The "Greatest" Carry Trade Ever?

Understanding Eurozone Bank Risks

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Abstract

This paper argues that the European banking crisis can in part be explained by a "carry trade" behavior of banks. Factor loading estimates from multifactor models relating equity returns to GIPSI (Greece, Ireland, Portugal, Spain and Italy) and German government bond returns suggest that banks have been long peripheral sovereign bonds funded in short-term wholesale markets, a position that generated "carry" until the GIPSI bond returns deteriorated significantly inflicting significant losses on banks. We show that the *positive* GIPSI factor loadings reflect actual portfolio holdings of GIPSI bonds in the cross-section of banks; and, the *negative* German loading reflects funding risk (flight away from bank funding to German government bonds), a risk that is increasing in the US money market mutual fund exposures of European banks as well as various proxies for bank short-term debt. Large banks and banks with low Tier 1 ratios and high risk-weighted assets had particularly large exposures and even increased their exposures between the two European stress tests of March and December 2010 taking advantage of a widening of yield spreads in the sovereign bond market. Over time, there is an increase in "home bias" – greater exposure of domestic banks to its sovereign's bonds – which is partly explained by the European Central Bank funding of these positions. On balance, our results are supportive of moral hazard in the form of risk-taking by under-capitalized banks to exploit low risk weights and central-bank funding of risky government bond positions.

Keywords: Sovereign debt crisis, banking crisis, risk-shifting, regulatory arbitrage, home bias

JEL Classification: G01, G21, G28, G14, G15, F3

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"And of course, the deterioration of the Euro zone situation and particularly the sovereign crisis in the peripheral economies hit very badly the group. And that's of course not a surprise for a group that still had very important short-term funding needs that was mainly present in strong exposures in peripheral countries. [...] Before 2008, it was the group's high rating granting easy access to wholesale funding that led to the situation of October 2008 with short-term funding need of €260 billion outstanding in October 2008, i.e. 43% of total balance sheet. [...] with very significant acceleration and buildup of the bond portfolio was amounting at €203 billion at the end of 2008. Mostly carry trades with marginal improvement of customer access [...] that led to a very significant gearing ratio because the portfolio size was, at that time, 25 times the group equity." - Pierre Mariani, Chairman of the Management Board and CEO, Dexia SA, Earnings Call, February 23rd, 2012

1. Introduction

The ongoing sovereign debt crisis in Europe has cast doubt on the solvency of European banks that incurred substantial mark-to-market losses and impairments on their peripheral (Greece, Ireland, Portugal, Spain and Italy, or GIPSI) sovereign bond holdings. Since mid-2008, government bond yield spreads between pairs of European countries, for example, between German bunds and GIPSI bonds, have widened considerably, mirroring the economic divergence between these countries (Figure 1).[1] This divergence has challenged even the survival of the Eurozone as a whole. Since then, banks have on average lost 70% of their market value and shed billions of euros of assets in an effort to increase regulatory capital ratios.

[Figure 1]

We show in this paper that banks' risks during this period can be understood as reflecting a "carry trade" behavior. With access to short-term unsecured funding in wholesale markets, banks appear to have undertaken long peripheral sovereign bond positions. On the upside, the trade would pocket the "carry", the spread between the long-term peripheral sovereign bonds and banks' short-term funding costs. On the downside, which has materialized, the spreads between two legs of the trade diverged even further resulting in significant losses for banks and

[1] For almost a decade prior to this, the ten-year sovereign bond yields for these countries hovered around the four percent benchmark with a small yield spread difference between core and peripheral European countries.

leading to questions in funding markets about their solvency and liquidity. In essence, this carry trade reflects a bet that Eurozone countries would converge economically resulting in a convergence of the spread between its two legs.

Dexia SA (Dexia), a Belgian financial group and one of the largest lenders to public sector entities, provides a quintessential example of such behavior as it invested heavily in these carry trades (see the introductory quote). Dexia built up a risky bond portfolio of almost a third of the bank's total balance sheet which was financed almost 50% with short-term funding. As the quality of the bond portfolio worsened, Dexia was unable to roll over the financing of its assets and was bailed out in October 2011. Dexia is not an isolated case. Bank of Cyprus more than quadrupled its investments in Greek government bonds in 2010 as Greek bonds were among the highest yielding sovereign bonds and financed its investment with short-term funds obtained from the ECB in 2009.

We document that this behavior has in fact been pervasive among Eurozone banks. We investigate the causes of the European banking crisis and argue that banks' substantial share price decline can in part be explained by banks placing a bet on the survival of the Eurozone, choosing to hold peripheral sovereign bonds and financing their investments in short-term wholesale markets. While correlations between bond yields of Germany (or France) and peripheral sovereign bond yields were above 95% in 2005, these correlations became negative in 2010 when markets became more reluctant to finance banks' investments in risky sovereign debt resulting in a flight into longer-term core European (particularly German) government bonds. In other words, the banks lost on both sides of the carry trade.

At the core of our analysis are the publicly listed banks that took part in five consecutive stress tests conducted by the European Banking Authority (EBA) starting in 2010 and ending in June 2012. March 2010 is the first reporting date as of which detailed information about

European banks' sovereign bond holdings is available. We document interesting patterns in the sovereign bond holdings of banks. Our data show that European banks already entered the stress test period with a substantial exposure to GIPSI sovereign debt which overall remains remarkably constant over the next two years. However and more importantly, GIPSI and non-GIPSI banks appear to have actively managed their sovereign bond portfolios by *increasing* their sovereign bond exposures to Italy, Spain and Portugal even as yield spreads on these countries' debt widened between March and December 2010. S&P downgraded Spanish bonds to AA from AA+ in April 2010 pushing yield spreads for ten-year sovereign bonds higher than (worse rated) Italian bonds. Our results indicate that banks with lower Tier 1 ratios, higher risk-weighted assets and larger loan-to-asset ratios increased their holdings particularly in Spanish sovereign bonds between March and December 2010. Interestingly, non-domestic banks increased their exposure more relative to domestic banks. For example, non-Spanish banks increased their Spanish sovereign bond positions by 66% between March 2010 and December 2010. This behavior rules out the alternative that banks were *passively* caught in the sovereign debt crisis due to exposures to peripheral sovereign debt prior to the emergence of Irish and Greek sovereign crises in 2009.

However, this active trading behavior reversed (only as late as) between January 2012 and June 2012, when domestic (Italian and Spanish) banks substantially increased their exposure to their domestic sovereign, while non-domestic banks even decreased their holdings. The European Central Bank (ECB) injected about EUR 1 trillion with a maturity of three years and a 0.75% coupon into the banking system in two three-year Long Term Refinancing Operations (LTROs) in December 2011 and February 2012 facilitating these trades. We document that Italian banks purchased domestic sovereign bonds for EUR 28.6 billion with a maturity of equal or below three years which is consistent with a match of the maturities of the securities they purchase with the

maturity of the ECB funds. Spanish banks also increased their exposures to Spanish government, albeit in smaller magnitudes. Non-Italian and non-Spanish banks reduced their exposures.

Overall, the descriptive evidence based on reported sovereign bond holdings imply an overall increase in risk exposure towards peripheral sovereign debt for both GIPSI and non-GIPSI banks during March 2010 and December 2010, and a shift in this risk exposure from non-GIPSI banks into GIPSI banks' portfolios between January 2012 and June 2012.

Micro level data of sovereign bond positions (except for the five EBA reporting dates) are unavailable to us on a high-frequency basis. Furthermore, banks may be exposed to sovereign bond risk other than through direct bond positions, e.g., through credit default swap positions and counterparty exposure in derivatives transactions with governments. Given this limitation and to link bank risk to both the investment and funding leg of the carry trade, we collect daily stock prices for these banks as well as daily ten-year sovereign bond yields over the January 2007 to June 2012 period. We then use the cross-sectional (across banks) and time-series (within bank) patterns in the correlations between banks' stock returns and sovereign bond returns to impute the effective exposure of banks to sovereign debt.

We find a significant positive correlation between banks' stock returns and GIPSI bond returns and a negative correlation with German bund returns. European banks are thus effectively, on average, long GIPSI government bonds and their stock returns decline when bond prices depreciate. The negative loadings on German government bonds (bunds) suggest that banks are "short" long-term German bunds. If long-term German bund prices appreciate whenever short-term funding dries up (due to a flight to safety or quality) and banks are exposed to short-term funding, then it would appear as if banks were "short" long-term German bunds. In other words, these results suggest that banks were financing long-term peripheral bonds with short-term debt in a carry trade.

We then show that these exposures relate to banks' actual government bond holdings rather than non-sovereign exposures (to firms, households and real estate). These results confirm that the factor loadings measured using market data proxy well for the underlying European banks' exposure to sovereign debt. Similarly, we document cross-sectional differences in the factor loadings on German bunds across banks arising from their short-term funding exposure, particularly through US money market funds (MMF)[2] but also using various other proxies such as short-term over total debt and repurchase agreements (with banks and central banks) over total assets. Stock returns of banks with more short-term funding risk are much more sensitive to German bund returns.

We then explore incentives for banks to engage in carry trades, namely: (1) implicit bailout guarantees, (2) risk shifting by under-capitalized banks, (3) regulatory capital arbitrage, and (4) European Central Bank (ECB) funding, which might have all – individually or in conjunction – made these trades more attractive for banks. We find that larger banks are significantly more exposed consistent with large banks exploiting an implicit bailout guarantee from their sovereign. Also, banks with greater leverage, and in particular, a higher percentage of short-term leverage relative to total debt, have somewhat higher exposure to GIPSI countries and lose significantly greater market value when German bond prices appreciate.

The regulatory capital arbitrage motive arises under the current Basel II regulations which assign a zero risk weight for investments in sovereign debt. The governments may themselves have had incentives to preserve the zero risk weight to be able to continue to borrow.[3] Undercapitalized banks, that is, banks with low Tier 1 capital ratios, now have an incentive to

[2] The dependence on US money market funds (MMF) by European banks for US-Dollar funding potentially poses a threat to their (short-term) liquidity and could be transmitted to other financial institutions or the real economy (Chernenko and Sunderam, 2012, and Ivashina, Scharfstein and Stein, 2012).

[3] The more entangled the financial sector with the governments, the more costly the government default would be due to "collateral damage" in the form of bank runs and disruption of inter-bank and repo markets (Broner, Martin and Ventura, 2010; Bolton and Jeanne, 2011 and Acharya and Rajan, 2011).

increase short-term return on equity by shifting their portfolios into highest-yielding assets with lowest risk weights in an attempt to meet the regulatory capital requirements without having to issue economic capital (regulatory capital arbitrage).[4] Moreover, riskier banks might shift into riskier government bonds placing a bet on their own survival (risk shifting) as this way they shift risk into the states of the world (government defaults) where they are likely to experience bank runs (as argued by Diamond and Rajan, 2011). While the regulatory arbitrage incentive would be stronger both for GIPSI and non-GIPSI banks, the second incentive would be stronger for domestic banks of GIPSI countries. We focus in our analysis of these incentives on Italy and Spain as largest bond markets among the GIPSI countries and find that banks with lower core Tier 1 ratios or higher risk-weighted assets have greater exposure to GIPSI bonds. This is reflected in both higher sensitivities of banks' equity to GIPSI bond returns as well as higher (reported) bond holdings by riskier and weakly capitalized banks, for banks of both GIPSI and non-GIPSI countries, lending support to the presence of regulatory arbitrage incentives.

Finally, we provide a large number of falsification tests based on GIPSI and German government bond exposures of returns of banks in the US and the UK, global macro hedge funds, and non-financial firms in GIPSI as well as non-GIPSI countries. These tests suggest that the return exposures consistent with a carry trade behavior were specific to banks and not to hedge funds or industrial firms, and specific to Eurozone banks and not to banks of other Western economies. This is potentially due to the funding "put" from domestic central banks and European Central Bank against Eurozone sovereign collateral, available only to Eurozone banks.

Our paper is related to the literature investigating the yield-chasing investment behavior of financial institutions. Becker and Ivashina (2012) analyze the investment behavior of insurance firms and document a reaching for yield behavior due to agency frictions. Kacperczyk and

[4] See Acharya, Engle and Pierret (2013) for a formal derivation of this perverse incentive when banks disregard risks arising from earning returns on capital subject to a risk-weight based capital requirement scheme.

Schnabl (2013) analyze the investment behavior of US MMF and find that these funds invested in riskier securities searching for yield as money inflow was responsive to fund yields. Fischer et al. (2012) focus on the investment behavior of German Landesbanken and document a searching for yield due to risk shifting incentives after the announcement that government guarantees will be revoked. We show in our paper that yield chasing by European banks implies investing in high yielding long-term government debt financed with low yielding short-term wholesale funds which ultimately leaves the banks exposed to risky assets and high funding risk.

