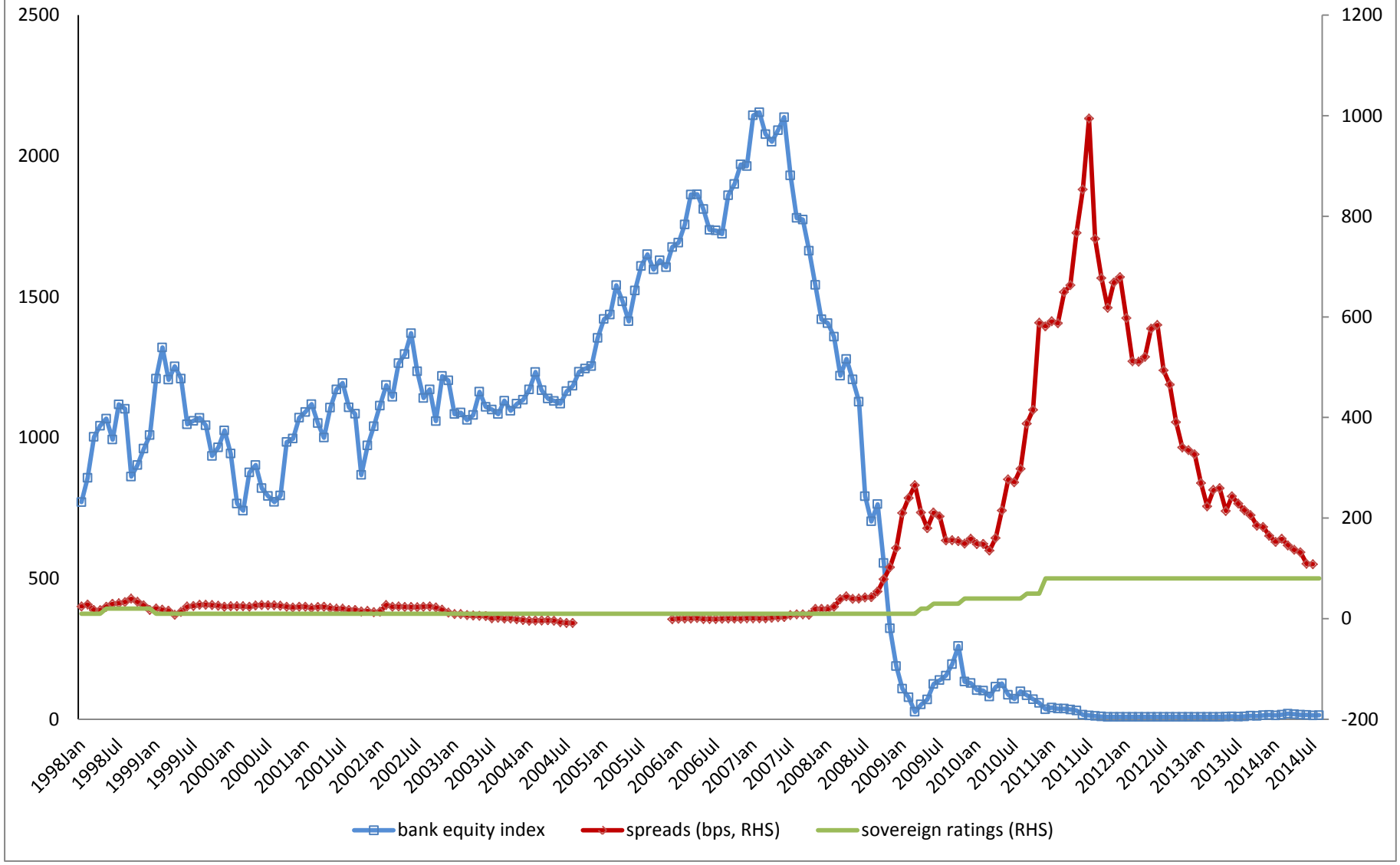


**Figure 4: Italy -- bank equity