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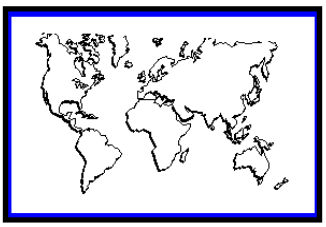

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Demand for sovereign bonds in the periphery: a regime-switching approach

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Abstract

The rise in sovereign bond holdings in stress countries could deepen a recession by allocating resources away from the private sector. Our paper investigates whether the demand function for sovereign bonds changed in the crisis period and the causes of such a change. We show that it did, and that bond holdings rose more than they would have in normal times given a set of fundamentals. However, we find this happened only for a short span of time, and similar behavior by OFIs suggests that the 0 risk weight on sovereign bond holdings was not the cause. Instead, sovereign stress is the likely driver: policies aimed at lowering the sovereign-bank nexus should target sovereign stress.

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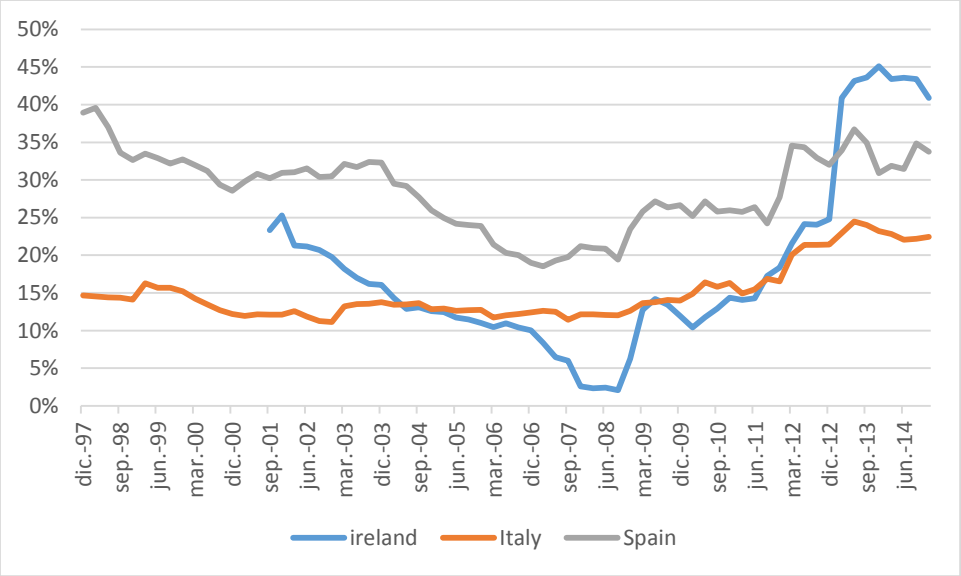
1. Introduction

One of the characteristics of the recent financial crisis was the large rise in banks´ exposure to domestic sovereigns. As Battistini et al. (2014) mentions, part of this retrenchment is common to many crisis, when financial institutions, worried possibly about redenomination risks of their assets, hold only domestic bonds to be protected from such risks (to the extent that most of their liabilities are in the domestic currency). In addition, in times of stress, since ultimately the sovereign is the backstop for bank capital, it could be optimal for the banks to tie the knot with the sovereign: at the end, it is the sovereign´s well-being that guarantees the banks existence, so the latter has an incentive to pre-emptively bail out the former.

This behavior can be particularly problematic in a currency union. As Abascal (2013) shows, the rise in financial fragmentation within the Eurozone can have a negative impact on financing conditions. Secondly, Broner (2014) points out that the increase in the holdings of sovereign debt can take resources away from the economy, as banks prefer to buy bonds instead of lending to the private sector, thus deepening the downturn. In addition, within country fragmentation can shut out parts of the banking system from normally functioning markets. According to Abascal (2013), during the recent crisis, fragmentation in the interbank market has been, on average, higher in the peripheral countries than in the core ones and it has increased particularly during periods of financial stress. Among the most significant factors that contributed to the high fragmentation levels observed are counterparty risk and financing costs (overall factors), and country-specific factors such as banking sector openness, the debt–to-GDP and the relative size of the financial sector. One of the manifestations of this fragmentation was the rise in banks´ home bias.

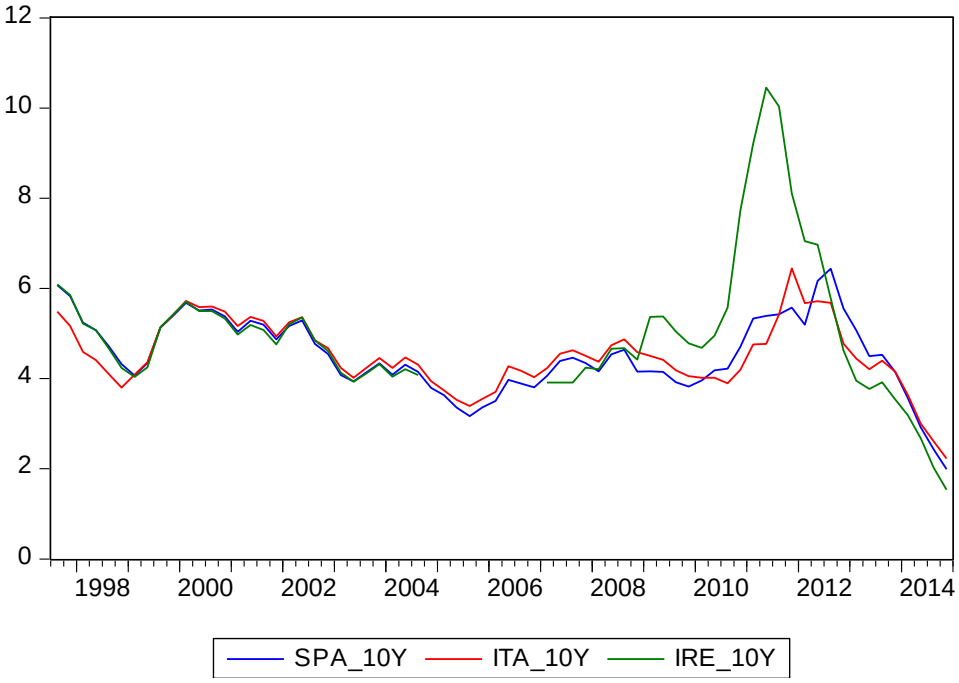
The pattern of buying up domestic sovereign bonds was particularly intense in the 2012-2013 period in Eurozone countries that were undergoing financial stress, and was a lot less intense in Eurozone countries that were not going through stress. This then begs the question: when the rise in yields and the associated increase in the riskiness of the bonds was leading foreign investors away from those assets, what led domestic banks to increase their holdings of sovereign bonds.

Graph 1: Sovereign debt holdings of domestic banks (as a % of total debt)



At the same time as those countries were undergoing major financial stress, with rising yields on bonds. As can be seen in the charts, holdings of domestic sovereign bonds rose at the start of the downturn in the three countries following the first round of stress in 2008-2009. These holdings accelerated in 2011-2012, as renewed tensions emerged in the Eurozone periphery.

Chart 2: 10 year yield on sovereign debt, key periphery countries (%)



Where Spa_10Y is the 10 year yield on Spanish debt, ITA_10Y the yield on Italian bond and IRE_10Y the yield on Italian debt

This behavior has spurred a large literature on the matter. In general, the explanations of the behavior can be separated into two groups.

First, the group that considers that the driver of the increase in sovereign bond holdings was the lack of investment alternatives in the home country. In a context of rising NPLs and economic uncertainty, banks preferred to hold the safest domestic asset available, government bonds, instead of lending to the private sector for which the solvency prospects had diminished. According to this view, the key to determining the determinants of sovereign bond holdings lies in disentangling the impact of the downturn from the impact of the rise in yields. Both happened broadly in tandem, but Castro and Mencia (2014) find, for the case of Spain, that the main driver was the economic downturn, and do not find evidence of search for yield by Spanish banks.