It is also related to the literature highlighting that regulatory arbitrage is an important motive for banks' investment and financing decisions. Acharya, Schnabl and Suarez (2011) investigate the widespread use of conduits in the securitization process and find evidence consistent with regulatory arbitrage: Most conduits were set up with capital reducing liquidity guarantees, they were particularly initiated by weakly capitalized commercial banks, and risks were not transferred to investors but losses were rather booked by the guarantee issuing institutions.[5] Boyson, Fahlenbrach and Stulz (2013) analyze the use of trust preferred securities by US bank holding companies as part of their regulatory capital and also find evidence consistent with a regulatory capital arbitrage motive.[6] Acharya, Engle and Pierret (2013) compare the results from macroprudential stress tests both in the US and Europe with stress tests based on market data. They conclude that the reliance on regulatory risk weights in the original stress tests is in part responsible for the undercapitalization of the banking sector creating incentives for banks to invest in low risk-weight assets.

[5] Acharya and Richardson (2010) also emphasize the importance of regulatory capital relief in explaining the huge increase in securitization schemes of banks.

[6] The Collins amendment to the Dodd-Frank Act requires that any trust preferred securities issued after May 19th, 2010 do no longer count towards Tier 1 capital which effectively eliminates the regulatory capital arbitrage using these instruments.

The paper relates more broadly to the literature on risk shifting incentives of firms (Jensen and Meckling, 1976). Several theoretical studies emphasize banks' incentives to shift into riskier assets. Furlong and Keeley (1987, 1989), for example, show that banks increase asset risks if they have higher leverage. Keeley (1990) shows that increased competition among banks induces risk shifting because of lower charter values. Relatedly, Hellman, Murdock and Stiglitz (2000) argue that banks have higher gambling incentives if they are poorly capitalized. The Japanese experience from the 1990s provides supporting evidence. Undercapitalized Japanese banks followed a policy of regulatory forbearance extending loans to troubled borrowers to avoid their insolvency and subsequent capital write-downs (Peek and Rosengren, 2005; Hoshi and Kashyap, 2010). Particularly affiliated banks channeled funds to these firms instead of giving credit to high quality firms betting that the banks were going to be bailed out by the government if the firms eventually defaulted (Caballero, Hoshi and Kashyap, 2008).

The paper proceeds as follows. Section 2 discusses Dexia as the quintessential example of carry trade behavior, explains the data sources and provides some descriptive statistics. Section 3 provides portfolio level evidence on sovereign bond exposures. Section 4 presents our carry trade exposure estimates from multifactor models and various robustness tests to demonstrate their validity. In Section 5, we relate our carry trade estimates to reported sovereign bond holdings as reported by the EBA and measures of short-term funding risk. In Section 6, we explore incentives of banks to invest in carry trades. Section 7 concludes with policy implications.

2. Background and Data

A. Carry Trades Gone Wrong - Dexia and Bank of Cyprus

Dexia SA was formed in 1996 through a merger of Crédit Local (France) and Crédit Communal (Belgium). In October 2011, the Dexia Group was bailed out for a second time because of carry trades that went wrong (see the quote of Dexia's current CEO at the start of the paper). This section provides a brief overview how the situation unraveled.

Dexia built a proprietary bond portfolio amounting to EUR 203 billion at the end of 2008 (about 32% of its balance sheet).[7] These investments were carry-trades, financed in short term wholesale markets. The bond exposure was mainly to fixed rate bonds and Dexia hedged the interest rate risk using credit derivatives. Effectively, Dexia was short German bunds in the Total Return Swap market betting on an increase in bund yields.

The sovereign debt crisis started in November 2009 when Greece forecasted an annual budget deficit of 12.7% for 2009. During the following months, Greece, Portugal and Spain announced first austerity measures to reduce their indebtness. Spain was downgraded by S&P losing its AAA rating in April 2010 and Greece was downgraded below investment grade. In May 2010, the Eurozone countries and the IMF agreed to the first EUR 110 billion bailout package for Greece. On May 5th, the ECB announced that it had started to accept Greek sovereign bonds as collateral independent of the rating responding to the tensions in funding markets. The European Commission explicitly addressed its concerns with respect to the large amount of sovereign debt in Dexia's portfolio and the use of interest rate derivatives which "probably requires significant collateral for Dexia, which may reduce its eligible collateral base for financing from the central banks or in the interbank repo market" (EC (2010)).[8]

[7] Holding a large amount of securities given Dexia's funding imbalances was even encouraged by rating agencies: "Dexia's widely diversified funding base and the liquidity reserve provided by its large securities portfolio offset its reliance on wholesale capital markets." (S&P Ratings Direct, 22 May 2008).

[8] Dexia held a portfolio of GIPSI sovereign bonds amounting to EUR 26.1 billion as of March 31st, 2010 consisting mainly of Italian bonds (EUR 17.6 billion) and Greek government bonds (EUR 3.7 billion). The size of the sovereign bond portfolio corresponds to almost three times of its book equity. Importantly, Dexia has kept the positions unchanged since then.

Even though Dexia made considerable progress in reducing its dependence on short-term wholesale funding and in reducing its overall balance sheet, it was poorly capitalized (given the huge impairments due to the deleveraging process) in summer 2011[9], i.e. when the crisis became worse, which contributed to the subsequent run on the bank. Moreover, both Moody's and S&P placed Dexia's ratings under review for possible downgrade. As reported by the group, EUR 22 billion in unsecured short-term funds have been withdrawn between April and June 2011 and their US Dollar position has been impacted first. Figure 2.A. shows that US Money Market Mutual Funds (MMF) reduced their holdings of Dexia's commercial papers and repos within a few months in spring 2011 from about USD 10 billion to zero after rating agencies have put Dexia on watchlist for possible downgrade.

[Figure 2]

Stock prices plunged following this liquidity shock. Consequently, Dexia needed to rely increasingly on central bank funding which reduced the amount of available collateral for further repo transactions.[10] Figure 2.B. shows the pairwise correlation of Dexia's stock return and Italian sovereign bond returns and its stock return and German sovereign bond returns from January 2011 onwards. This graphic shows strikingly how the two legs of the carry trade diverged when Italian yields surged and German bund yields continued to fall as investors continued their flight into long-term German government bonds. Dexia lost about EUR 40 billion short-term funding within 6 month in the second half of 2011. An additional EUR 6 billion unsecured short-term funding was withdrawn during the July - September period, and another EUR 6 billion after Moody's announcement of placing the group's long and short-term rating under review for

[9] Dexia's Tier 1 ratio fell to 7.56% at end of 2011 due to losses incurred while Dexia divested its assets.
[10] The ratio of repurchase agreements with the ECB over total repurchase agreements almost doubled between 2010 and 2011.

possible downgrade on October 3rd, 2011. Moreover, the group lost commercial deposits of EUR 7 billion in the fourth quarter of 2011.

Figure 2.C. shows the 1-year CDS spread of the banking subsidiary Dexia Crédit Local. The CDS spread increased within a few weeks after June 2011 from 200bps to 1,000bps reflecting its rise in short-term funding costs as well as the market expectation of Dexia's default probability over the next year. Dexia's derivative positions put even more pressure on short-term liquidity. Between June and September 2011, Dexia had to post EUR 15 billion cash collateral due to the fall in interest rates. On October 7th, Dexia incurred an additional EUR 16 billion margin call but was unable to post the collateral and eventually was bailed out by the governments of Belgium, France and Luxembourg. The government assured debtholders as well as swap counterparties that they would not incur any losses in order not to trigger a default event. This is similar to September 2008, when the US government bailed out American International Group (AIG). Also in the case of Dexia, governments were concerned with massive losses that had to be booked by the (unidentified) counterparties emphasizing the systemic importance of Dexia. Figure 2.D, shows Dexia's stock price decline when the carry trade and Dexia eventually went under. Dexia was bailed out a third time in November 2012 and the European Commission extended an additional EUR 85 billion refinancing guarantee to restructure Dexia in December 2012.

Dexia is not an isolated example. The bailout of Cyprus to rescue its two failing banks Bank of Cyprus (BOC) and Cyprus Popular Bank provides the most recent example how aggressive yield chasing by banks in the form of investing in risky sovereign debt brings an entire country at the verge of collapse. A recent investigation by the Cypriot central bank into the

activities of Bank of Cyprus (BOC) showed that BOC purchased about EUR 2 billion Greek government bonds in 2010 increasing its holdings to about EUR 2.4 billion (A&S, 2013).[11]

Based on internal emails from BOC employees they infer the motives behind these purchases. The existing non-performing loan portfolio eroded the profitability of the firm. BOC thus purchased Greek government bonds to pursue an "absolute yield" strategy to deliver net interest income and "relative value" strategy to take advantage of selling opportunities to generate gains around reporting dates ("window dressing"). They invested in amongst the highest yielding bonds including longer maturity inflation linked bonds, which resulted in BOC ultimately experiencing higher losses on account of the related hedging that was entered. Hedges were put in place to swap longer dated bonds onto floating rates and maintain target durations.[12]

This carry trade was funded by the ECB. On December 16th, 2009, BOC applied and received EUR 3 billion of ECB funding in a 1-year LTRO. The funds were not required to fund the bank's existing balance sheet, but was obtained to invest in government and / or government guaranteed bonds. Shortly thereafter, on Dec 21, 2009, BOC approved an increase in the overall limit of the banks' bond portfolio to EUR 6 billion, which limits for investment in Greek and Cypriot bonds set at 2 billion each. The yields on Greek and Cypriot were significantly higher than interest rates on the ECB funds, and thus the ECB funding provided BOC with the opportunity to increase net interest income.

[11] The data published by the EBA shows a consistent increase in Greek bond exposure.

[12] Total losses as a result of BOC's Greek government bond holdings amounted to EUR 1.9 billion on 16 November 2012: EUR 910 million relate to the costs of restructuring due to the Private Sector Involvement program (PSI); EUR 562 million relate to mark to market adjustments on the new bonds; EUR 48 million relate to transfers from Available for Sale (AFS) reserves; EUR 399 million relate to the costs of unwinding hedges related to the bonds.

B. Data Sources

To identify the effects of banks' carry trades on stock returns, we construct a dataset using three major data sources. We collect market information (bank stock prices, bank and sovereign CDS spreads, and sovereign bond yields) from Bloomberg, information about bond portfolio holdings from the European Banking Authority (EBA) and annual and quarterly reports from the banks, and financial information from SNL Financial as well as company reports. We augment the data with information from S&P Credit Portal, investor presentations and the European Central Bank and Bank of International Settlement (BIS).

We start with all public European banks included in the EBA stress tests. A list of these banks is included in Appendix II.[13] We collect financial information such as size, leverage and capitalization from SNL Financial. In addition, we compute stock returns from daily stock prices. We use ten-year benchmark government bond yields, which are observed on a daily basis. Stock prices and bond yields are collected from Bloomberg.

Information about banks' actual portfolio holdings of sovereign bonds is obtained from the EBA. The EBA took over the responsibilities from the Committee of European Banking Supervisors (CEBS) on January 1, 2011. They have been responsible for five stress tests and capitalization exercises that have been conducted in the European banking market since 2010 to "ensure the orderly functioning and integrity of financial markets and the stability of the financial system in the EU."[14] The results of the tests together with detailed information about banks

[13] We exclude six banks from our analysis either because of data availability or because the bank is part of a banking group where the parent owns the vast majority of stocks. These are: Bankia (BKIA), Raiffeisenbank International AG (RBI), Österreichische Volksbanken AG (VBPS), Caja de Ahorros del Mediterraneo (CAM), Hypo Real Estate (HRX) and Irish Life and Permanent (IPM).

[14] The first stress test was already performed in 2009, but neither the identity of the participating institutions nor details about the results have been disclosed except for the information that all institutions were adequately capitalized.

sovereign bond portfolios were published for the following reporting dates: (1) March 2010, (2) December 2010, (3) September 2011, (4) December 2011 and (5) June 2012.[15]

We use the iMoneyNet database to collect monthly information about the holdings of US Money Market Mutual Funds (US MMF) in European banks' commercial paper and repurchase agreements (repos). As a consequence of the financial crisis, the SEC approved changes to Rule 2a-7 of the Investment Company Act of 1940 in 2010 and took other actions to strengthen the regulatory framework that governs MMFs. Following SEC regulation, US MMFs have to report monthly market-to-market net asset value per share (NAV) of their portfolios on Form N-MFP which is then published by the SEC. We can access the data from November 2010 onwards.

C. Summary statistics

We provide descriptive statistics for the returns of GIPSI as well as German ten-year government bonds in Table 1. Panel A of Table 1 shows the mean daily bond returns since January 2007 in basis points (bps). Greek government bonds have the highest negative return as well as the highest variance followed by Portugal and Ireland. All three countries have already been bailed out by the European Union. Germany has positive daily returns with a small variance.

[Table 1]

Panel B (Panel C) reports bond return correlations between 2001 and 2007 (2007 and 2012). In the period between 2001 and 2007, bond returns were almost perfectly correlated. This demonstrates that these countries were perceived by investors as being almost identical despite the major economic differences between them. Greece and German government bond returns, for example, had a correlation of 0.99. This changed significantly as the sovereign debt crisis

[15] The data is publicly available on the website of the EBA (http://www.eba.europa.eu/Home.aspx).

unfolded. Between 2007 and 2012, the bond return correlation among the GIPSI countries declined and the correlation between GIPSI and German bond returns became negative showing the divergence within the Eurozone and the flight to quality.[16]

Panel A of Appendix III lists the averages of key variables for each bank. Log-Assets is the natural logarithm of total book assets. Loans / Assets is measured as total customer loans divided by total assets. ST-LVG is short-term debt divided by total debt. RWA / Assets is risk-weighted assets divided by book assets. Tier 1 is the Tier 1 capital divided by risk-weighted assets. On average, 33% of the total debt is short-term debt and banks have a Tier 1 ratio of 10.15%. Panel B of Appendix III provides time-series characteristics of banks' stock returns and CDS prices observed on a daily basis. The average daily realized return is -13.21 bps and the average five-year CDS spread is about 185 basis points.