index, sovereign bond spreads and sovereign ratings**

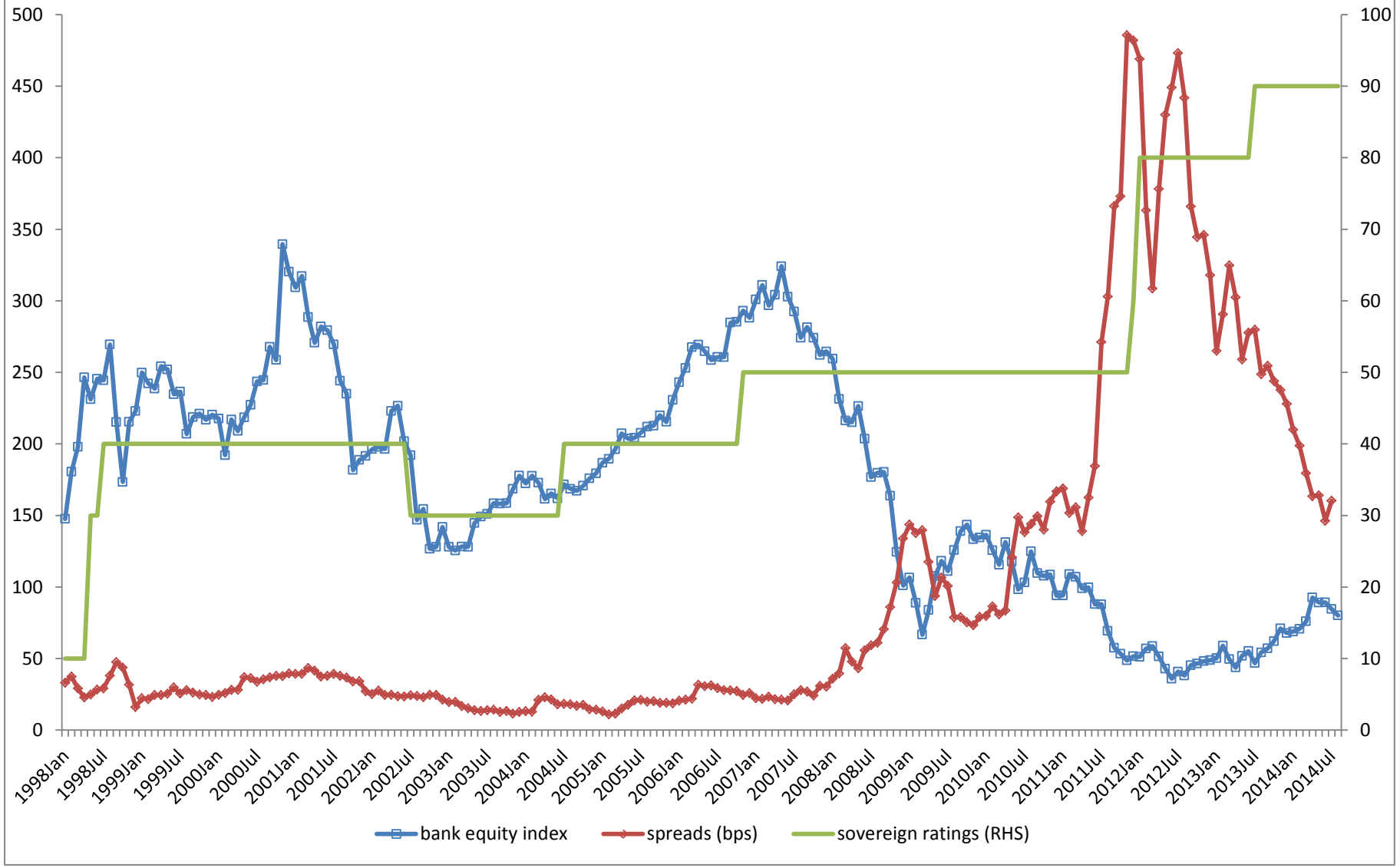
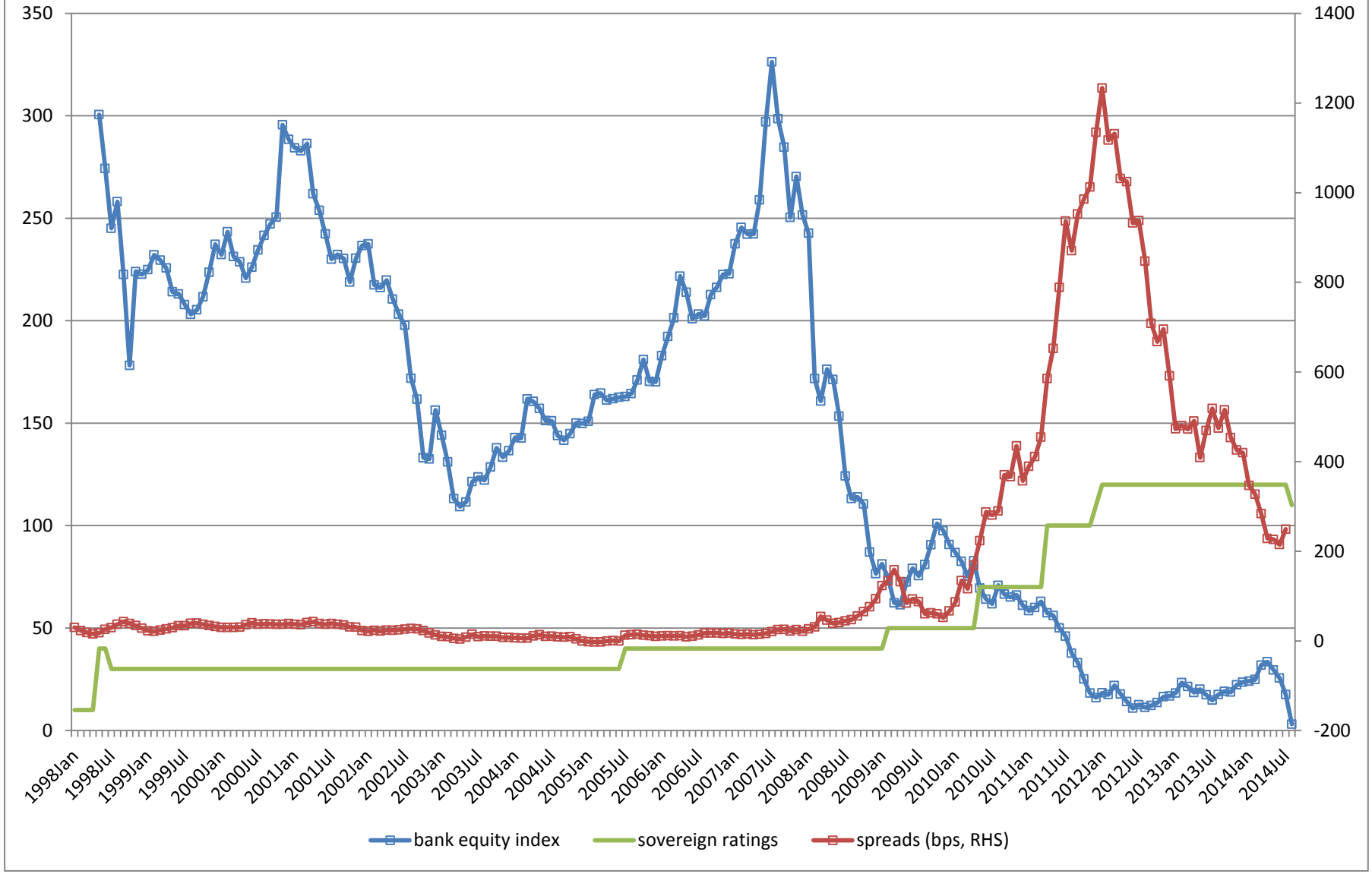