A second set of explanations suggests that the rise in yields was the driver of the rise in sovereign bond holdings. The key debate evolves around what made sovereign bonds so attractive in bad times. In bad times certain distortions can alter bank behavior and lead them to hold more bonds than they would in normal times, given the underlying conditions.

The first such distortion can be moral suasion. By this count, governments in stress that have difficulty financing their deficits in the market ask domestic banks to hold government assets, and they do so even if a certain government bond is not particularly attractive to them. Acharya and Steffen (2015)test the moral suasion hypothesis by looking at whether intervened or non-intervened banks were more likely to increase their holdings, assuming that the sovereign only exerts real influence over the intervened banks. However, this is unconvincing: the sovereign has broad powers to affect non intervened banks, so the fact that home bias affected the non-intervened banks should not exclude the use of moral suasion.

A second possibility is that this was due to regulatory incentives: since sovereign debt holdings carry a 0 risk weight in the calculation of banks´ capital requirement ratio, banks may have preferred to hold that asset over others. Of course, banks consider the capital impact of their investments at all times, not just during stress times, so this bias would be present at all times. However, if rising NPLs lead to capital shortages and equity market valuations decline, raising capital could be particularly difficult. As a result, the deterioration in banks' balance sheet may lead it to want to hold more sovereign bonds than before, when the capital adequacy ratios of the banks were broadly stable. Acharya and Scheffen (2015) find that low capitalized banks were the more likely to be involved in carry trade, which lends some support to this hypothesis.

The distinction between holding government bonds just because there are no investment alternatives or whether it is due to biases in banks´ investment decisions has important welfare consequences.

As Broner (2014) shows, by detracting resources from the wider economy, holdings of sovereign bonds are problematic. Of course, banks continually value the risk-return tradeoff in their investment decisions, so the particularly negativeconsequence arises because during a downturn because there is a distortion, arising from the fact that, according to Broner (2014), sovereign debt

holdings provide an extra yield to domestic banks. This extra yield can take many forms: one can be the fact that banks have an interest in bailing out the government, as a banks´ access to markets tends to be related to its sovereign´s financial health.

Also, in a monetary union, as Uhlig (2014) shows, the perverse incentives can lead to a greater exposure of banks to its own sovereign. According to Uhlig (2014), banks use domestic debt to obtain liquidity at the central bank in repurchase operations, with the implicit backing of the state. In Uhlig (2014) ´s model, a safe sovereign has an incentive to limit these operations to solvent banks, as it does not want to bail out insolvent banks. However, a risky sovereign has an interest in these operations, as it knows at if the bank fails, the sovereign will ultimately fail and so will not have to honor the guarantee. In other words, financial fragmentation in a monetary union can lead to increased holdings of government debt in risky countries.

The literature also provides a number of reasons for which banks may be biased towards holding more sovereign bonds than other institutions in normal times, such as the liquidity of bonds, or their role as market makers in sovereign bond markets. If these arguments hold, this should be visible not only by looking at whether bond holdings increased in a given period, but rather whether something forced banks to change their sovereign bond demand function at a time of stress (which could be the extra yield that domestic banks obtain a certain point mentioned by Broner, 2014).

Our contribution is two-fold. First, we analyze the difference between the sovereign bond demand function in crisis and in normal times, and we look at what changed in the demand function in crisis times. The distortion should show not in changes in sovereign bond holdings but rather in the sovereign bond demand function.

Secondly, we test whether the behavior of banks was the same as investment funds: while the latter have some restrictions on own funds, they are not subject to the regulatory capital restrictions of banks, so that they have no incentive to increase sovereign holding in their optimal asset allocation. However, they are subject to moral suasion: to the extent that they also change their behavior during the crisis, it would undermine the role played by regulatory arbitrage, and would signal that other factors may have been at play.

Our strategy to test changes in sovereign bond demand and the reasons for it is the following: we use a time series since the early 90s, on which we calculate the cointegrating relationship between sovereign bond holdings, bond yields and the state of the economy (that we proxy through the European Commission´s consumer confidence indicator). By using a relatively long time series, we overcome the problems that arise from the short time period used in other papers, in which cointegrating relationships may be spurious (see Castro and Mencia, 2014).

The yield can be thought of as the market valuation of the asset. Banks could have a structural advantage/disadvantage in buying bonds which would be different from other market participants, so there could be a long term relationship between yield and bank holdings. Some of these benefits that banks obtain from their holdings of sovereign bonds can be found in Castro and Mencia (2014) or in Nakaso (2013), and they include liquidity provision, etc... This should be present in the long run determinants of bond holdings.

In a second step, we calculate the adjustment equation for sovereign debt holdings of the VECM as a regime switching equation, where the regime switching parameter is the constant. This way, we first obtain a long run relationship, and then we see whether the adjustment towards that long run relationship between bank holdings, sovereign yields and underlying economic conditions changed during the crisis period. The higher the constant, the larger the response from sovereign holdings to a shock in any of the determinants.

We find evidence that while there was a change inthe demand function of banks, favoring domestic sovereign bonds more than in the pre-crisis period, we find, in most countries, a similar behavior by other financial institutions, which signals that the driving force of this home bias was not regulatory arbitrage in those countries. While in the 2008-2009 turmoil the behavior of both was similar, we find some evidence for Spain the increase in home bias was a bank-specific phenomenon. However, evidence from a probit model suggests that the sovereign bond bias was sparked by stress in the sovereign, rather than a search for yield.

The rest of the paper is organized as follows: first we will review the capital requirement regulation for banks and other financial institutions. Next, we will introduce the model to determine the holdings of sovereign bond by both types of institutions. We will then discuss the results and the conclusions of the paper.

2. The regulation of banks and other financial institutions

Microprudential regulation isused to prevent and mitigate risks inindividual banks' balance sheets. In this section we summarize the treatment of sovereign exposures in Basel and EU regulation.

Capital requirements are calculated based on either a simple Standardized approach, which draws upon Credit Rating Agencies ratings, or based on banks' internal credit ratings, the Internal Ratings Based approach (IRB). Pillar 1 capital requirements are calculated either way and complemented with supervisory review (Pillar 2) and banks' disclosures requirements (Pillar 3).

The standardized approach calculates sovereign debt exposures according to their external rating. However a domestic sovereign carve-out means that national supervisors may apply a lower risk weight to banks' exposures to their own sovereign (when denominated in domestic currency and funded in that currency). In practice, in the EU exposures to member states´ central governments carry a 0% risk weight.

In addition, banks that use an IRB approach apply a partial use of the standardized approach for central government exposures in the EU. As a result, a bank using the IRB approach can end up applying the standard a 0% RW for exposures within the EU, regardless of the risks associated with a given sovereign. As Nouy (2012) points out, the partial use of the SA is justified by the fact that the calculation of the key risk parameters is difficult for sovereign portfolios from advanced economies, as sovereign defaults by advanced countries are rare events.

As a result, the application of IRB models would lead to very low capital requirements for sovereign exposures. In fact, the lack of sovereign defaults leads banks to use external ratings even under the IRB. As a result, IRB estimates would be similar to the 0 RW allowed under the carve-out.

In order to avoid excessive exposures that may escape the risk-weighted minimum capital requirements, the leverage ratio introduced recently limits overall bank leverage, regardless of the risk weighting of specific exposures. This ratio, therefore limits the exposure of banks to their sovereign (or to any counterparty).

Asset managers, as of yet, are not bound by the requirement to hold capital against their exposures. However, there are calls to revise the regulation on account of their growing prominence in financial markets, and, consequently, their ability to have an impact on the functioning of markets. In particular, large holders of a given asset may be prone to fire sales in times of rising tensions, which can lead to an increase in market turmoil (Financial times, 2015).

2.1. Market risk

Similarly to the credit risk treatment, market risk (to which asset managers may be subject, see below), may also be calculated through two methods, a standardized one and one based on internal models. The standardized method allows national supervisors to apply a lower specific risk charge to sovereign debt denominated in the domestic currency and funded by the bank in the same currency (Basel Committee, 2006).