3. How Did Banks Manage their GIPSI Exposure? Portfolio Level Evidence

A. Sovereign bond holdings

The carry trade hypothesis suggests that banks exploited a widening of yield spreads betting on their subsequent convergence while short-term funding was still available. The incentives were particularly strong for weakly capitalized banks to shift their portfolios into riskier assets and to improve their regulatory capital without the costs of raising fresh equity as these exposures had zero capital requirements. However, there are alternative explanations for these findings. For example, it could be that European banks did not increase their exposure to GIPSI sovereign debt but they are they simply holding on to their pre-crisis holding, that is, before the spreads widened ("inertia hypothesis"). European banks' exposure to GIPSI countries

[16] We explore further time-series characteristics of GIPSI bond yields. The time-series are non-stationary but first differenced time-series are. GIPSI bond yields are thus integrated of the order of 1 (I(1)). We test the co-integration relationship between, for example, Italian government bond and German government bond yields and find that there is no co-integrating relationship in the period starting in Q4 2009.

might also simply reflect a home-bias of banks holding domestic sovereign debt ("home bias hypothesis").

The EBA disclosed the sovereign bond holdings of European banks at five reporting dates during the March 2010 to June 2012 period which provides first evidence that helps to analyze banks' behavior as to investments in risky sovereign debt and to disentangle the different hypotheses. Table 2 shows a highly aggregated statistic of European banks' sovereign bond holdings at five reporting dates since March 2010 both for the full sample (Panel A) and separately for GIPSI and non-GIPSI banks (Panel B).

[Table 2]

We document four important findings: First, European banks entered the sovereign debt crisis with a substantial exposure to peripheral sovereign debt and their total exposure towards Italian, Spanish and Portuguese government debt did not decrease substantially during the March 2010 to June 2012 period. For example, Italian government bond positions decreased only from EUR 264.5 billion to EUR 258.9 billion. Second, we observe an *increase* in GIPSI and non-GIPSI banks' exposure to Spanish, Italian and to some extent also Portuguese sovereign debt between March and December 2010 when yield spreads widened (compare Figure 1). Non-GIPSI banks even increased their exposure to Spanish sovereign debt more than GIPSI banks in absolute euro amounts. Spanish bond yields surged above Italian bond yields after Spain was downgraded by S&P in April 2010 despite a higher rating of Spain vis-à-vis Italy. In other words, banks were not *passively* caught by the emergence of the sovereign debt crisis as suggested by the inertia hypothesis, but *actively* increased risky sovereign debt positions in their portfolios. This also rules out the alternative home bias hypothesis that our results are driven by peripheral

banks' exposure to their home country. Particularly non-GIPSI banks were increasing their exposure to peripheral sovereign debt during this period.[17]

Third, we observe a further substantial exposure increase to GIPSI sovereign debt in the portfolios of GIPSI banks between December 2011 and June 2012. For example, Italian banks invested about EUR 37 billion in domestic sovereign debt; Spanish banks increased their exposure to Spanish government debt by about EUR 13 billion. Non-GIPSI banks, on the other hand, kept their exposures largely unchanged during this period.[18] In December 2011 and February 2012, the ECB injected about EUR 1 trillion of liquidity into the banking system at a coupon of 0.75% and with a maturity of three years. Fourth, due to a substantial reduction of GIPSI sovereign debt in non-GIPSI portfolios in 2011 and a relatively larger increase of exposures in non-GIPSI bank portfolios (particularly during December 2011 and June 2012), we observe a shift in risk exposure towards peripheral sovereign debt from non-GIPSI banks into GIPSI banks' portfolios. Nonetheless, non-GIPSI banks keep a substantial exposure to peripheral sovereign debt and our findings suggest that banks were actively purchasing these securities after yield spreads widened in search for returns.

B. Increasing sovereign exposures: Moral hazard vs. home bias

In this sub-section, we investigate more generally European banks' incentives to purchase GIPSI sovereign debt after emergence of the sovereign crisis end of 2009 and how bank behavior has changed between March 2010 and June 2012. To do this, we analyze the change in banks' sovereign bond holdings (1) by domestic vs. non-domestic bank, (2) by bank risk and (3) by bond maturity. The results are reported in Table 3.

[17] Our introductory example "Bank of Cyprus" demonstrates this active yield searching behavior in Greek government bonds in 2010.
[18] Note that Greek banks did not participate in the stress tests or capitalization exercises since September 2011.

[Table 3]

Panel A of Table 3 reports the absolute change in Italian and Spanish sovereign bond holdings for domestic and non-domestic banks between March and December 2010, January to December 2011 and January and June 2012 as well as the percentage change. Between March and December 2010, non-domestic banks had a higher absolute as well as percentage increase in both Italian and Spanish sovereign debt than domestic banks. For example, non-Spanish banks increased their holdings by 66.34%. Between January and June 2012, non-domestic banks reduced their portfolio exposures towards both countries, whereas domestic (and, in particular Italian) banks purchased a significant amount of the debt of their own sovereign. Particularly non-domestic banks reduced their exposures between January and December 2011.

In Panel B of Table 3, we show the change in Italian and Spanish sovereign debt as a percentage of total assets separately for various risk characteristics. High Tier 1, High RWA/Assets and High Loans/Assets are indicator variables equal to 1 if the banks' Tier 1 ratio (RWA/Assets ratio, Loans/Assets ratio) is within the lower (upper) quartile of the distribution among all sample banks. For example, banks with a Tier-1 ratio below 9.03% (the 25% quartile) increase their Italian bond holdings, on average, by 0.49% of total assets between March and December 2010. Overall, we find that banks with low Tier-1 ratios, high RWA / Assets and high Loans / Asset ratios, that is banks with higher incentives to gamble and for regulatory arbitrage, increase their exposure to Italian and Spanish sovereign debt more relative to other banks.

High Tier 1 banks, for example, decreased their exposure to Italy in 2011 while low Tier 1 banks even marginally increased their holdings. This is intuitive as those banks have capital to support reinvesting in assets with higher RWA and absorb possible write-offs from divesting Italian sovereign bonds which have substantially lost in value after Italy has been downgraded to A in September 2011.

While non-domestic banks increased their holdings in Italian and Spanish bonds relatively more than domestic banks between March and December 2010, this trend reversed between January and June 2012. Domestic banks increased their holdings while non-domestic banks even decreased their sovereign bond exposures. These results indicate an increase in home bias in the first half of 2012 which has been funded by the ECB. In December 2011 and February 2012, the ECB injected about EUR 1 trillion in two three-year LTROs into the banking system at an initial interest rate of 1% at that time.[19] Panel D of Table 3 reports the change in Italian and Spanish sovereign bond holdings of our sample banks between January and June 2012. We aggregate all individual bank exposures to the country level and distinguish between changes in bond holdings with maturities equal / smaller than three years and greater than three years. If banks use LTRO funds for new carry trades and match the maturities of the securities they purchase with the maturity of these funds we expect to see increases in sovereign debt holdings particularly for maturities equal or below three years.[20] The data show that Italian banks increased Italian sovereign bond holdings with a maturity of equal / below three years by EUR 28.6 billion and longer dated bonds by EUR 7.8 billion. Similarly, Spanish banks increased their exposure to Spanish sovereign bonds by EUR 6 billion with a maturity of equal / below three years and EUR 6.6 billion with maturities above three years.[21] Some non-GIPSI banks have increased their exposure, for example, French banks increased their Italian bond holdings by EUR 3.1 billion. Overall, however, these exposure changes were small in comparison to purchases by Italian or Spanish banks and holdings were, on average, rather reduced than increased. Taken together, these results indicate that carry trades with Italian and Spanish

[19] Since then, the interest rate on these funds has decreased to 0.75%.
[20] Note that Panel B of Table 3 reports holding changes. That is, if banks use the funds to simply replace maturing bonds or to replace own funding with ECB funding, this is not recognized in this analysis. Only increases in euro exposures are recognized as "new" carry trades.
[21] However, about EUR 12 billion short term bonds have matured between December 2011 and June 2012, net purchase of Spanish banks were thus about EUR 19 billion.

sovereign debt have been done by domestic banks consistent with the notion that "home bias" has increased over time funded by the ECB.

4. Estimating Banks' Carry Trade Exposure Using Multifactor Models

A. Methodology: Measuring Banks' Carry Trade Exposure

Unfortunately, micro level data of sovereign bond positions are unavailable to us on a high frequency basis. Furthermore, banks may be exposed to sovereign bond risk other than through direct bond positions, for example, through credit default swap positions and counterparty exposure in derivatives transactions with governments. Given this limitation and to link bank risk to both the investment and funding leg of the carry trade, we use multifactor models in which the sensitivities of banks' stock returns to sovereign bond returns are measures of banks' exposure to sovereign debt. The lack of micro level changes in portfolio holdings of banks gives these tests more power and increases the efficiency of the estimates.[22] More precisely, we estimate the following regression

$$R_{i,t} = \beta_{0,i} + \beta_{GIPSI,i} R_{GIPSI,t} + \beta_{Germany,i} R_{Germany,t} + \beta_{m,i} R_{m,t} + \varepsilon_{i,t} \qquad (1)$$

where $R_{i,t}$ is bank i's daily stock return, $R_{GIPSI,t}$ is the daily return on ten-year government bonds from Greece, Italy, Portugal, Spain or Ireland, $R_{Germany,t}$ is the daily return on ten-year German government bonds and $R_{m,t}$ is the daily return of the equity market index in country m in which the bank is headquartered. Because of the co-movement of $R_{m,t}$ and the

[22] Our approach to estimate European banks' sovereign risk exposure is similar to the procedure employed by Agarwal and Naik (2004) to characterize the exposures of hedge funds.

sovereign bond returns of country m and Germany, we orthogonalize $R_{m,t}$ to both return series.[23] Note that the ten-year German government bond is an additional risk factor in our model.

The estimate of $\beta_{GIPSI,i}$ provides an unbiased estimate of the exposure of bank i to GIPSI sovereign debt. A positive factor loading suggests that banks have invested in long-term (peripheral) government bonds. $\beta_{Germany,i}$ is an estimate of bank i's short term funding exposure. The negative factor loading suggests that banks are "short" long-term German bonds. This reflects a "flight to quality" of investors who purchase long-term safe (German) government bonds, at the same time reducing the supply of short-term capital. If long-term bond prices appreciate whenever short-term funding dries up and banks are exposed to short-term funding, then it appears as if banks were short long-term bonds. $\beta_{GIPSI,i} > 0$ and $\beta_{Germany,i} < 0$ is consistent with a "carry trade" behavior of European banks: they appear to have invested in long-term government bonds financed in the short-term wholesale market to maximize the carry between both legs of the trade.

[Table 4]

Panel A of Table 4 provides descriptive statistics of the estimated carry trade exposures, for the full sample of banks and separately for GIPSI and non-GIPSI banks. The factor loadings are estimated quarterly and averaged across all banks. The mean factor loadings for peripheral bond exposure (Italy and Spain) are positive and suggest, on average, more exposure of banks to Italian sovereign debt. A large negative loading of German bunds indicates the funding pressure on banks during our sample period due to a flight to quality of investors. Interestingly, the factor loadings for Italian and Spanish bonds are larger for the non-Italian and non-Spanish banks, respectively. This suggests that non-domestic banks had large exposures to the periphery. The pre-2007 carry trade estimates show that the exposure estimates were close to zero and

[23] Not orthogonalizing gives qualitatively similar results.

sometimes even small and negative before the yield spreads widened in mid-2008 supporting our hypothesis that banks have built substantial carry trade positions as bets on the convergence of sovereign bond yields in the euro area.

B. "Carry trade" behavior of European banks

We estimate regression equation (1) using pooled OLS regressions and cluster standard errors at two dimensions, bank and quarter, to account for (unobserved but time-variant) variation that is both bank specific in different quarters and that is common across all banks in the same quarter. The results are reported in Panel B of Table 4.

The estimated values of β_{GIPSI} and $\beta_{Germany}$ represent the cross-sectional averages of European banks' carry trade exposure. We also estimate (1) for each bank individually. Our results indicate that banks' stock returns are very sensitive to peripheral sovereign bond returns. Model (1), for example, estimates the sensitivity of stock returns to Greek government bond returns. The positive factor loading suggests an (unhedged) exposure of banks to Greek government debt. All other factor loadings are (when employed individually) positive and significant and the exposure seems largest with respect to Italian and Spanish government debt. Model (6) estimates the sovereign debt exposures collectively. The R^2 of the models show that a substantial proportion of the variation in stock returns is explained by these covariates. $\beta_{Germany}$ is negative and large in magnitude indicating banks' funding pressure caused by their exposure to short-term debt. Overall, our results are consistent with a carry trade behavior of European banks.