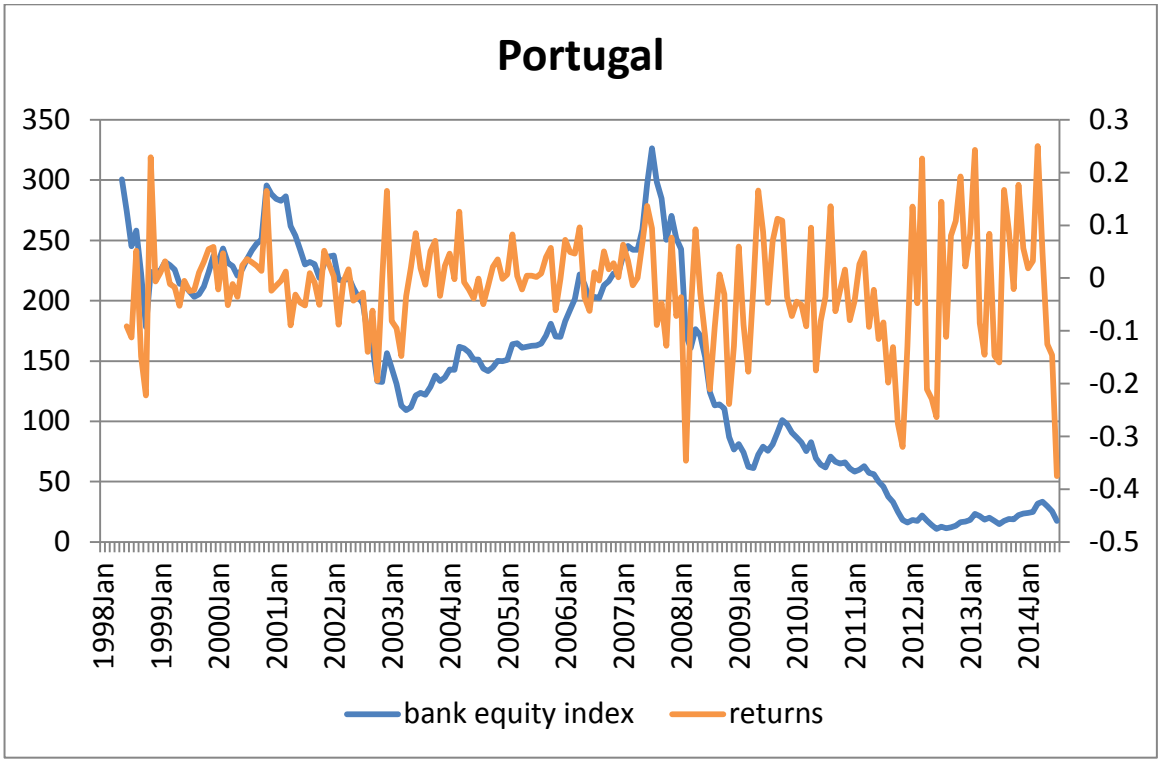
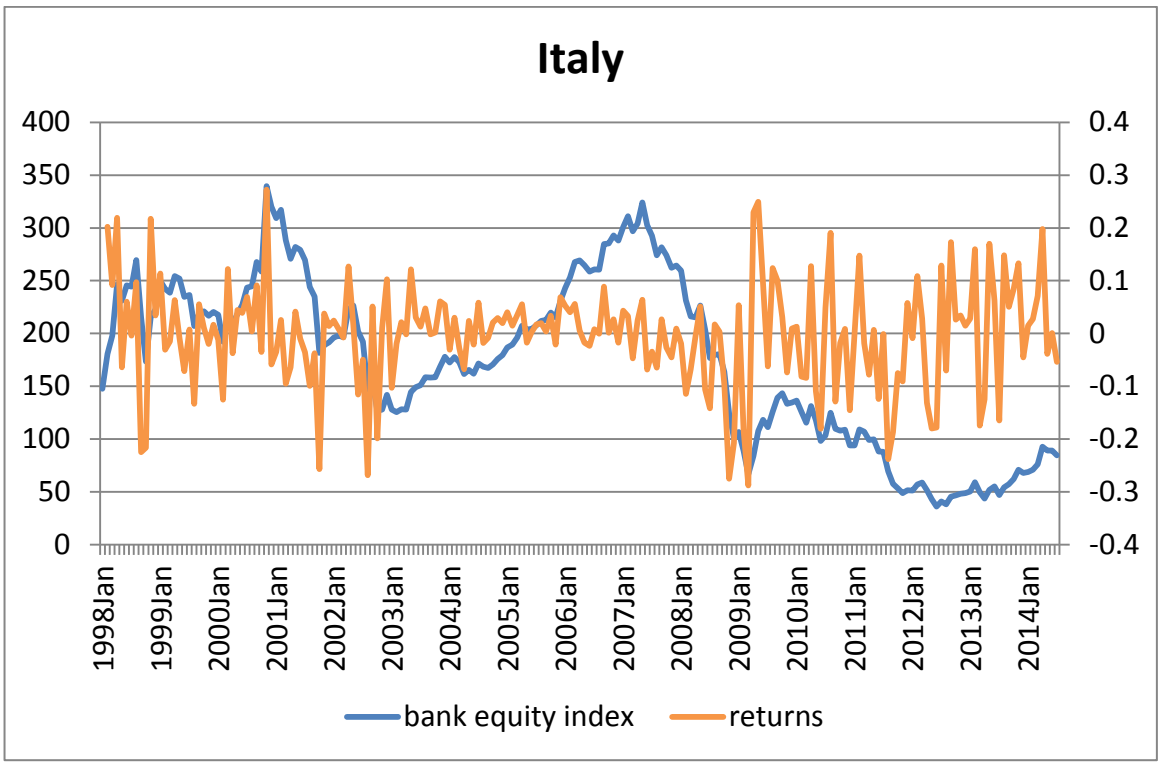