2.2. Liquidity risk

Another change in the regulation has been the introduction of the Liquidity Coverage Ratio (LCR), which requires banks to hold a minimum buffer of unencumbered high-quality liquidity assets against their stress net cash outflows over a 30 days' time window.

The composition of the liquidity buffer is divided in two tiers. The first tier comprises those assets of highest quality in the pool of eligible assets, like cash and highly rated Sovereign debt (AAA-AA). The LCR also includes a "carve-out" for domestic sovereigns, considering them Tier I assets even if rated below AA-.

Basel III also introduces a second liquidity requirement, the Net Stable Funding Ratio (NSFR), aimed to ensure that there is a minimum amount of stable funding

available in relation to the liquidity characteristics of banks' assets . The NSFR is not a binding requirement in the EU yet. But the CRD4/CRR provides for a reporting obligation to national supervisory authorities. And national authorities are also allowed to apply provisions in the subject even before the specific regulation is passed.

2.3. Concentration risk

Diversification requirements (i.e. concentration risks) could lead to a regime of limits to large exposures, by which exposures exceeding 10% of capital will be subject to a mandatory reporting requirement, with a limit of exposures of 25% of capital. Sovereign exposures have been excluded both in the BCBS and in CRD IV from the large exposures limit.

2.4. Recent proposals

Given the relevance of the debate on sovereign exposures, the ESRB (2015) proposed avenues to reduce the incentive of banks to holding domestic sovereign bonds. These proposals cover the broad set of instruments available to regulators.

First, stricter Pillar 1 capital requirements for sovereign exposures could be achieved by removing the domestic carve-out in the standardized approach, introducing a non-zero risk-weight floor for sovereign exposures in the standardized approach. Also, they propose reducing the reliance on external credit ratings in the standardized approach (although the methodological difficulties of the alternatives exposed above deem this problematic). Finally, they propose the use of overcoming the lack of observations by setting a minimum (regulatory) floor in the internal ratings-based (IRB) approach.

Diversification requirements could be implemented by fully or partially removing the exemption of sovereign exposures from the large exposures regime and introducing a capital requirement for concentration risk. Or, alternatively, coverage of sovereign exposures in macro-prudential regulation, a flexible tool that would changes to the capital requirement on sovereign debt to vary over the cycle.

As a result, in the current discussions, sovereign bonds may be left out of the solvency ratio but included in other ratios, such as the large exposures ratio. This is intended to reduce the procyclicaclity of the regulation (as shown by Repullo and Suarez, 2013, capita requirement rations tend to have procyclical consequences) has , while at the same time discouraging banks to being too exposed to a certain sovereign.

Recently, the financial regulation community has started to debate the role played by asset manager in financial markets (see Financial Times, 2015). Asset managers are playing an ever larger role in financial markets, in part covering some functions that used to be carried out by banks, which have been deleveraging and faced adverse market conditions and higher capital

requirements. One aspect currently on the table is the possible special treatment of the largest asset managers. This special treatment could lead to heightened supervision or to capital surcharges.

As of now, however, the own funds requirements regulation deals with some aspects related to asset managers: first, they must hold enough capital to be able to continue business in bad times (this justifies holding capital against fixed overheads) and secondly, they must have rules for a smooth winding down of business. Finally, they must hold capital for the market risk they may face in their operations. Typically, however, capital, is a small fraction of the assets they manage.

In this context, the risk weighting of the underlying assets is usually not an issue for asset managers, and holding sovereign debt will only have a marginal benefit from a market risk perspective. This is all the more are true given that around half of asset managers in Europe do not execute the transactions themselves, but rather use a third party, typically an investment bank, to carry out the execution of the transaction, so they do not incur in market risk.

A final aspect to consider is the prudential regulation regarding banks´ participation in asset managers, typically the look through approach. This means that banks must treat their equity participation in asset managers as if it was their own, so it does not provide a significant advantage. However, to the extent that the asset manager does not bear the risk on the underlying asset, the bank does not have to treat the asset as if it was on its balance sheet.

In any case, own funds requirements are barely a constraint for asset managers, so that they are relatively free to hold the assets they want to within their mandate, without affecting the own funds they need to hold to back them. Given the signs that this regulation could change, this paper tries to contribute to the debate by shedding some light on how these institutions behave.

In particular, own funds requirements of investment firms are fixed as a percent of fixed overheads. The approach for calculating fixed overheads is the subtractive approach, by which variable cost items are deducted from the total expenses as calculated in the firms´ accounting. The subtractive approach ensures that changes to the accounting framework are automatically taken into account, limiting the leeway for firms to change the accounting of fixed overheads. It is also easier to be calculated by firms that do not follow the IFRS.

The difference in the regulation of holdings by banks and investment funds provides an opportunity to shed light on whether the regulatory motive was the driving force of bank´s increase in bond holdings, or whether it was some other aspect (Angeloni and Wolff, 2012): if funds behave like banks in increasing home bias in the downturn, it can be a sign that home bias was driven by other factors and not regulatory arbitrage by banks.

3. Data

We analyze the determinants of sovereign holdings for Spain, Italy, Greece and Ireland. These are four countries that suffered stress during the crisis, for which we have found comparable data. The period used is 2000-2015 with quarterly data.

Sovereign bond holdings by banks and other financial institutions refer to the logarithm of sovereign bond holdings by monetary financial institutions and other financial institutions in each of their countries, as reported by the national central banks.

Secondly, we use consumer confidence as a proxy for domestic economic conditions. This is the indicator published on a monthly basis by the European Commission.

Finally, the 10 year yield on sovereign bonds is used as a proxy for the yield on all banks´ sovereign bond holdings. This is consistent with the fact that the bulk of bank holdings tend to be around that remaining maturity (EBA, 2014), and that it is typically one of the more liquid benchmarks.

4. Specification

Our baseline model is a VECM, in line with the standard literature on the holdings of bonds of the domestic sovereign, which allows us to disentangle causality amongst the various drivers and short term effects from long term relationships. However, as mentioned before, our modeling strategy is designed to overcome two difficulties common in the literature: the fact that the crisis period had too short a time span to test long term relationships and, secondly, testing specifically the role played by regulatory incentives during the crisis period.

In order to test whether the behavior changed at certain points in the crisis, we employ a regime switching error correction model, in line with Alzadeh et al (2008). We proceed in the following way: first, we determine the stationarity properties of the variables. This is done through the unit root tests that determine that the null of the existence of a unit root cannot be rejected. However, none of the variables have a unit root test in first differences, signaling that they are all integrated of order 1.

Secondly we analyze whether the variables are cointegrated. Some papers in the literature have used this approach for a sample of just the crisis period, which has been subject to the criticism of Mencia and Castro (2014) of having too short a time span. Furthermore, by taking just the crisis period, understanding the counterfactual can be elusive, as the cointegrating relationship may or may not be driven by anomalies specific to that period.

We solve this problem by using a longer sample. In the long run, one can think of banks as having a different bond demand function than other market participants: as discounting to obtain liquidity in the central bank, or in order to keep safe assets in the balance sheet, sovereign bonds can be more attractive to banks

than to other businesses. Secondly, since banks are large holders of sovereign bonds, they may act as automatic stabilizers in financial markets, trying to reduce the volatility of market prices so as to reduce the impact on their portfolio (El Erian, 2010).

The lag structure of the VECM is based on the Wald test criteria (Dolado and Lutkepol, 1996), which suggests we use two lags in the cointegrating relationship and the corresponding adjustment equations.

Table1: lag structure of the VECM

	Spain	Italy	Ireland
DLag 1	36,89	15,35	27,66
	[2.75e-05]	[0.08]	[0.00]
DLag 2	16,45	11,07	36,80
	[0.06]	[0.27]	[2.86e-05]
DLag 3			48,71
			[1.88e-07]

Statistic and in brackets, the p value of the Wald lag test

Therefore, we estimate the following equation, by which we will obtain the long term relationship between the variables and the short run dynamics

$$\begin{aligned}\Delta holding_t = \propto [holding_{t-1} + \beta' cconf_{t-1} + \beta'' yield_{t-1}] + \beta_2 d(holding_{t-1}) \\ + \beta_3 d(holding_{t-2}) + \beta_4 d(cconf_{t-1}) + \beta_5 d(cconf_{t-2}) \\ + \beta_6 d(yield_{t-1}) + \beta_7 d(yield_{t-2}) + u_t + c\end{aligned}$$

Where *holding* is the log of sovereign bond holdings, *cconf* the consumer confidence index, *yield* the 10 year yield on sovereign bonds d is the first difference operator, and u is an error term. D() is the first difference operator, and c is a constant.