C. Robustness of our carry trade estimates

In Table 5, we report a series of robustness tests that supports the notion of carry trade behavior of European banks.

[Table 5]

We first construct an index of bond returns using the daily average return of sovereign bonds from Euro area members other than GIPSI countries or Germany or France (*Bond Index*). If banks invested in GIPSI government debt to exploit the highest yielding sovereign investments, banks' stock returns should be less sensitive to the return of this index. Model (1) of Table 5 reports a regression including *Bond Index* as separate control variable and, as expected, its coefficient is not statistically significant.

Banks are also the largest domestic bond investors. A higher sensitivity of bank equity to sovereign bond returns could also reflect a lower ability or willingness of the domestic government to bail out a distressed bank. It could also reflect a higher exposure to the domestic sovereign through bond holdings ("home bias"). To address both concerns, we include the home country bond return (Home) of each bank in model (2). Home, as an example, reflects the amount of Italian government debt that is held by Italian banks. The positive factor loading on the banks' home country bond return indicates that banks are exposed to sovereign bonds of their home country. The factor loadings of Italian and German bonds do not change materially suggesting Italian bonds as primary asset class for carry trades.

We include a variety of other macroeconomic state variables to control for changes in macroeconomic fundamentals that could drive both stock and sovereign bond prices, namely: (i) *VSTOXX*, the European counterpart to the VIX index in the US, is the change in the volatility index of the European stock market; (ii) *TermStructure* is the slope of the term structure of interest rates measured as the difference between the yield on a ten-year euro area government bond and the one-month Euribor; (iii) *BondDefSpread* is the difference between the yield on ten-year German BBB bonds and yields on ten-year German government debt; (iv) *1mEuribor* is the level of the short-term risk-free interest rate measured as the one-month Euribor; (v) ΔESI is the

monthly change in the economic sentiment indicator obtained from opinion surveys conducted by the European Central Bank; (vi) $\Delta IntProd$ is the monthly change in the level of industrial production; (vii) ΔCPI is the change in the rate of inflation measured as the monthly change in the European Consumer Price Index. Model (3) reports the results. Most importantly, the factor loadings do not change including these variables.

The sovereign debt market is characterized by a high degree of collinearity as shown in Table 1. Principal Component Analysis (*PCA*) offers a way to construct different linear combinations of the factor returns that are uncorrelated with each other using the covariance matrix of the returns. As the covariance matrix is symmetric, it has linearly independent eigenvectors corresponding to the number of positive eigenvalues. The eigenvectors are called principal components and are ranked according to the eigenvalue. The first principal component (*PC1*) is the linear combination of GIPSI bond returns with the highest eigenvalue. It is the component that explains the largest part of the variation in GIPSI bond returns. Instead of using the GIPSI returns as independent variables, we regress the banks' stock return on PC1 and Germany. We find a positive and significant relationship between PC1 and stock returns (model (4)), which is consistent with a carry trade behavior of banks.

In model (5) we substitute French for German government bonds and find a negative and significant value for β_{France}, which is smaller in magnitude compared to the factor loadings of German bunds. This is reflecting the increasing divergence of yields between French and German government debt that started in 2011. The coefficients of Greece and Italy are even stronger. In model (6), we include the Fama-French factors *SMB* and *HML*, however, the results remain unchanged.[24]

[24] HML and SMB are measured for European portfolios and available on Kenneth French's website since 1990.

Carry trade exposure should also be reflected in CDS spreads as an important proxy for bank risk and funding costs. We expect to see that CDS spreads reflect a widening of the gap between GIPSI bond and German bund yields, either through an increase in peripheral bond yields or if funding conditions deteriorate. We test this in models (7) and (8) and use *Δ Log (Bank CDS)* as a dependent variable, which is the change in the natural logarithm of daily bank CDS spreads. As reported in column (7), the coefficient of Greek bond returns is negative and significant, whereby, if Greek bond prices fall, banks experience, on average, an increase in their CDS spreads. Moreover, if German bund prices appreciate, banks' funding costs also rise, *ceteris paribus*, pointing to their exposure to short-term wholesale markets. The PCA in model (8) shows a similar result. Overall, and across our various tests, we find strong evidence consistent with a carry trade behavior of European banks.[25]

D. Alternative return indices

We provide a variety of falsification tests as to the incentives of European banks versus other financial and non-financial firms to load up on GIPSI sovereign exposures. US banks, for example, were systematically recapitalized after the US mortgage crisis. European banks, on the other hand, were, and still are, undercapitalized based on various standards (such as leverage ratios). Moreover, US banks cannot use sovereign debt to the same extent as collateral for liquidity as European banks. A similar argument applies to UK banks. Many of them have been nationalized and their capital position strengthened after the financial crisis. They also do not have access to the ECB using peripheral debt as collateral. We thus expect to find smaller

[25] We perform a series of further tests that remain unreported for brevity. We include bank fixed effects to control for time-invariant bank characteristics. In other tests, we use bond yield changes instead of bond returns. We also construct an equally weighted portfolio of bank stocks from our sample and estimate a time-series regression. In separate tests, we exclude broker-dealer banks. These banks might have larger portfolios due to this specific function. Lastly, we use weekly (instead of daily) stock returns. In all tests, our results from Table 4 remain qualitatively unchanged.

estimates on similar tests using US or UK banks. A third set of firms we consider are non-financial (industrial) firms which do not have similar incentives such as gambling or regulatory capital arbitrage as banks which should also be reflected in the carry trade estimates.

We run a series of tests with various index returns as dependent variables. There are: (1) a value weighted index of all EBA banks in our sample; (2) a value weighted index of UK banks; (3) a value weighted index of the 100 largest US banks based on market values; (4) a HFRX Macro Hedge Fund Index; (5) an equally weighted industrial index formed from the underlying MSCI industrial indices from Italy, Spain and Portugal (MSCI GIPSI)[26]; (6) the MSCI Industrial Germany index; (7) an equally weighted index of the most important countries in Europe other than Germany and the periphery (France, Netherlands, Norway, Denmark and Sweden); and (8) the MSCI Industrial UK index.

[Table 6]

Table 6 reports the results from OLS regressions. Control variables include the Fama-French Factors SBM and HML. As market return, we include the Euro Stoxx 600 index for European indices, the S&P 500 index for the US banks and MSCI World for the HFRX Macro Hedge Fund index. Standard errors are adjusted for heteroscedasticity and auto-correlation using Newey-West with 8 lags. Column (1) shows the time-series estimates for all EBA banks which reflect our earlier cross-sectional results. We do not find statistically significant exposure of UK banks to peripheral sovereigns (column (2)). Moreover, the value of $\beta_{Germany}$ is much smaller indicating lower funding exposure. Column (3) reports the result for US banks echoing the results

[26] We exclude Ireland and Greece from this index due to missing data in the respective industrial index.

for UK banks.[27] We use daily returns of the HFRX Macro fund as dependent variable in column (4). The results are intriguing and suggest that macro hedge funds are betting against Italy but are long German bunds, thus effectively taking the opposite positions in trades with European banks. Columns (5) to (8) show sensitivities of country specific industry indices to GIPSI and German sovereign debt. Overall, the betas are close to zero and mostly insignificant.

5. Factor Loadings, Sovereign Bond Holdings & Liquidity Risk

A. Results from Seemingly Unrelated Regressions (SUR)

Do these exposures relate to actual government bond holdings of banks or simply reflect some other underlying economic exposures and linkages? And what determines banks' liquidity, i.e. short-term funding, risk? To address these important questions, we exploit bank level data on sovereign bond holdings and short-term funding exposure. Since June 2010, the EBA has disclosed bank level sovereign bond holdings reported during five sequential stress tests.[28] If $\hat{\beta}_{GIPSI}$ reflects higher exposure to GIPSI sovereigns, we expect to find higher $\hat{\beta}_{GIPSI}$ if banks' have higher reported holdings.

We were arguing above that the negative factor loading of German bond returns reflects a flight-to-quality from short-term investors into long-term German government bonds. We thus expect to see cross-sectional differences in the factor loadings across banks arising from their short-term funding exposure. An important source of funding risk for European banks is their exposure to US money market mutual funds (MMF). Ivashina, Scharfstein and Stein (2012), for example, show that the reduction in US-Dollar lending by US MMF caused a significant decline

[27] We also run these results for a portfolio of Goldman Sachs, JP Morgan, Morgan Stanley, Citigroup and Bank of America. It has frequently been claimed that these banks had huge counterparty exposure to the GIPSI countries. We do not find significant exposures to either of the GIPSI sovereigns.

[28] Note that not all banks participated in all stress tests or the capitalization exercise.

in the dollar lending relative to euro lending by European banks which was not the case for US banks.

[Figure 3]

Figure 3.A shows US MMF's exposure to European banks since October 2010. As explained above, new regulation enforced by the SEC made it mandatory for MMF to disclose the NAV of their investments on a monthly basis. In 2011 alone, US MMF funds withdrew about USD 167 billion in repurchase agreements and commercial paper from European banks. Figure 3.B shows the percentage withdrawal from individual banks in 2011. US MMF completely eliminated their exposure to seven banks in the Eurozone, among them Dexia S.A. Other banks, predominantly Scandinavian banks, experienced massive inflows such as Svenska Handelsbanken AB, SEB Banken AB or Swedbank indicating the divergence in funding opportunities for European banks. Figure 3.C plots time-series betas of Dexia's equity and Italian ($\hat{\beta}_{Italy}$) and German bonds ($\hat{\beta}_{Germany}$) as well as monthly holdings of US MMF (dashed line). The betas were constructed using a multivariate GARCH model with dynamic correlations (Engle, 2002, and Engle and Sheppard, 2001). Figure 3.D extends this approach to other banks using an equally weighted portfolio of banks that have US MMF exposure during our sample period. Both plots strikingly show the co-movement of $\hat{\beta}_{Germany}$ and US MMF withdrawals.

We assess the importance of portfolio holdings of sovereign debt as well as money market fund exposure in explaining our factor loadings in a one-step framework

$$R_{i,t} = \beta_0 + \alpha_0 R_{GIPSI,t} + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}} R_{GIPSI,t} + \alpha_2 R_{Germany,t} + \alpha_3 \frac{\Delta MMF_{i,t}}{Assets_{i,t-1}} R_{Germany,t} + \beta_m R_{m,t} + \varepsilon_{i,t} \quad (2)$$

using Zellner's (1968) seemingly unrelated regression (SUR) technique.[29] $\hat{\beta}_{GIPSI}$ is taking the form $\alpha_0 + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}}$ and $\hat{\beta}_{Germany}$ is taking the form $\alpha_2 + \alpha_3 \frac{\Delta MMF_{i,t}}{Assets_{i,t-1}}$. ΔMMF are monthly money market withdrawals denominated in million euros. The pooled time-series cross-sectional approach is well suited in our setting because there might be substantially more variation in the bond portfolios across banks as there is variation over time for a single bank given the limited portfolio data that is available to us. This system of equations consists of *N* (i.e. the number of banks) time series equations and is estimated using GLS. *T* is the number of time-series observations and $\hat{\alpha}_0$, $\hat{\alpha}_1$, $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are point estimates constrained to be constant across all banks. We thus can interpret these coefficients as average factor loadings of our sample banks. We expect the value of $\hat{\alpha}_1$ to be positive and the value of $\hat{\alpha}_3$ to be negative. The results are reported in Table 7.

[Table 7]

The exposures to Italy and Spain show that equity returns are sensitive to GIPSI and German government bond holdings consistent with a carry trade behavior of banks and the results reported in Panel B of Table 4. $\hat{\alpha}_1$ is positive and significant showing that banks' stock returns are responding more positively to GIPSI bond returns if banks have larger holdings of these securities in their portfolios. Correspondingly, banks with larger withdrawals from MMF experience more funding pressure as indicated by the negative and significant coefficient of $\hat{\alpha}_3$. $\hat{\alpha}_2$ is also negative and significant suggesting that even if banks do not have US MMF exposure, they are still subject to short-term funding risk. In unreported test, we also analyze the effect of other measures of liquidity risk (*LIQ*) on banks' sensitivity to German bunds which have been used widely in the literature. There are: short-term debt over total debt (*ST-LVG*) and repurchase

[29] This approach has also been used, for example, in French et al. (1983) to estimate the effects of nominal contracting on stock returns.

agreements with other banks or the ECB over total assets (*Repo / Assets*). As expected banks with more short term debt (relative to total debt) or more repo funding have more negative $\hat{\beta}_{Germany}$.

B. Results from a two-step-procedure

The advantage of the one-step procedure over a two-step procedure is to avoid a measurement (sampling) error in estimating $\hat{\beta}_{GIPSI}$ and $\hat{\beta}_{Germany}$. The two-step procedure estimates the factor loadings in a first regression and uses these estimates in a second step to analyze their determinants. If the sampling error is not constant across banks, this might induce heteroscedasticity in the second stage regression. More importantly, a possible contemporaneous correlation between the error terms in estimating (1) could induce a correlation among the factor loadings which, in turn, could inflate our t-statistics in the second step. However, the SUR methodology requires a balanced panel restricting the number of time-series observations that can be used in the regressions. Given the limitations of both approaches, this section presents the results from the two-step procedure to further investigate the link between our carry trade estimates and the actual bond holdings from bank disclosures. In a first step, we relate the factor loadings estimated for each bank in the time period 60 days before and 60 days after each reporting date on the sovereign bond holdings scaled by total assets. To visualize this relationship, we plot the factor loadings on the sovereign bond holdings for each reporting date and country separately in Figure 4. We use logs for illustration purposes.