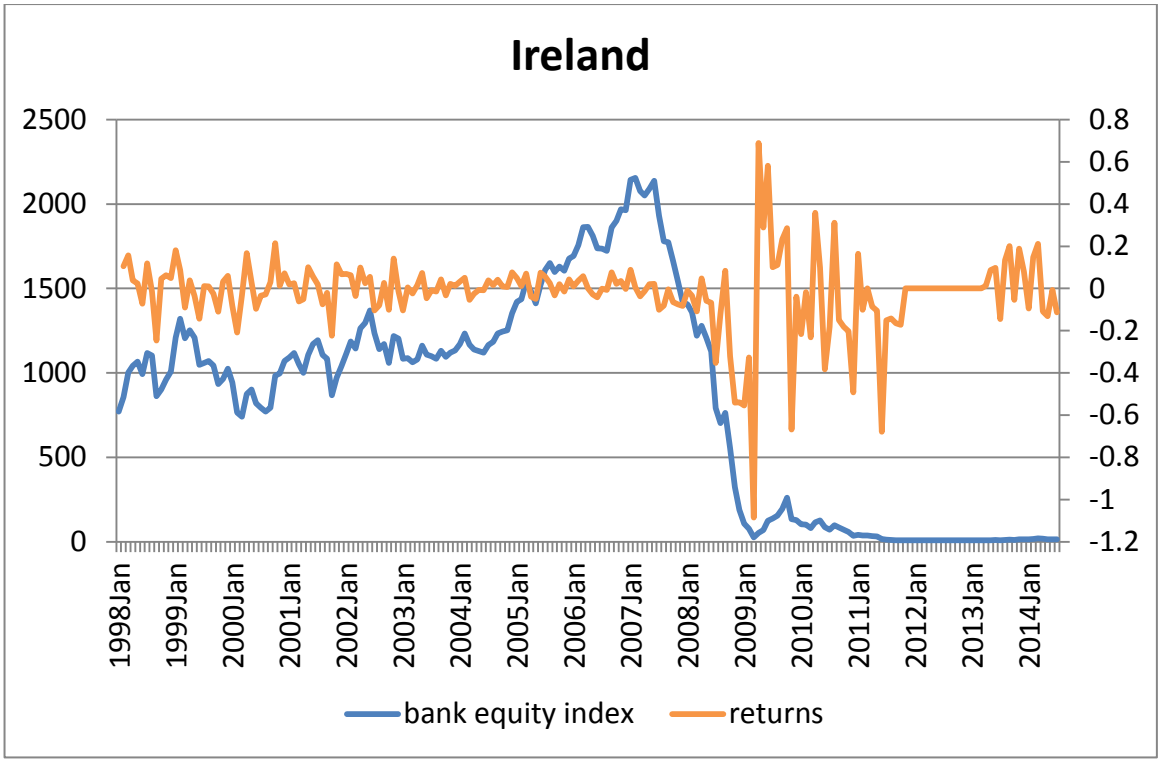
**Figure 5: Portugal -- bank equity index, sovereign bond spreads and sovereign ratings**