Note that the equation describes the adjustment process of the variable holding. the first term of the right hand side of the equation shows the speed of correction from the cointegrating relationship, the second term the dependence on own lags, the third term the dependence on the lags of other variables and finally, the residual. The cointegrating relationship is obtained through the Johansen (1988) method.

The ∝coefficient on the previous equation is the error correction term, and describes how the holdings of sovereign bonds react when there is a shock to the long run relationship. The higher the absolute value of the coefficient, the quicker holdings revert back to their long run relationship.

We estimate the VECM equation that describes the adjustment process of all the determinants in the cointegrating relationship, and focus on adjustment path of bond holdings. Note that this equation can be estimated using OLS: all variables on the right hand side are exogenous and stationary, as it is composed of the lags of the determinants in differences and the lag of the error in the cointegrating equation.

The equation above can be modeled as a first order Markov chain. The stochastic process for generating the unobservable regimes is an ergodic Markov chain, defined by the transition probabilities: The probability of being in a certain regime will be state-dependent. Specifically, we will estimate it using the following conditions.

$$c = \begin{cases} c_1 \; if \; s_t = 1 \\ c_2 \; if \; s_t = 2 \end{cases}$$

$$p_{ij} = \Pr(s_{t+1} = j \; s_t = i) \, , \sum_{j=1}^{2} p_{ij} = 1$$

Evidence that there could be a regime change in the cointegrating relationship during the crisis can be found in the shape of the residuals. As can be seen above, in practically all the countries, for some periods in the 2008-2014 period, there is evidence that the cointegrating relationship does not capture all the effects. Our regime- switching approach will attempt to capture the specific issues that arose in this period.

In order to further examine whether a regime switching process is appropriate, we can run parameter stability tests on the error correction equation. Below we show the results for the Chow breakpoint test used for different periods of time. We see that for different dates, we find a breakpoint which may warrant the use of a regime switching equation.

Table 2. Chow breakpoint test results

	Spain	Ireland	Italy
F-statistic	5,02	2,65	2,19
Log likelihood ratio	19,61	15,08	9,28
Wald Statistic	20,07	13,25	8,75
	2012Q2	2008Q1	2012Q1
Prob. F(4,57)	0,00	0,05	0,08
Prob. Chi-Square(4)	0,00	0,01	0,05
Prob. Chi-Square(4)	0,00	0,02	0,07

The bottom three lines show the p values associated to the breakpoint in the date shown. The null hypothesis of not break at the specified breakpoint can be rejected for all of them

5. Results

First, note that the variables tend to be I(1), as seen in table X. this result is robust to the use of alternative methods for determining whether the is a unit root, be it Phillips and Perron(1988) or ADF. As a result, we search for the existence of a cointegrating vector. We model the cointegrating vector with an intercept, using the option for which we do find that such a vector exists, according to the Johansen (1988) method.

Table 3. Unit root test results

		ADF statistic	
		levels	first differences
Spain	bond holdings	2,5	-7,888 ***
	10 year bond yield	-1,8	-5,66 ***
	consumer confidence	-2,4	-5,08 ***
Italy	bond holdings	0,77	-7,11 ***
	10 year bond yield	-2,7	-6,08 ***
	consumer confidence	-1,7	-7,61 ***
Ireland	bond holdings	0,77	-6,799 ***
	10 year bond yield	2,54	-3,86 ***
	consumer confidence	-1,67	-7,56 ***

*** indicates significanca at the 1% level, ** at the 5% and * at the 10%.
An asterisk would indicate rejection of the null that the variable has a unit root.

Table 4: cointegration test results

Country	Variable used	Number of CE	Trace statistic	p-value
Spain	Banks	None *	44,52	0,00
		At most 1	4,27	0,88
		At most 2	0,02	0,90
	OFI	None *	44,33	0,04
		At most 1	1,94	0,26
		At most 2	0,02	0,90
Italy	Banks	None *	32,37	0,02
		At most 1	7,03	0,57
		At most 2	0,13	0,71
	OFI	None*	22,25	0,04
		At most 1	4,26	0,67
		At most 2	0,35	0,62
Ireland	Banks	None *	30,14	0,05
		At most 1	10,17	0,27
		At most 2	2,78	0,10
	OFI	None *	36,37	0,01
		At most 1	9,13	0,35
		At most 2	3,17	0,07

*Marks rejection of null hypothesis at the 5% level

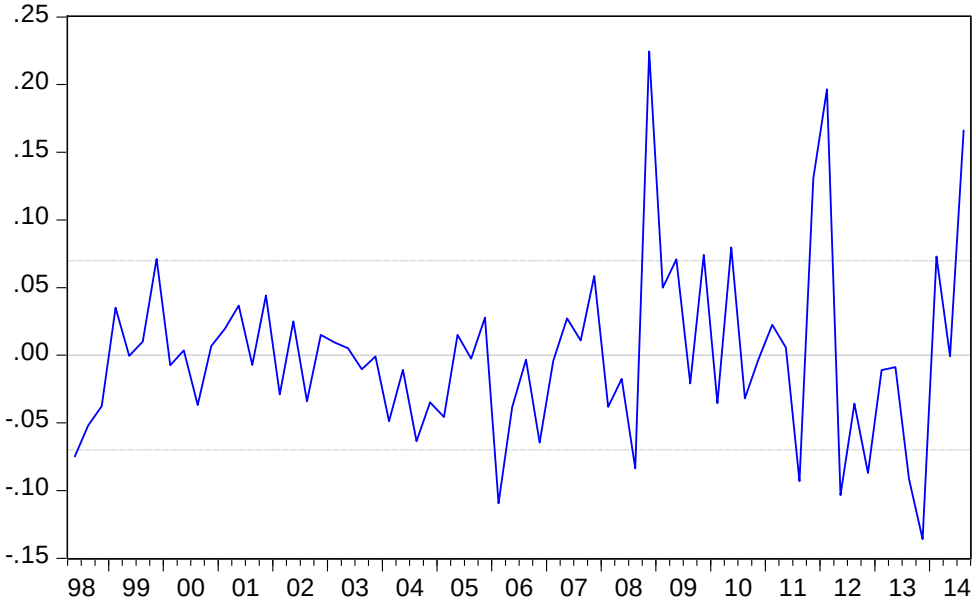
Table 5. Cointegrating equation

	GREECEBANKH	GREECEOFIH	LSPBANK	LSPOFI	LIRBANK	LIROFI	LITBANK	LITOFI
10 year yield	0,10 *	-0,61 **	3,30 **	-0,19 **	0,12 **	-0,18	2,50 ***	-0,71 *
Consumer confidence	0,03 **	-0,40	-0,34 **	-0,36 *	-0,09 *	-0,90 **	-0,30 *	0,04 *
Constant		-10,80	15,48	-0,31	18,35	5,30	3,67	-8,36