[Figure 4]

The scatterplot shows a positive relationship between factor loadings and portfolio holdings. We estimate regression (3) to analyze how $\hat{\beta}_{GIPSI.i,t}$ varies with actual portfolio holdings in the cross-section of banks. Similar to the one-step-procedure, we scale holdings by total assets (alternatively by book value of equity) to construct a measure that has the same unit

of measurement as $\hat{\beta}_{GIPSI.i,t}$ and expect α_{GIPSI} to be positive. A positive value indicates that the sensitivity of banks' equity return is higher if banks have higher actual exposure. α_0 measures other influences on $\hat{\beta}_{GIPSI,i,t}$ which are assumed to be constant across banks.

$$\hat{\beta}_{GIPSIi,t} = \alpha_0 + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}} + \omega_{i,t} \qquad (3)$$

The results are reported in Appendix IV. Panel A of Appendix IV shows the result for exposures to Italian and Spanish government bonds. The standard errors are White's heteroscedasticity consistent standard errors. We find that α_{GIPSI} is positive and significant at the one percent level which supports our methodology to infer banks' exposure to sovereign debt through the sensitivity of the banks' equity returns to sovereign bond returns. This result extends to Spanish bonds as investment leg of the carry trade as well as book equity as alternative scaling factor.

We aggregate the monthly MMF holdings data to the quarter and estimate quarterly $\hat{\beta}_{Germany,i}$ using (1). As an example, we chose a carry trade with Italian bonds as the investment leg. We find some variation in the value of $\hat{\beta}_{Germany,i}$ ranging from -3.92 to -0.93. Figure 5 explores the relationships between the factor loading estimates and MMF withdrawals graphically.

[Figure 5]

The correlation between $\hat{\beta}_{Germany,i}$ and MMF withdrawals is 0.71 suggesting that US MMF exposure is an important determinant of banks' liquidity problems. We regress quarterly factor loadings on MMF withdrawals scaled by total assets (using previous MMF exposure and short-term debt as alternative deflators) over the full sample period starting October 2010.

$$\hat{\beta}_{Germany,i,t} = \alpha_2 + \alpha_3 \frac{\Delta MMF_i}{Assets_{i,t-1}} + \omega_{i,t} \qquad (4)$$

We expect $\hat{\alpha}_3$ to be negative. An decrease in MMF over a quarter should make German long-term bond returns more negatively correlated with equity returns resulting in a lower value of $\hat{\beta}_{Germany,i,t}$. Panel B of Appendix IV reports the results. Our cross-sectional results suggest that banks that experience larger withdrawals from US MMF have more negative factor loadings.[30]

C. Real sector exposure

In a second step, we use the data on banks' real sector exposure in each country. One could argue that our factor loadings reflect cross-border investments of internationally active banks rather than exposure to sovereign debt. We construct a new variable Italy-Real/Assets which is the sum of each bank's exposure to firms, the retail sector (including retail real estate) and commercial real estate scaled by total assets. The real sector exposure to Spain is constructed accordingly. Table 8 reports the results of regressions of our factor loadings estimated 60 days before and after 31 Dec 2010 on real sector and sovereign exposure.

[Table 8]

Using Italy as an example, models (1) and (2) show that our factor loadings are positively related to reported sovereign and real sector exposure in separate regressions. Model (3) includes both types of exposures and model (4) excludes Italian banks. Particularly in our sample of non-Italian banks, we find that sovereign holdings explain our factor loadings while real sector

[30] We also scale MMF changes by book value of equity. Moreover, we repeat all cross-sectional tests using Spanish government bonds as investment leg of the carry trade. The results are qualitatively similar but not reported for brevity.

exposures are not significantly related to the latter. Interestingly, around this reporting date, we do not find a significant relationship between factor loadings and sovereign holdings among the sample of non-Spanish banks. These findings point to interesting differences and dynamics between countries and over time. They also suggest that Italian sovereign debt is the primary asset class for banks' investment in carry trades.

6. Carry Trade Incentives

A. Factor loadings and bank risk

The primary hypothesis studied in this paper is that investment behavior of European banks reflects a moral hazard behavior in the form of risk taking that exploits low risk weights of risky government bond positions. Particularly under-capitalized banks are more likely to invest in carry trades to comply with regulatory capital requirement ("regulatory arbitrage") and / or to shift risk betting on their own survival ("gambling").

We use various bank risk factors, such as bank size (Log-Assets), short-term leverage (ST-LVG) and the size of the loan portfolio (Loans/Assets) to investigate the investment behavior of European banks. In all tests, we use the one-year lagged bank characteristics.[31] As in previous tests, standard errors are clustered at the bank and quarter level. We include all risk proxies individually and collectively and run regressions on the full sample of banks. The results are reported in Table 9.

[Table 9]

We document that larger banks (that is banks with more international focus, more wholesale funding and that are more systemically important) have larger sovereign exposures to

[31] ST Debt and Loans/Assets are included in addition to the interaction terms in the respective models as well as a constant term, but all remain unreported for brevity. Log-Assets is added as a control variable in all models.

Italy. Also, riskier banks, i.e. banks with more short-term leverage and loan to asset ratios have more exposure. These results provide strong support for the carry trade hypothesis but are not consistent with alternative hypotheses such as home bias.[32] We document similar results as to European banks' exposure to Spanish sovereign debt.

A further motive as to why banks are heavily invested in government debt is regulatory capital arbitrage because of how banks' balance sheet exposure to sovereign debt is treated under existing capital rules. Basel II encourages banks to hold sovereign debt. The Capital Requirement Directive (CRD) assigns a zero risk weight for "exposures to Member States' central government […] denominated and funded in the domestic currency of that central government" (BIS, 2011).[33] That is, despite (even little) differences in country ratings, banks are allowed to reduce the capital they hold against these positions to zero. Consequently, particularly undercapitalized banks, that is, banks with low Tier 1 capital ratios, have an incentive to shift their portfolios into assets with lower risk weights (regulatory capital arbitrage). We test this hypothesis using the Tier 1 ratio, which is defined as Tier 1 capital divided by risk-weighted assets, and RWA/Assets as proxies for capital adequacy. Table 9 contains the results of the cross-sectional regressions. We report the results again separately for Italy (column (2)) and Spain (column (4)). In all regressions, we include Log-Assets as well as interaction terms with GIPSI and Germany to control for bank size.

Again, we focus on banks' exposure to Italy first. Consistent with our earlier results, we find that larger banks have a larger exposure to Italian sovereign debt. We find that banks with higher Tier1 capital ratios have lower exposure to Italian sovereign debt. Tier 1 capital increases

[32] Analyzing a subsample of Italian banks, we find that larger Italian banks have more exposure to their own domestic sovereign debt. Interestingly, riskier Italian banks have lower sovereign exposure suggesting that moral hazard (even though there is some evidence) is not the only motive of these banks to hold domestic sovereign debt. Among Spanish banks, we find strong evidence consistent with carry trade behavior.

[33] Under the standardized approach, sovereign debt has a zero risk weight. Even under the Internal Ratings Based (IRB) approach there is a loophole. Usually, banks have to hold capital based on an assessment of the default likelihood estimated with their own internal models. However, they can choose to switch back to the standardized approach for assessing capital requirements for sovereign debt eventually holding no capital ("IRB permanent partial use").

if banks have higher RWA or if they decide to hold more economic capital. For a given amount of RWA, the negative coefficient implies higher risk-shifting incentives. Moreover, the positive coefficient on RWA/Assets (unlike the sign on Tier1) suggests that there is a regulatory arbitrage motive. Only including one of these variables might result in biased estimates of the coefficients due to confounding effects.[34] Moreover, we find that banks with high exposure to short-term funding have significantly more exposure to Italy. Additionally, European banks with more short-term debt are also more exposed to funding shocks. These results provide strong evidence for carry trade (moral hazard) behavior of European banks.[35] The results extend to European banks' exposure to Spanish government debt.[36]

B. Sovereign bond holdings and bank risk

Our carry trade estimates show that particularly risky and undercapitalized banks are purchasing more Italian and Spanish sovereign debt consistent with carry trade behavior of these banks. Therefore and in line with the descriptive results from Table 3, we expect to find also higher reported Italian and Spanish sovereign bond holdings of these banks around the EBA stress tests. In separate tests, we regress Italian (Spanish) sovereign debt holdings by our sample banks (scaled by total assets) on Tier-1 ratio, RWA/ Assets, Loans / Assets and Log-Assets using OLS regressions. The results are reported in Table 10.

[34] In unreported results, we include either Tier 1 or RWA / Assets and find that the coefficient of Tier 1 is less negative when we do not control for RWA / Assets. This result suggests that the discretionary part of Tier1 capital is more strongly related to the risk-shifting motive. In other words, not controlling for RWA understates the risk-shifting effect.

[35] Interestingly, we do not find statistically significant evidence that riskier Italian banks (that is, banks with lower capital ratios or higher RWA or short-term debt) are investing more in domestic sovereign debt, which is in line with our earlier results. Domestic banks most likely have different motives to invest in own sovereign debt (over and above the carry trade motive).

[36] In unreported tests and in a subsample only Spanish banks, we find strong evidence that even Spanish banks with low Tier 1 capital ratios and high RWA / Assets invested more in domestic sovereign debt compared to better capitalized Spanish banks and they also were more exposed to short term funding. In other words, these results are consistent with carry trade (moral hazard) behavior among Spanish banks.

[Table 10]

Bank risk characteristics are lagged by one year and standard errors are clustered at the bank level. The results reported in column (1) in Panel A suggest that increasing Tier-1 ratios from the first to the third quartile decreases Italian sovereign bond holdings over total assets by one percentage point, ceteris paribus. The t-statistic is -4.42 and the R^2 suggests that a substantial part of the variation of Italy / Assets can be explained by a bank's capitalization. Similarly, we find that banks with higher RWA / Assets and Loans / Assets have higher Italian bond holdings. Moreover, larger banks also have higher bond exposures. Overall, these tests as well as the previously reported results are consistent with the interpretation that riskier and weakly capitalized banks have stronger incentives to invest in carry trades using Italian and Spanish sovereign debt.

C. Home Bias and LTROs

Our descriptive results suggests a shift in risk exposure to peripheral sovereign debt from non-GIPSI banks to GIPSI banks through the ECB interventions in December 2011 and February 2012. In this sub-section, we show that the increase in home bias is also reflected in our carry trade estimates. We estimate regression (1) and augment the model with time indicator variables: Before March'10, March'10 – Dec'10, Dec'10 – Sept'11, and After Sept'11. We interact sovereign bond returns with these indicator variables. $\hat{\beta}_{GIPSI}$ ($\hat{\beta}_{Germany}$) represents banks' equity sensitivity to GIPSI (German) bond returns in the period after September 2011, including the two three year LTROs but also the ECB's one year LTRO from October 2011. The interaction terms then show incremental effects in each respective time period. Table 11 reports the results.

[Table 11]

Columns (1) to (3) report the results for banks' exposure to Italian sovereign debt and columns (4) to (6) for the exposure to Spanish sovereign debt. We always run the regression for the full sample, non-domestic and domestic banks. The full sample results in column (1) and (4) show that banks, on average, still have substantial exposure to Italian and Spanish sovereign debt. The exposure, however, has decreased over time as shown by positive and significant coefficients of the interaction terms. This is consistent with the summary statistics reported in Table 2. This result extends to the subsample of non-domestic banks (columns (2) and (4)). The subsample of non-Italian banks reflects the increase in home bias. The factor loading on $\hat{\beta}_{GIPSI}$ is 0.808 (which is significantly higher as the factor loading of non-Italian banks (0.286, p-value < 0.001)) and the incremental effects are negative. The incremental effect in the subsample of Spanish banks are insignificant which is consistent with the total exposures summarized in Table 2 indicating that Spanish banks have reduced their bond holdings since March 2010 to some extent.

7. Conclusion

During the past three years, increasing economic divergence between the core of Europe and the periphery have caused a surge in the yield spread of peripheral countries (such as GIPSI, or Greece, Italy, Ireland, Portugal and Spain) and a flight to German bunds. Our article argues that European banks have placed bets on the opposite economic development – convergence – within the euro area expecting yield spreads between, for example, Italy and Germany or Spain and Germany to converge. These bets or "carry trades" were designed as investments in GIPSI government bonds financed with short-term debt. As the sovereign debt crisis deepened, European banks lost a substantial portion of their market value. In a series of cross-sectional and time-series tests, we find evidence that these trades have been widespread among European banks, not just GIPSI banks but even non-GIPSI European banks. We find convincing evidence

for bank moral hazard and regulatory capital arbitrage in that large banks, banks with more short-term debt, and undercapitalized banks with high risk-weighted assets, are more likely to engage in carry trades employing low risk-weight GIPSI government bonds to earn higher and riskier returns on their diminished economic capital while meeting regulatory capital requirements.