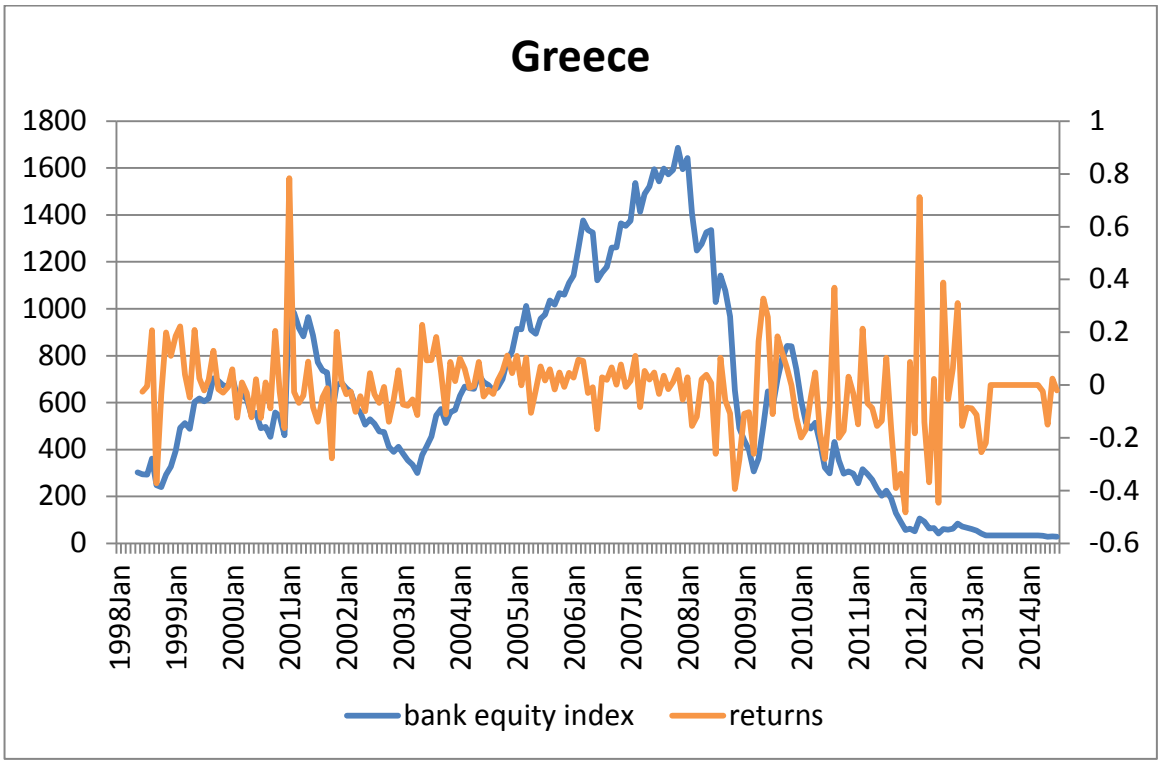


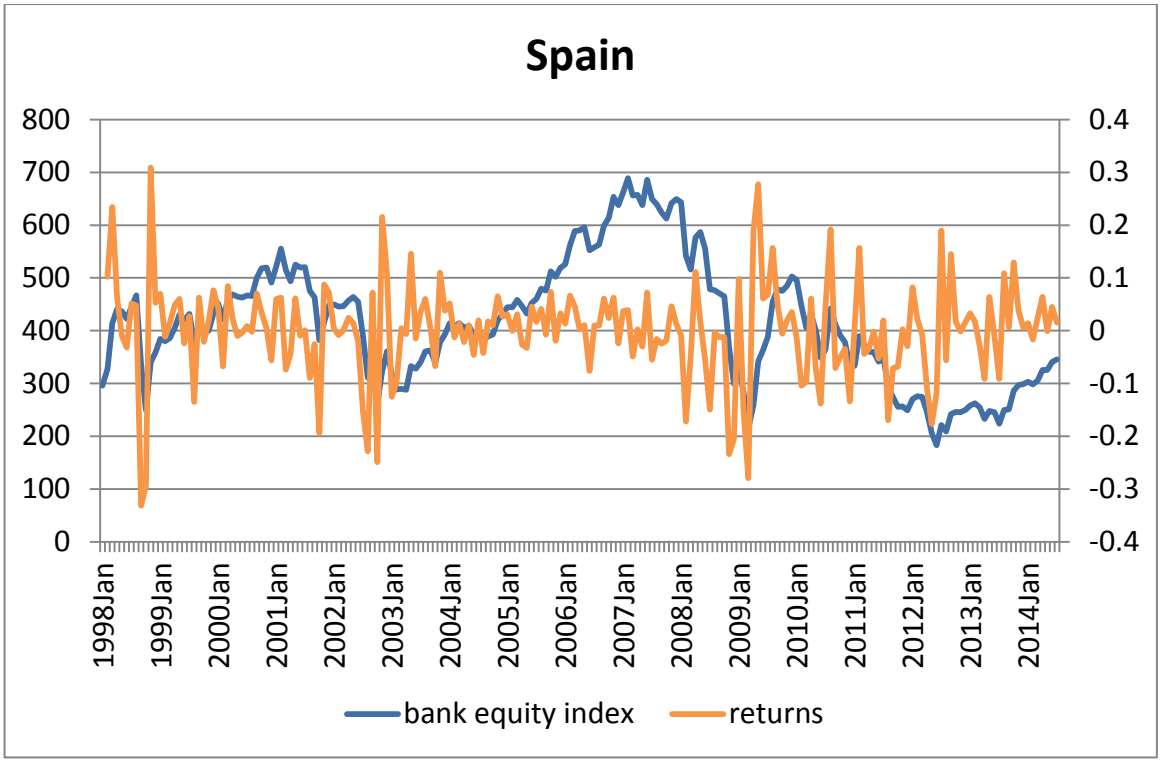
**Appendix I: bank equity indices and bank equity returns**