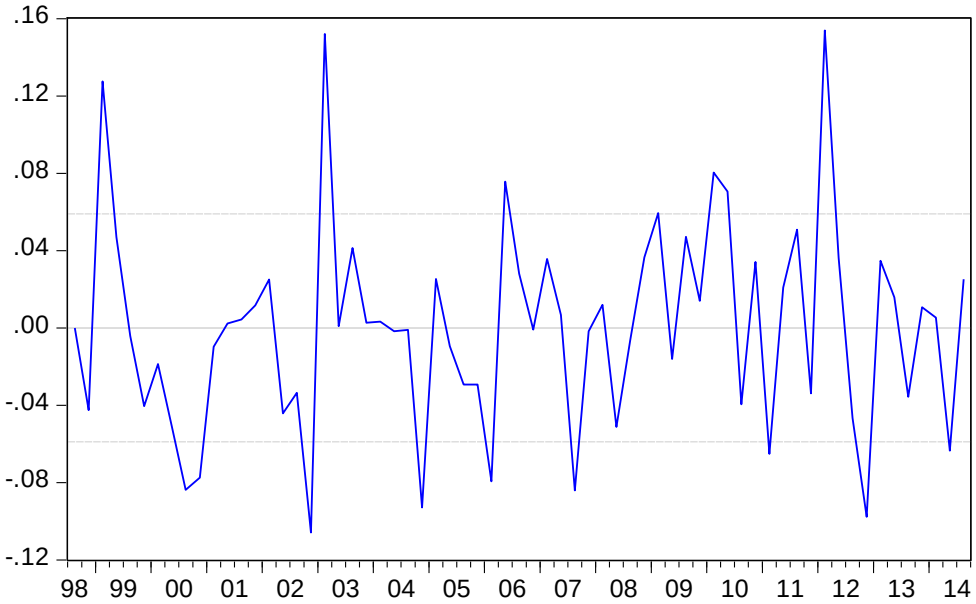
*** indicates significanca at the 1% level, ** at the 5% and * at the 10%.

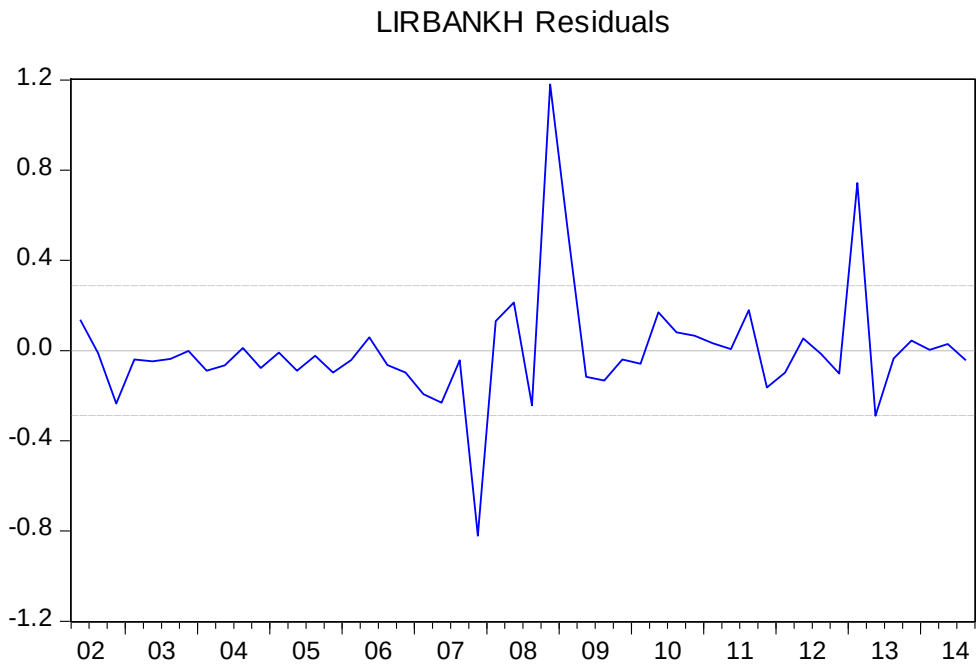
Chart 3: Residuals of the cointegrating relationship

LSPBANK Residuals



LITBANK Residuals





Where LIRBANKH, LITBANK and LSPBANK indicate the log of the holdings of domestic sovereign debt by Irish, Italian and Spanish banks.

We find a negative, long term relationship between bond holdings and consumer confidence: when growth prospects are good, we can expect holdings to decline, as mores investment opportunities may exist. This is consistent with the view that banks turn to domestic bonds in bad times, forced possibly by the absence of other investment alternatives. As result, our results suggest that in the long term, both the search for yield and the safe asset hypothesis can be seen in the data.

With these facts in mind, we must examine the behavior during the crisis period: The key question we are trying to shed light on, is whether the demand for sovereign bonds function changed during the crisis period, reflecting some of the afore-mentioned distortions. Note that even if banks´ demand function had remained the same as in good times, the increase in yield and the recession would have led to an increase in holdings. The fact we explore is whether that demand function changed during the crisis.

The evidence that the behavior changed during the crisis can be first noticed in the residuals from the cointegrating equation. These residuals suggest that bank demand and, in some cases, OFI demand, reacted different in the crisis period than in normal times.

The regime switching approach can help us identify whether the peak in the residuals was due to a change in the sovereign demand function, which would be captured by the constant term.

The charts below, we see how the demand function changed for both banks and other institutions at the height of financial stress. The higher constant means that the holdings of domestic bonds increased more as either of the determinants were shocked than in the pre-crisis period.

Our interpretation of that result is that, indeed, in the height of the crisis, the banks´ holdings of sovereign bonds were larger than would be predicted by the long run sovereign bond demand function. This was driven by a larger reaction to shocks to yields and economic conditions.

The comparison with OFI suggests that there were two differentiated episodes. In the 2008-2009 period, and around 2012-2013, both banks and OFIs preferred sovereign bonds. In this period, regulatory incentives do not seem to play a role, as both types of institutions show a change in their demand function for sovereign bonds (towards increased holdings of bonds as a reaction to any of the exogenous variables). The reason could be related to the save the sovereign of the redenomination risk found in Acharya (2013) and Battistini (2013)

A key aspect of the results is that the regime with high demand for sovereign bonds is short lived. This can be seen in the regime probabilities, and also in the expected duration of each regime and the probability of switching a regime once we are in that regime: when the starting regime is the low demand one, the probability of continuing in that regime is high, while when banks and OFIs are in a high demand for sovereign bonds regime, the probability of switching is high, which suggests that this is indeed a 'crisis mode' regime rather than a persistent result.

6. Drivers of the change in bond demand

We take a closer look at what may have driven the switch in regime for Spanish banks. The behavior is similar for both banks and OFIs in the different countries, which may exclude the role played by regulatory incentives exclusive to banks, however, we see a change in the demand function, so we must explore the drivers of that change in behavior.

We set up a probit model, where the dependent variable is a dummy defined by sovereign bond demand function being in a crisis mode. The determinants are two different factors: first, the level of the 10 year yield, and, second, the 2 year and 10 year spread.

Our interpretation is the following: if banks moved to a higher holdings regime in the height of the turmoil, the motivation would show in the determinant of the higher holdings: in particular, if the motivation is to obtain a larger carry trade, banks should react to a rise in the yield of those assets of which they increased holdings. If the motivation was bailing out the sovereign, the determinant was probably the spread between the sovereign and the risk free asset (the German yield in this case. We add international risk aversion, as captured by the vix, as a control.

Table 6: Spanish bond holdings by Spanish MFI, by residual maturity (Source: ESRB)

	dec 2012	june 2013
[0 - 3M]	13.883	14.666
[3M - 1Y]	18.502	20.793
[1Y - 2Y]	18.114	23.587
[2Y - 3Y]	26.631	20.065
[3Y - 5Y]	26.672	32.551
[5Y - 10Y]	45.731	51.898
[10Y - more]	18.055	23.055
Total	157.934	186.614

In contrast, if banks hold more sovereign bonds because they want to save the sovereign (the motivation being, either, moral suasion, or the fact that their own rating and survival is linked to their sovereign), they would increase their holdings in response to heightened worries of the solvency of the sovereign have shown that these heightened tensions tend to show in the shorter dated bonds, a sign of either exit from the currency union or significant short term distress.