Several policy implications stem from our empirical findings. One, under-capitalized banking sectors as the European countries had at the end of the financial crisis of 2007-08 can lead to subsequent problems through excess risk-taking, a theme that is reminiscent of the Japanese banking crisis of the 90's. The European response in Fall of 2008 and early 2009 featured more debt and asset guarantees than bank recapitalization, unlike the United States, and the ongoing sovereign crisis has again left several banks under-capitalized sufficiently to the point that their market funding has dried up.

Second, simply restoring bank capitalizations up to regulatory risk weight based requirements does not suffice in environments where the regulatory risk weights have become out of sync with market's perception of risk of assets, and indeed the underlying fundamental risk of assets, in this case the zero risk weights on sovereign bonds of peripheral countries being far from being risk-free to deserve such regulatory capital treatment. Worse, the continuation of reliance on such risk weights, as in the first two stress tests of 2010 in Europe, can give under-capitalized banks perverse incentives to shift portfolios towards low risk weight, but high economic risk and return assets. In the case of Europe, this created a strengthening of the nexus between sovereign and financial sectors, making sovereign crises in southern periphery a pan-European concern. The stress tests of July 2011 in Europe did address the zero risk-weight issue more seriously and the outcomes – at least for non-GIPSI banks – since then have been more salubrious.

Finally, while the European Central Bank's LTRO facilities appear to have provided funding to domestic Spanish and Italian banks to significantly build up their exposures to their

sovereign debt, a move that should have helped the sovereigns in question, the resulting "home bias" in debt holdings of these sovereigns has nevertheless strengthened the financial sector and sovereign's nexus in the periphery, implying that a further deterioration of the sovereign health would lead to a significant peripheral crisis, even if not a fully pan-European one (in similar magnitude). Again, this form of ECB funding does not tackle head on the problem of bank recapitalization for GIPSI banks and their incentives to load up on sovereign debt – and of their sovereigns to encourage (or not discourage) such home bias – remain unaddressed.

References

Acharya, V., Drechsler, I. and Schnabl, P. (2010) 'A Pyrrhic Victory? – Bank Bailouts and Sovereign Credit Risk', working paper, NYU-Stern.

Acharya, V., Engle, R. and D. Pierret. (2013) 'Testing Macroprudential Stress Tests: The Risk of Regulatory Risk Weights', working paper, NYU-Stern.

Acharya, V. and Rajan, R.G. (2011) 'Sovereign Debt, Government Myopia and the Financial Sector', *Review of Financial Studies,* forthcoming.

Acharya, V., Schnabl, P. and Suarez, G. (2011) 'Securitization without Risk Transfer', *Journal of Financial Economics*, forthcoming.

A&S (2013) 'Bank of Cyprus – Holdings of Greek Government Bonds (Prepared for the Central Bank of Cyprus)', Investigation Report Alvarez & Marsal Global Forensic and Dispute Services, LLP.

Becker, Bo and Ivashina, V. (2013) 'Reaching for Yield in the Bond Market', working paper, Harvard Business School.

Bolton, P. and Jeanne, O. (2011) 'Sovereign default and bank fragility in financially integrated economies', NBER working paper, 16899.

Boyson, N.M., Fahlenbrach, R., and Stulz, R. (2013) 'Trust Preferred Securities and Regulatory Abritrage', working paper.

Broner, F., Martin, A. and Ventura, J. (2010) 'Sovereign risk and secondary markets', *American Economic Review* 100, pp. 1523–1555.

Caballero, R.J., Hoshi, T., and Kashyap, A.K. (2008) 'Zombie Lending and Depressed Restructuring in Japan' *American Economic Review* 98 (5), 1943 – 1977.

Chernenko S., and A. Sunderam (2012) 'Frictions in Shadow Banking: Evidence from Lending Behavior of Money Market Funds', Working Paper, Ohio State University.

Diamond, D. and Rajan, R.G. (2011) 'Fear of Fire Sales and the Credit Freeze', *Quarterly Journal of Economics*, 126(2), pp. 557–591.

Duffie, D. (2011). *'How Big Banks Fail and What to Do About It'*, Princeton University Press, Princeton and Oxford.

EBA, (2010) 'Aggregate outcome of the 2010 EU wide stress test exercise coordinated by CEBS in cooperation with the ECB', available at: http://stress-test.c-ebs.org/documents/Summaryreport.pdf.

EBA, (2011 a) 'European Banking Authority: 2011 EU Wide Stress Test Aggregate Report', available at: http://stress-test.eba.europa.eu/pdf/EBA_ST_2011_Summary_Report_v6.pdf.

EBA, (2011 b) 'Capital buffers for addressing market concerns over sovereign exposures', available at: http://stress-test.eba.europa.eu/capitalexercise/Methodology%20FINAL.pdf.

Engle, R. F., 2002, "Dynamic conditional correlation: a simple class of multivariate generalized autoregressive conditional heteroskedasticity models," *Journal of Business and Economic Statistics,* 20, 339–351.

Engle, R. F., and Sheppard, K. (2001) 'Theoretical and empirical properties of dynamic conditional correlation multivariate GARCH," Discussion Paper 2001-15, University of California, San Diego.

Fischer, M., Hainz, C., Rocholl, J. and Steffen, S. (2012) 'Government Guarantees and Bank Risk Taking Incentives', working paper.

French K.R., R. S. Ruback, and G. W. Schwert (1983) 'Effects of Nominal Contracting on Stock Returns', *Journal of Political Economy* 91(1), 70 – 96.

Furlong, F. T. and M. C. Keeley (1987) 'Bank Capital Regulation and Asset Risk', *Economic Review*, Federal Reserve Bank of San Francisco, Spring 1987, 20 – 40.

Furlong, F. T. and M. C. Keeley (1989) 'Bank Capital Regulation and Risk Taking: A Note', *Journal of Banking and Finance*, Vol. 13, 883 – 891.

Gennaioli, N., Martin, A. and Rossi, S. (2011) *Sovereign Defaults, Domestic Banks, and Financial Institutions*, available at: http://crei.cat/people/gennaioli.

Huang, R. and Ratnovski, L. (2011) 'The Dark Side of Bank Wholesale Funding', *Journal of Financial Intermediation* 20, pp. 248–263.

Hoshi, T., and Kashyap, A.K. (2010) 'Will the U.S. Bank Recapitalization Succeed? Eight Lessons from Japan', *Journal of Financial Economics* 97, 398 – 417.

Ivashina, V., D. S. Scharfstein and J. C. Stein (2012) 'Dollar Funding and the Lending Behavior of Global Banks', NBER Working Paper.

Kacperczyk, M. and Schnabl, P. (2013) 'How Safe are Money Market Mutual Funds? *Quarterly Journal of Economics*, forthcoming.

Keeley, M.C. (1990) 'Deposit Insurance, Risk and Market Power in Banking' *American Economic Review*, Vol. 80, No. 5, 1183 – 1200.

Jensen, M., and W. Meckling (1976) 'Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure', *Journal of Financial Economics* 3, 305 – 360.

Peek, J., and Rosengren, E.S. (2005) 'Unnatural Selection: Perverse Incentives and the Misallocation of Credit in Japan', *American Economic Review* 95 (4), 1144 – 1166.

Figure 1.A. Pairwise Comparison of Government Bond Yield Spreads: Italy versus Germany

This graphic shows the time series of 10-year government bond yields comparing Italian and German 10-year government bond yields since January 2009. Vertical lines indicate rating downgrades by S&P.

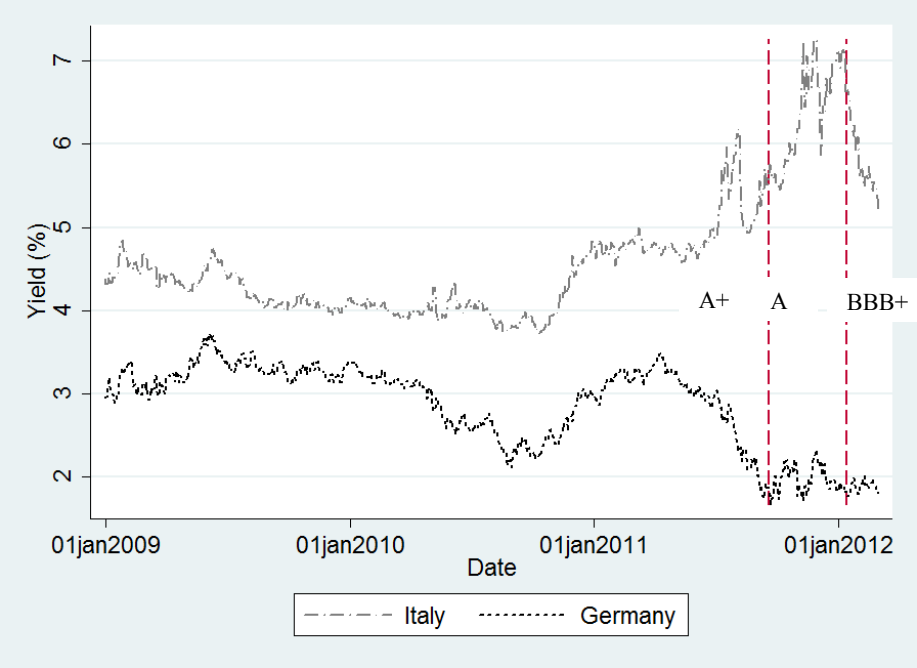


Figure 1.B. Pairwise Comparison of Government Bond Yield Spreads: Spain versus Germany

This graphic shows the time series of 10-year government bond yields comparing Spanish and German 10-year government bond yields since January 2009. Vertical lines indicate rating downgrades by S&P.

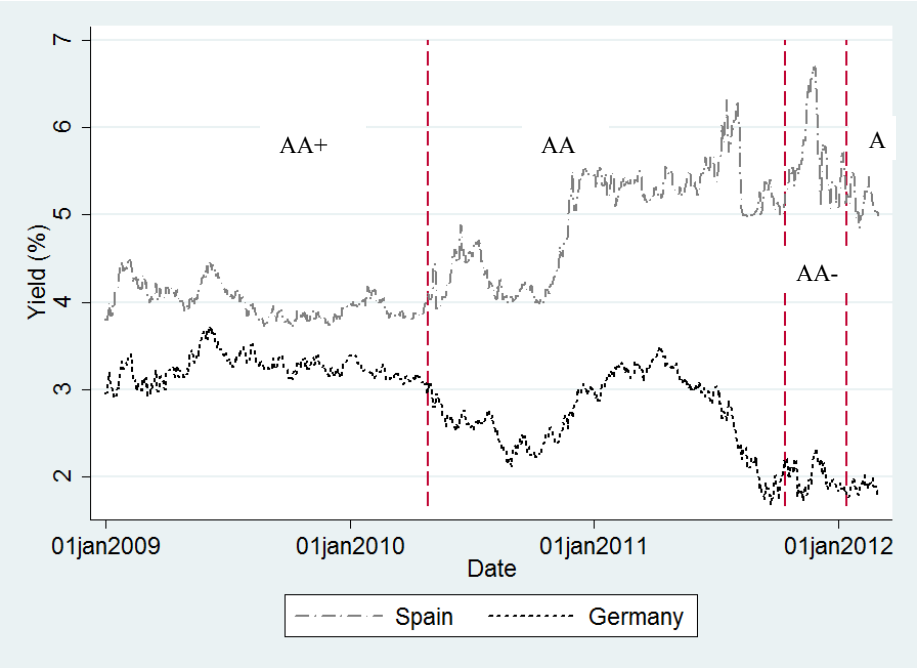


Figure 1.C. Pairwise Comparison of Government Bond Yield Spreads: Italy, Spain and Germany (2005 – 2012)

This graphic shows the time series of 10-year government bond yields comparing Italian, Spanish and German 10-year government bond yields since January 2005.

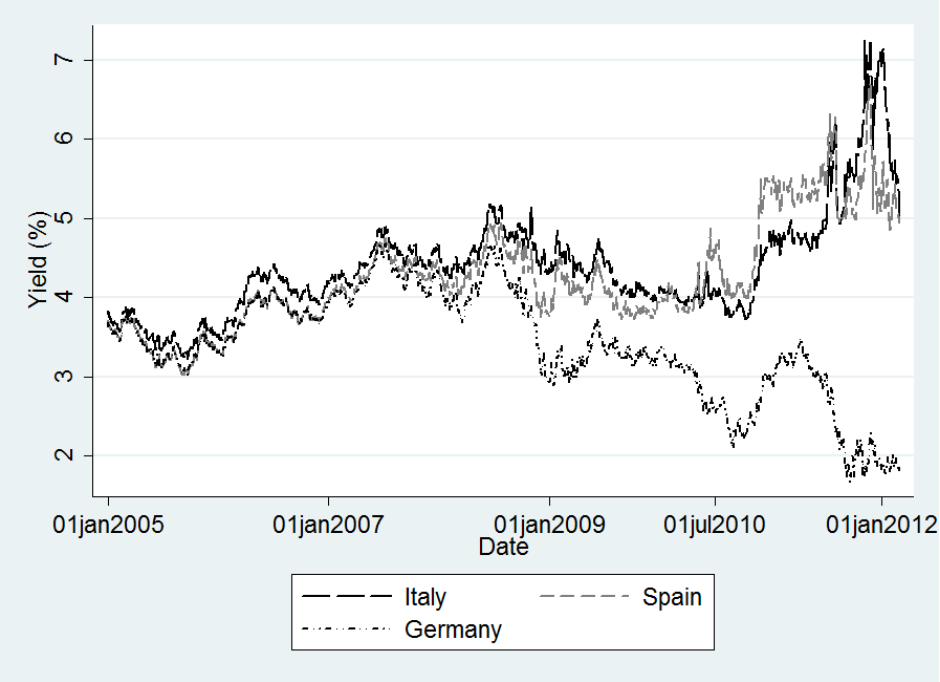


Figure 2.A. Dexia Stock Price and US Money Market Mutual Fund Holdings (Nov 2010 – September 2011)

This graphic shows Dexia's stock price and commercial paper and repo holdings of US Money Market Mutual Funds over the November 2010 to September 2011 period.