Ireland
2500
2000
1500
1000
500
0
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
-1.2
1998Jan
1999Jan
2000Jan
2001Jan
2002Jan
2003Jan
2004Jan
2005Jan
2006Jan
2007Jan
2008Jan
2009Jan
2010Jan
2011Jan
2012Jan
2013Jan
2014Jan
bank equity index
returns


Greece
1800
1600
1400
1200
1000
800
600
400
200
0
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
1998Jan
1999Jan
2000Jan
2001Jan
2002Jan
2003Jan
2004Jan
2005Jan
2006Jan
2007Jan
2008Jan
2009Jan
2010Jan
2011Jan
2012Jan
2013Jan
2014Jan
bank equity index
returns


Spain
800
700
600
500
400
300
200
100
0
0.4
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
1998Jan
1999Jan
2000Jan
2001Jan
2002Jan
2003Jan
2004Jan
2005Jan
2006Jan
2007Jan
2008Jan
2009Jan
2010Jan
2011Jan
2012Jan
2013Jan
2014Jan
bank equity index
returns

**Appendix II: data sources**

| | |
|---|---|
| FTSE banking sector index | Datastream-Reuters |
| 10-year government bond yields | ECB Statistical Data Warehouse |
| Sovereign ratings | Internet sites of rating agencies |
| Bank ratings | Bloomberg |
| Macroeconomic data | Datastream-Reuters |
| Fiscal news | Spring, Autumn Forecasts, European Commission |
| Political Stability index of political stability Datastream-Reuters | IFO World Economic Survey |
| Bank specific data | Bankscope |

**Appendix III: Banks included in sample**

In order to construct the bank-specific variables we use the banks below. The choice was made on the basis of (i) size of the bank; (ii) availability of data for the years 2000-2014. Data for 2000-2013 is taken from Bankscope. Data for 2014 is taken directly from banks' half-year results. As noted in the main text, the bank-specific indicators are calculated for each country by aggregate data from the individual banks and then calculating the ratios.

Spain: Banco Sandander, Banco Bilbao Vizcaya Argentaria, Caja de Ahorros y Pernsiones de Balcelona
Greece: National Bank of Greece, Piraeus Bank, Eurobank Ergasias, Alpha Bank
Ireland: Bank of Ireland, Allied Irish Banks
Italy: UniCredit, Intesa Sanpaolo, Banca Monte dei Paschi di Siena
Portugal: Caixa Geral de Depositos, Banco Comercial Portugues, Banco Espirito Santo

For bank ratings, we convert the ordinal ratings to cardinal ones (in the same manner as for sovereign ratings) for the top 2 banks in each country (top 4 in Greece) and then take the arithmetic average, thus generating the variable "bank rating" for each country over time.