Table 7: results of Probit on sovereign debt holding regime

Dependent variable: high sovereign debt demand regime			
SPA_10YSPREAD			0,65 **
SPA_10Y		0,69	
SP2YSPRE	0,61 **		
VIX	0,11 ***	0,11 **	0,13 ***
C	-5,18 ***	-7,69 ***	-6,13 ***
McFadden R-squared	0,52	0,38	0,56
AIC	0,32	0,39	0,30
Schwarz	0,42	0,49	0,41
* indicates a p-value of 0,1, ** of 0,05 and *** of 0,01			

This is related to the debate on regulatory incentives: banks wanting to use the carry trade to save their balance sheet from capital shortages would be more likely to react to a rise in the 10y yield, which would offer the better carry trade opportunities. Note that our analysis does not look at individual banks: it could be that the lower capitalized institutions would do the carry trade, but this does not show in the aggregate because the driver of the holdings of the larger institutions was different.

As can be seen in the results of the probit model, the one explanatory factor was the spread, either at the short end of the curve or on the 10 year, which is evidence that the motivation for holding more sovereign bonds was, on aggregate, more related to relieving the stress of the sovereign that doing the carry trade.

7. Conclusions

Our analysis suggests that the retrenchment during the crisis periods did stem from a change in the sovereign demand function of banks and OFIs. However, the crisis mode demand, by which banks and OFIs responded to shocks in the yield or consumer confidence by holding more bonds suggests, was short lived in most cases. Therefore, the impact on the recovery of the detraction of resources from the private sector was probably rather small, by this count.

Second, in the countries studied, the behavior of banks and OFIs was similar, suggesting that regulatory incentives (in particular, the 0 risk weight on the holdings of sovereign debt) did not play a significant role. This suggests other factors, like moral suasion, or banks´ incentives to safeguard the sovereign´s stability at certain specific points in time may have played a more important role. This is emphasized by our finding that the key driver of the crisis-mode sovereign demand function was more the spread (and so the risk attached to it by the markets) than the yield on the assets.

The policy conclusions are significant. First, the results suggest that the introduction of a risk weight on sovereign bond holdings would not make much of a difference. This is because the other drivers of sovereign spread (for example, moral suasion) are the more likely reasons for the rise in the holdings of sovereign bonds.

The key response would probably lie in avoiding sovereign stress in the first place. Given the particularly damaging consequences of sovereign stress in a monetary union, enhancing (or completing) the monetary union with instruments that may avoid sovereign stress, and so, financial fragmentation, should be a priority.

Chart 4. Regime switching results: Smoothed probability of being in each of the regimes