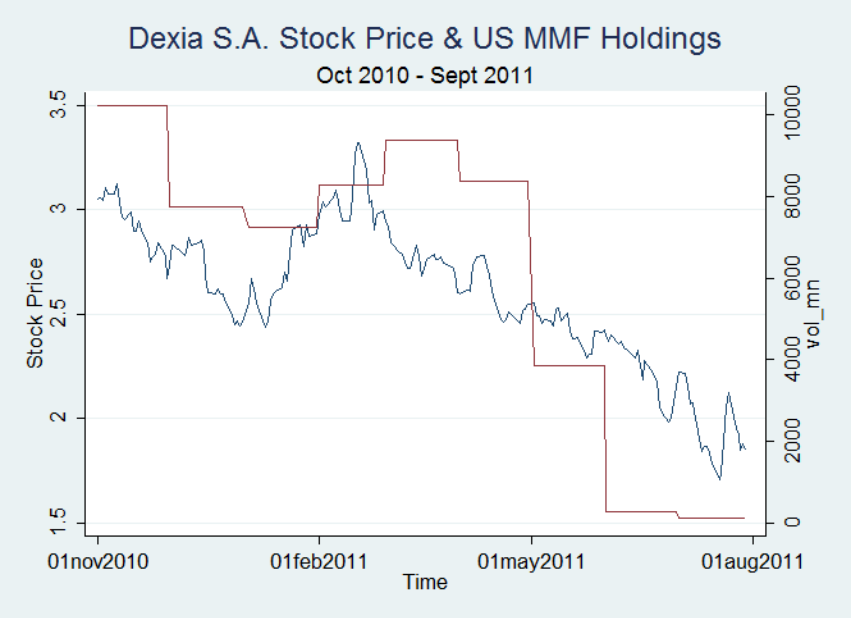


Figure 2.B. Dexia Return Correlations

This graphic shows the time-series of 30-day rolling correlations of Dexia's stock returns with 10-year Italian and 10-year German government bond returns since January 2011. The vertical red lines indicate the two 3-year Long-Term-Refinancing-Operations (LTRO) of the European Central Bank (ECB) in December 2011 and February 2012.

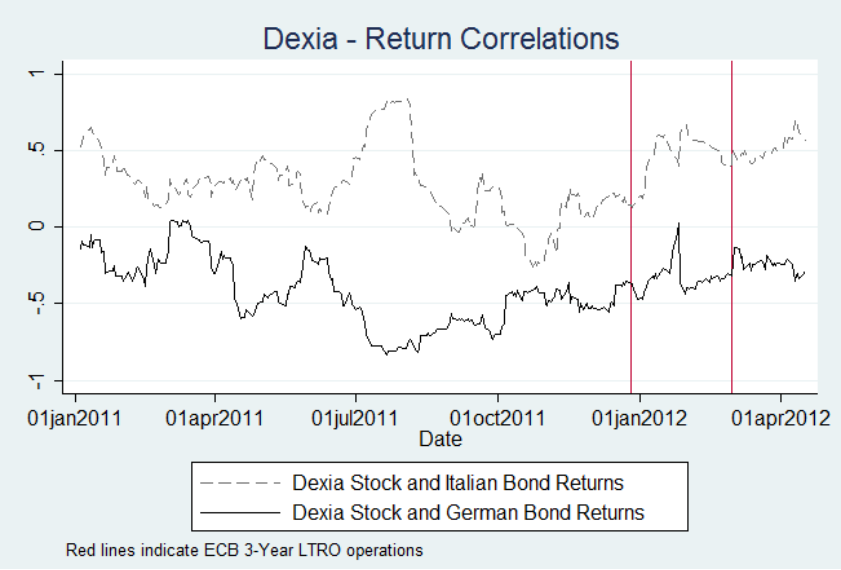


Figure 2.C. Dexia 1 Year CDS Prices
This graphic shows the 1-year CDS spreads of Dexia's bank subsidiary in France, Dexia Crédit Local starting in July 2008.

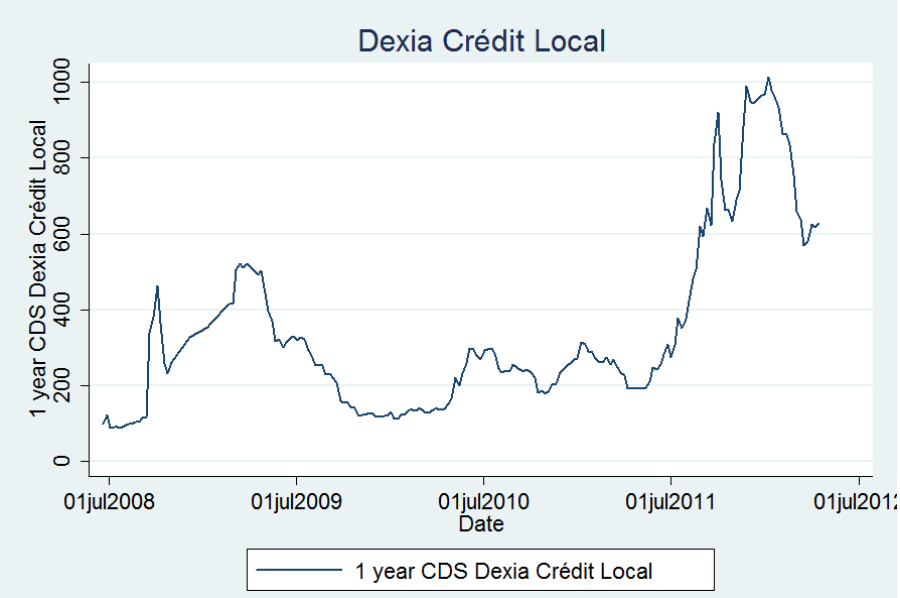


Figure 2.D. Dexia Stock Price Decline since Janurary 2011
This graphic shows Dexia's stock price performance since January 2011.

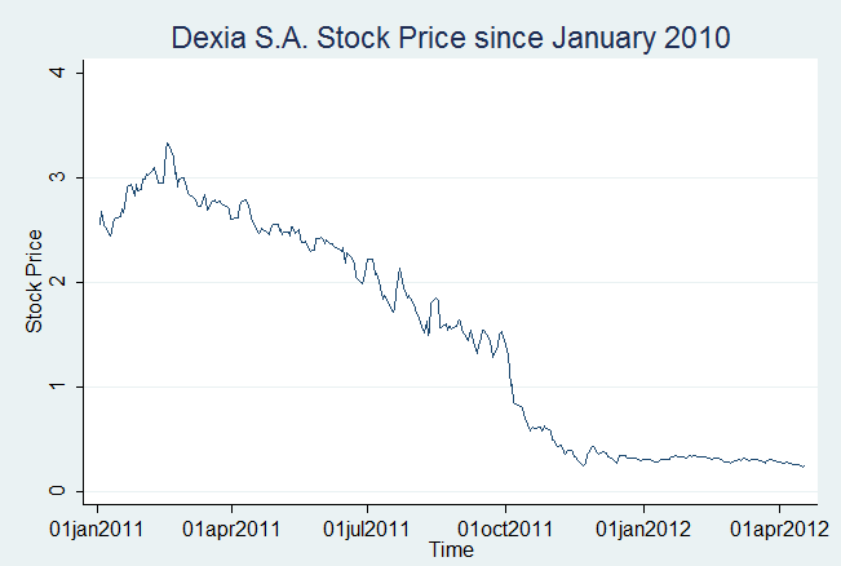


Figure 3.A. US Money Market Fund Holdings of European Banks
This figure depicts the investments of US MMF in European banks since October 2010.

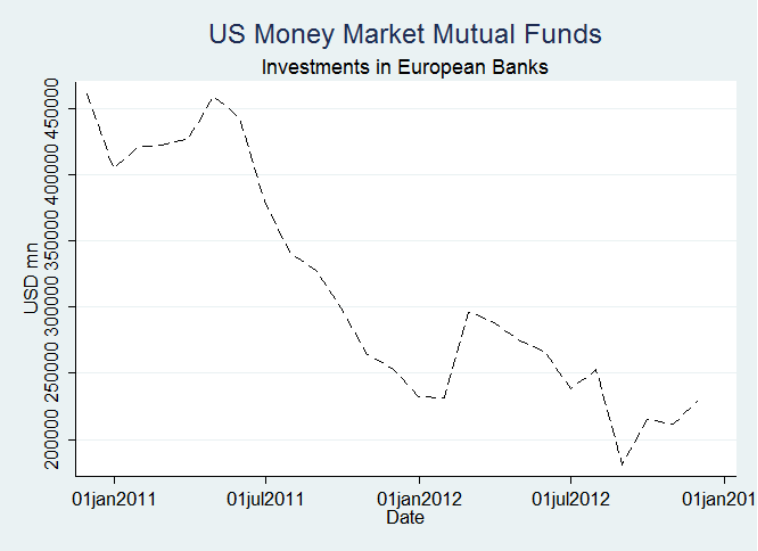


Figure 3.B. % Sell off of US MMF in 2011
Sale of commercial paper and repurchase agreements of European banks during the January to December 2011 period.

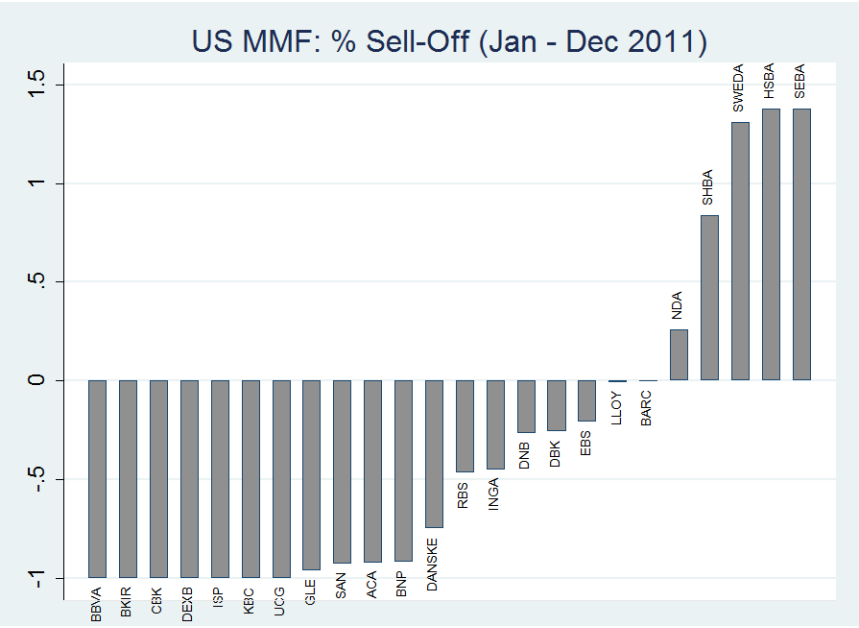


Figure 3.C. Dexia S.A. – Time Varying Betas and MMF Exposure
This graphic shows time-varying betas (Germany and Italy) estimated using an MGARCH-DCC model and monthly US MMF holdings in Dexia since November 2010.

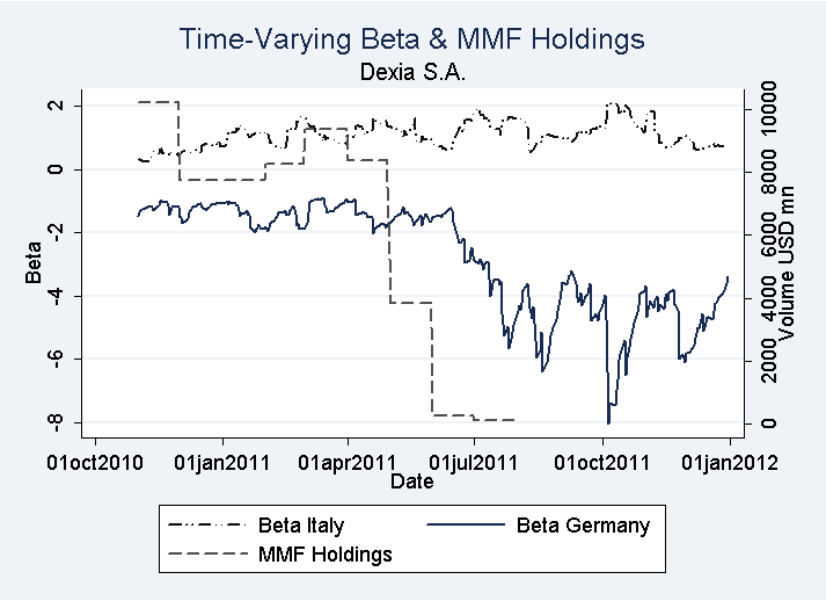


Figure 3.D. Time Varying Betas and MMF Withdrawals
This graphic shows time-varying betas (Germany and Italy) estimated using an MGARCH-DCC model and monthly changes of US MMF holdings in European banks since November 2010. Estimates are based on an equally weighted portfolio of European banks that have MMF exposure during this time period.