Chart 4.1: Spain Banks

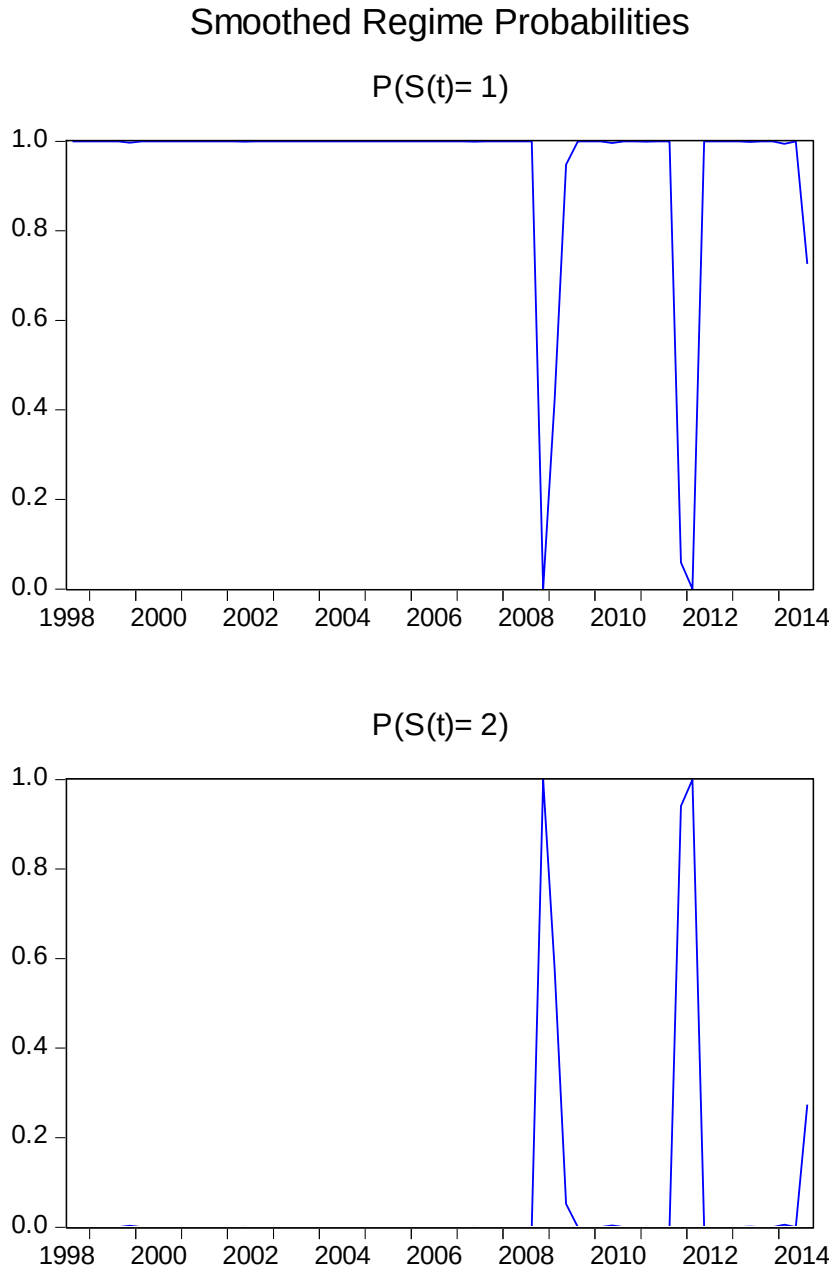


Chart 4.2: Spain OFI

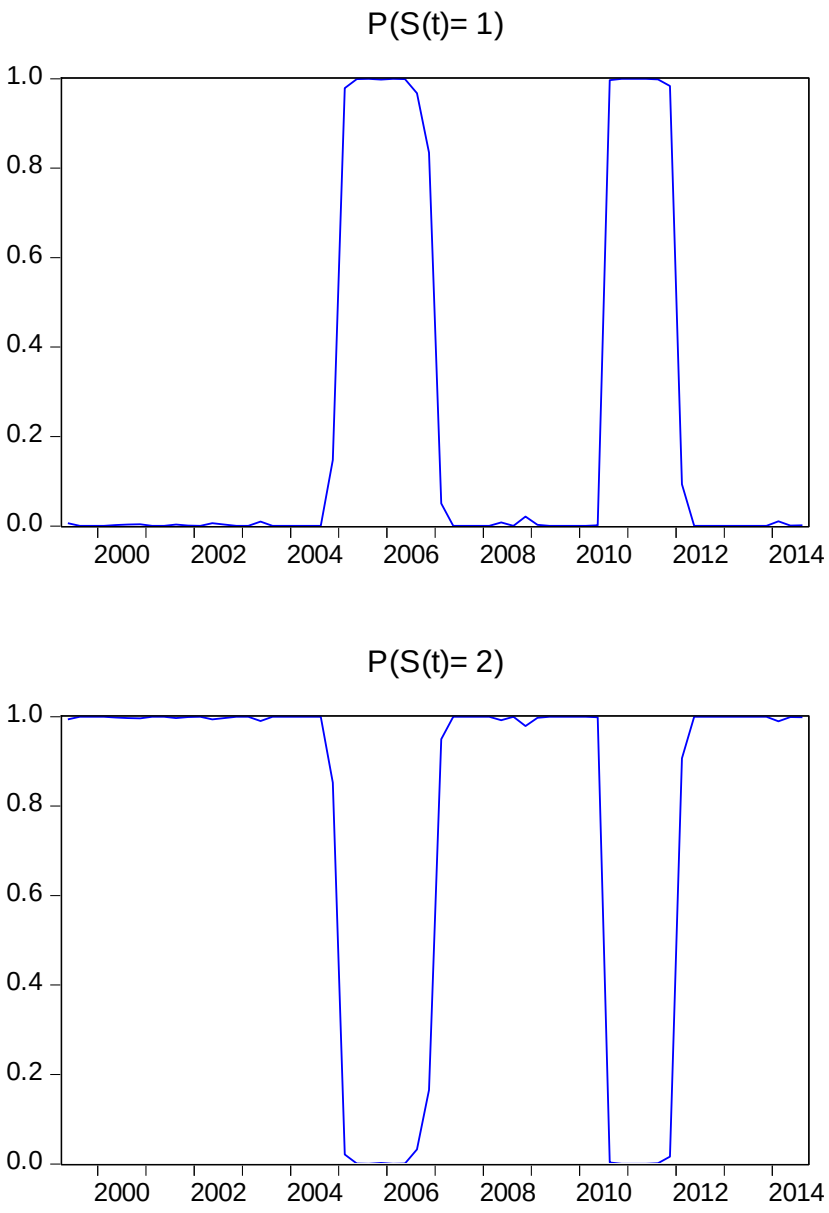


Chart 4.3: Italy banks

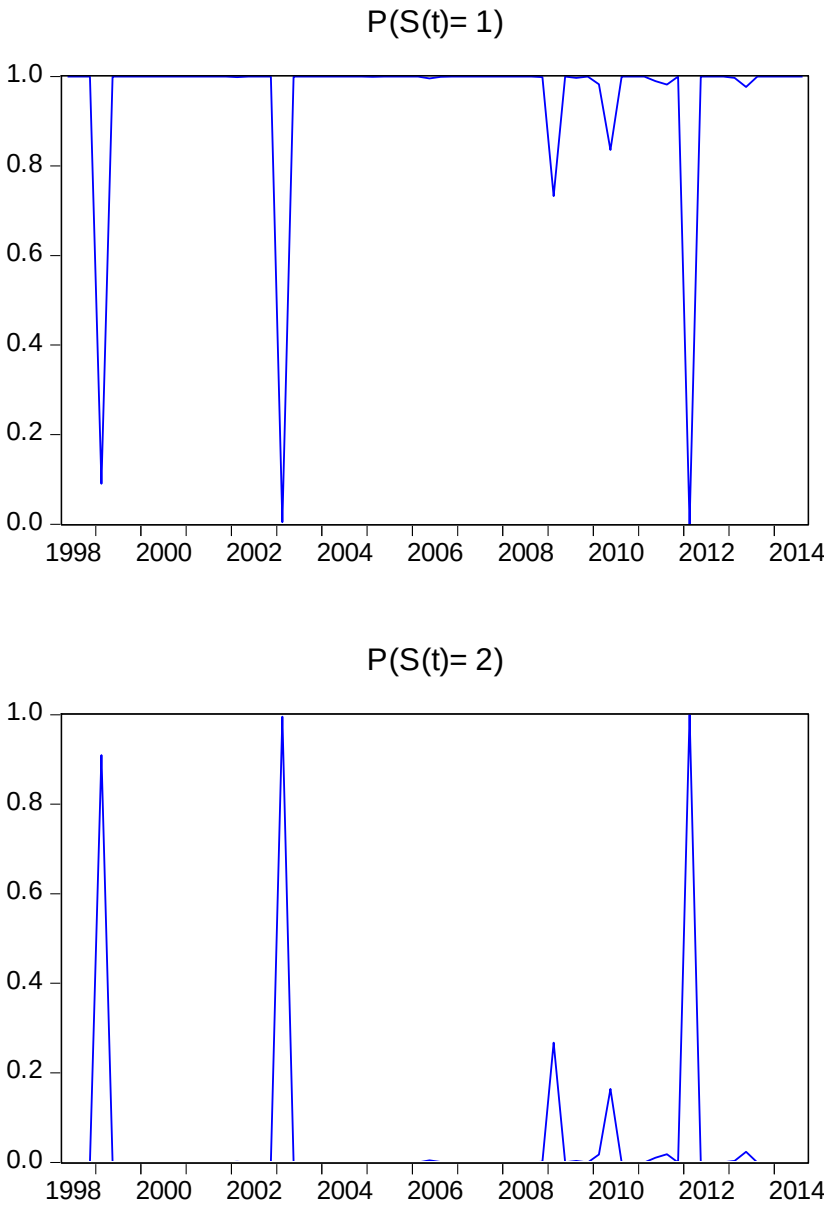


Chart 4.4: Italian OFI

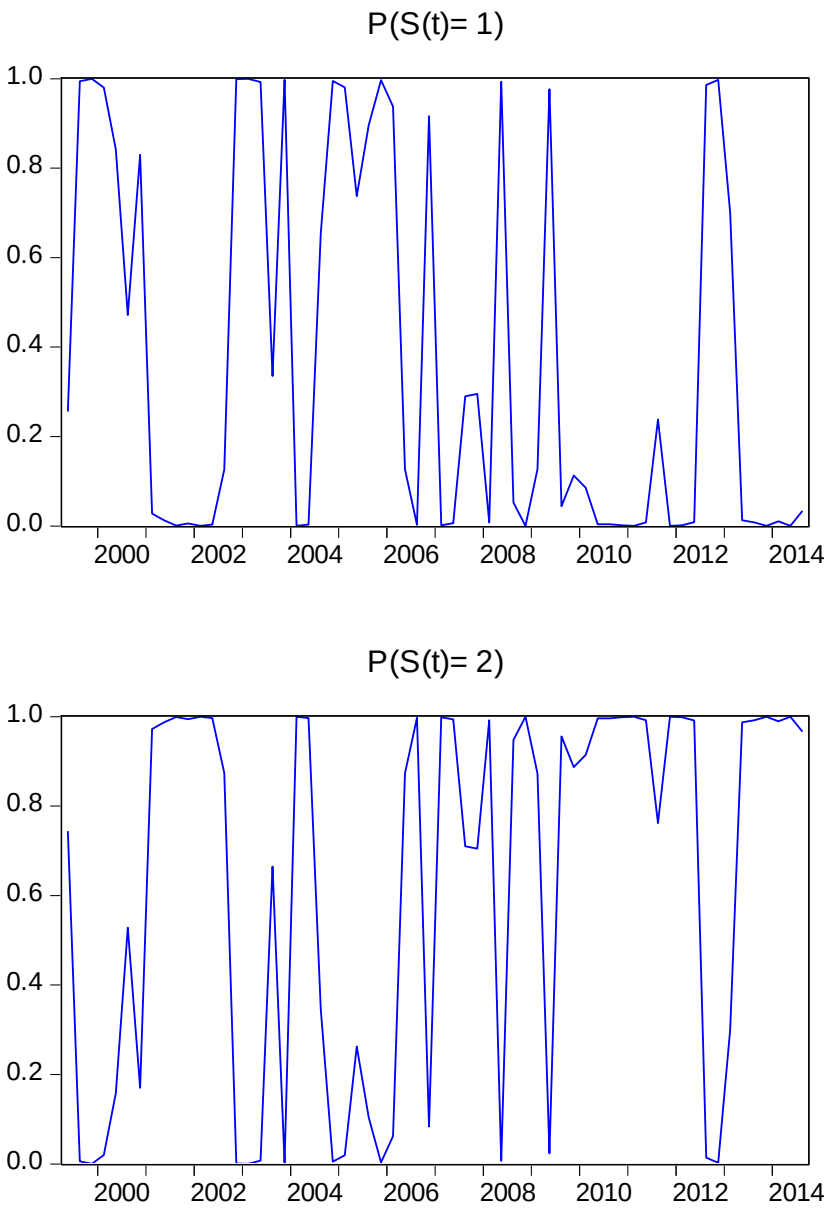


Chart 4.5: Irish OFI

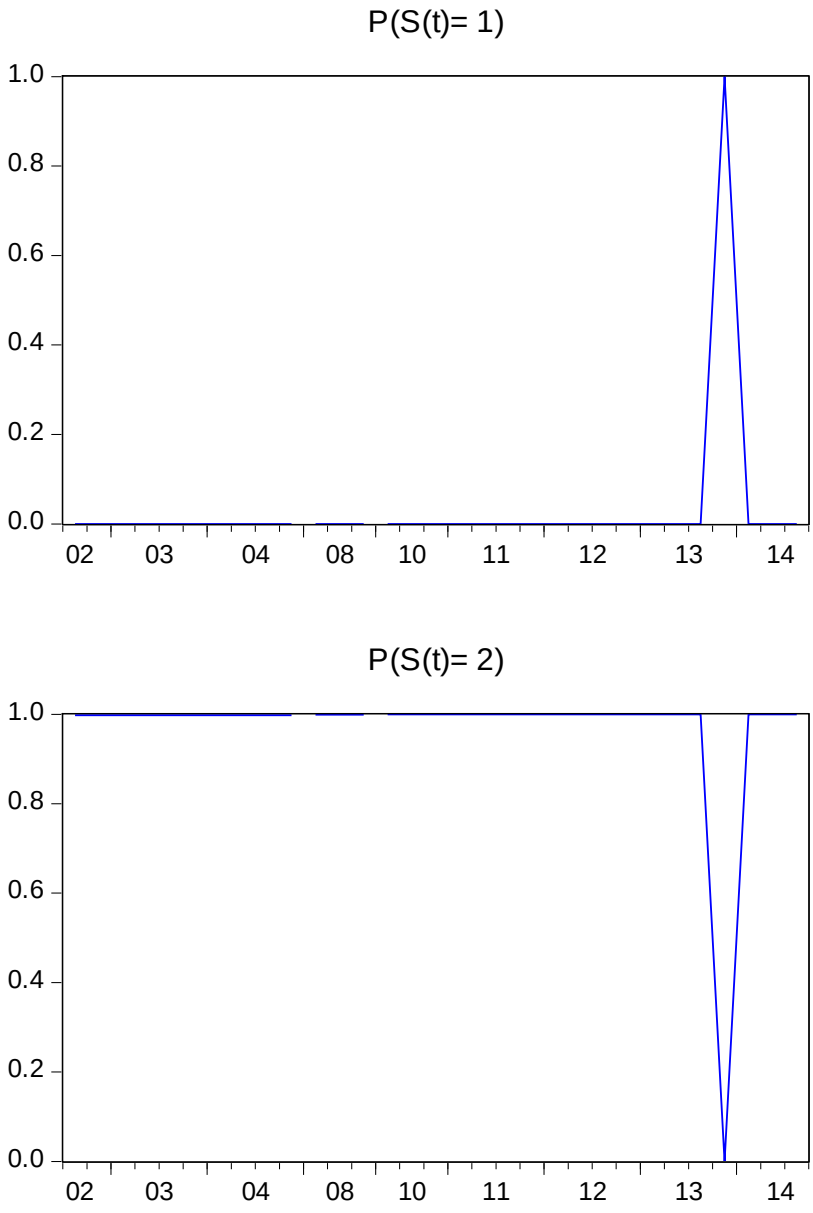


Chart 4.6: Ireland banks

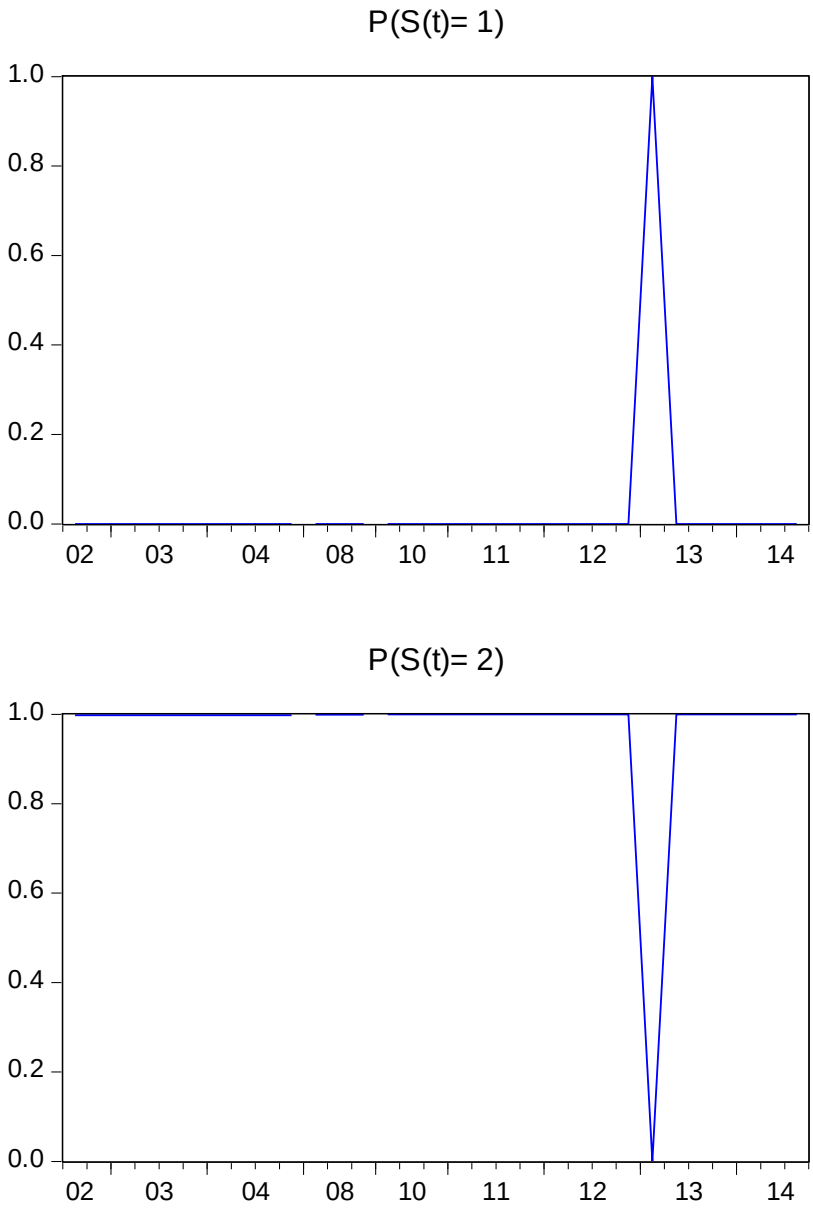


Table 8: Regime switching equations

	Spain banks		Spain OFI		Italy		Italy OFI		Ireland		Ireland OFI	
	regime 1	regime 2			regime 1	regime 2			regime 1	regime 2	regime 1	regime 2
C	0,01	0,19 ***	0,07 ***	0,00	0,00	0,15 *	-17,90 ***	13,33 ***	0,00	0,19 ***	2,60 ***	-0,10
COINTEQ01	-0,01 ***		-0,02 **		-0,02		4,44		-0,03 **		-0,02	
D(CONSCON	0,00		0,002 **		0,05		-1,30 ***		0,00		-0,01	
D(10Y(-1))	-0,03		0,02 **		0,05 *		7,70		0,02 **		0,15 *	
LOG(SIGMA)	-2,95 ***		-3,7 ***		-3,20 ***		2,42 ***		-2,48 ***		-1,27 ***	
P11-C	3,25 ***		1,66 **		2,46 **		0,39		4,2 **		-22,50	
P21-C	0,28		-3,17 ***		24,5		-1,18 **		18,1		-3,36 ***	
* indicates significance at the 10% level, ** at the 5% level and *** at the 1% level												
AIC	-2,56		-3,72		-2,75		8,83		-1,24		1,16	
DW	2,09		1,66		1,97		1,92		2,08		1,91	
Expected du	26,96	1,75	6,28	24,79	12,79	2,3	2,48	4,24	2,7	29,8	2,1	27,8
In all cases, switching variable confidence intervals do not overlap even at the 10% confidence level												
Transistion probabilities												
P11	0,96		0,95		0,87		0,76		0,97		0,97	
P12	0,04		0,04		0,13		0,23		0,03		0,03	
P22	0,42		0,84		0,1		0,59		0,03		0,03	
P21	0,57		0,16		0,9		0,41		0,97		0,97	

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