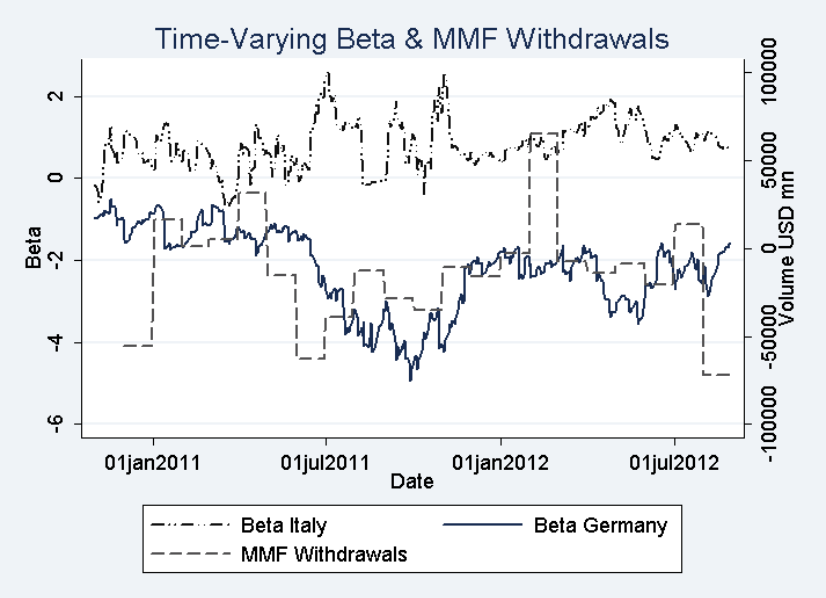
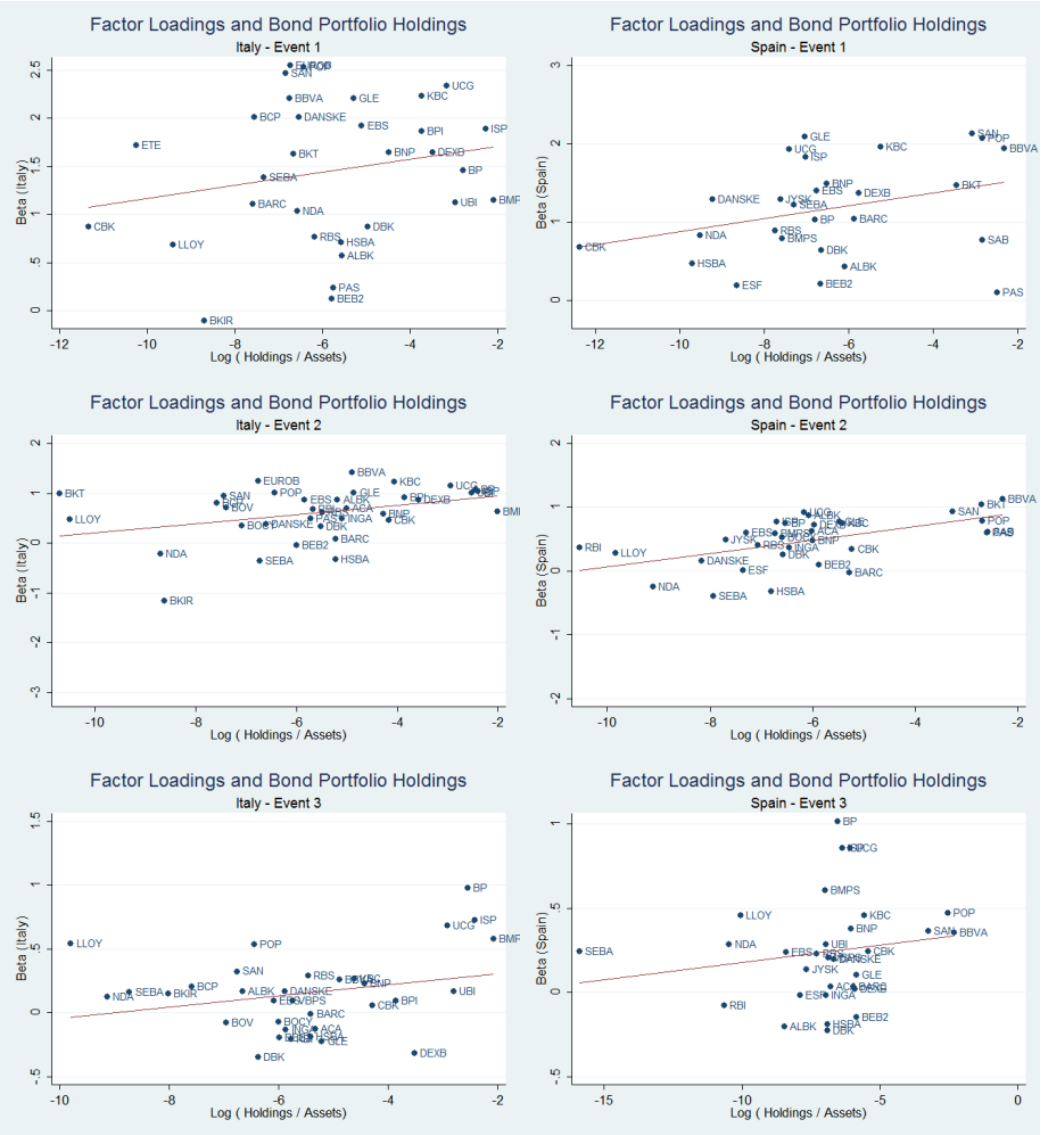


Figure 4. Factor Loadings and Bond Portfolio Holdings

The graph depicts a scatter plot of Log(Beta) estimated from a cross-sectional regression of stock on 10-year Greek and German government bond returns on Log(Holdings / Assets). Factor loadings are estimated within 60 days before and after the reporting date of the portfolio holdings.



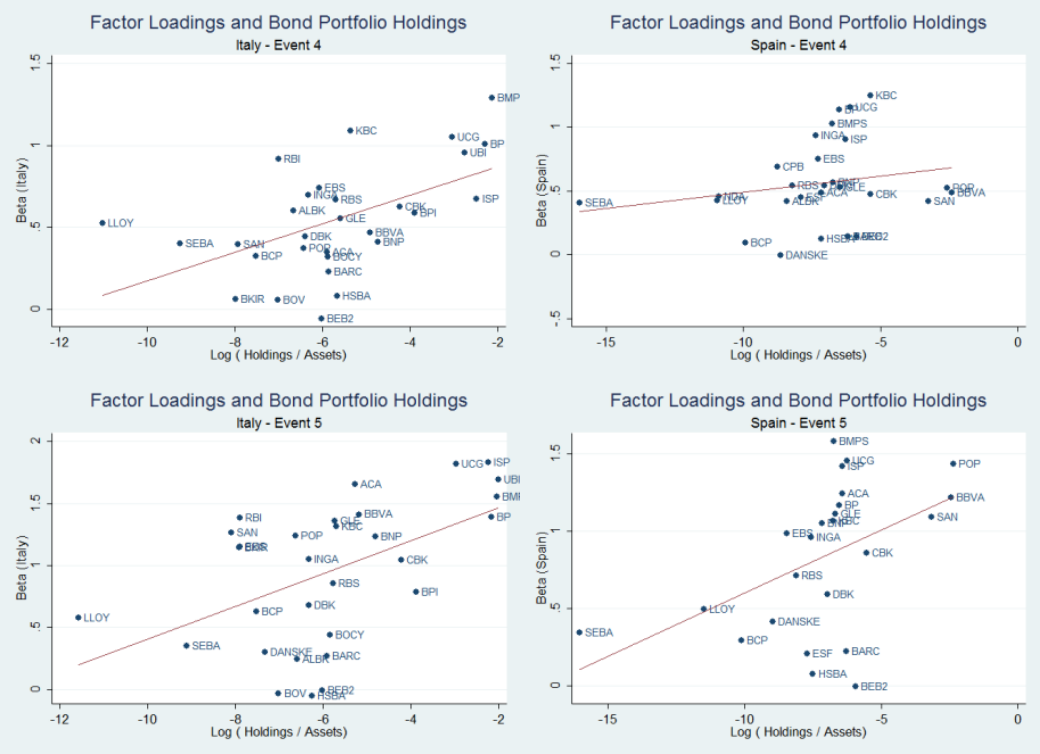

Factor Loadings and Bond Portfolio Holdings
Italy - Event 4
Beta (Italy)
Log (Holdings / Assets)
Factor Loadings and Bond Portfolio Holdings
Spain - Event 4
Beta (Spain)
Log (Holdings / Assets)
Factor Loadings and Bond Portfolio Holdings
Italy - Event 5
Beta (Italy)
Log (Holdings / Assets)
Factor Loadings and Bond Portfolio Holdings
Spain - Event 5
Beta (Spain)
Log (Holdings / Assets)

Figure 5. Cross-Sectional Differences

This graphic plots $\hat{\beta}_{Germany.i}$ measured during the Jan 2011 – Dec 2011 period against US MMF withdrawals in 2011 scaled by total assets.

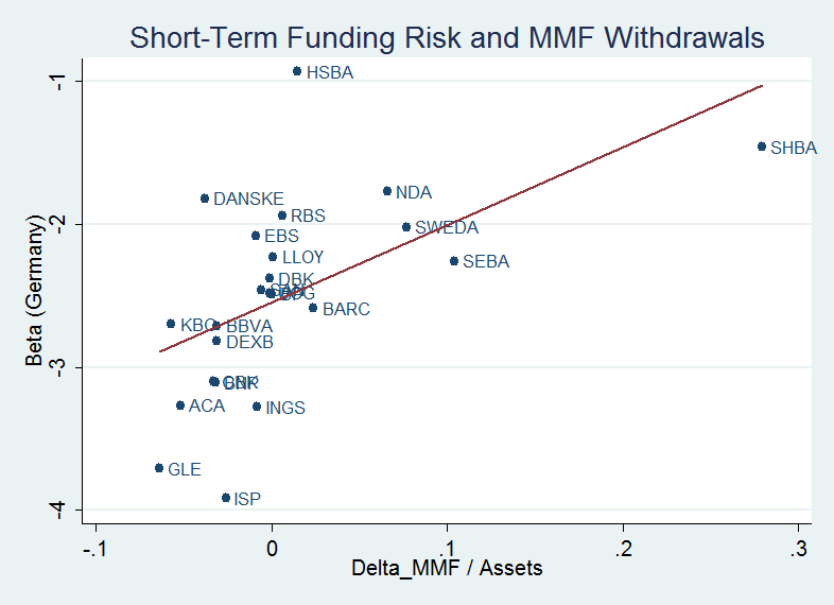


Table 1
Descriptive Statistics on Return Correlations

This table contains descriptive statistics (Panel A) and correlations (Panel B and C) of ten-year sovereign bond returns of Greece, Italy, Portugal, Spain, Ireland, Germany and France.

Panel A. Descriptive statistics of daily sovereign bond returns

Country	Mean (bps)	Std. Dev. (bps)	Variance (bps)	Min (bps)	Max (bps)
Greece	-9.537	176.35	3.11	-2,449.1	4,253.8
Italy	-0.669	50.45	0.26	-445.7	755.1
Portugal	-2.999	107.91	1.16	-1,868.4	1,549.3
Spain	-0.602	50.68	0.26	-362.6	837.1
Ireland	-1.619	71.55	0.51	-791.1	1,076.1
Germany	0.662	38.69	0.15	-224.4	252.22

Panel B. Soverein bond return correlations (2001 - 2007)

	Greece	Italy	Portugal	Spain	Ireland	Germany
Greece	1.00					
Italy	1.00	1.00				
Portugal	0.97	0.96	1.00			
Spain	1.00	1.00	0.97	1.00		
Ireland	0.99	0.99	0.97	0.99	1.00	
Germany	0.99	0.99	0.97	0.99	0.99	1.00

Panel C. Soverein bond return correlations (2007 - 2012)

	Greece	Italy	Portugal	Spain	Ireland	Germany
Greece	1.00					
Italy	0.79	1.00				
Portugal	0.95	0.80	1.00			
Spain	0.78	0.79	0.80	1.00		
Ireland	0.72	0.54	0.82	0.77	1.00	
Germany	-0.79	-0.43	-0.71	-0.62	-0.67	1.00

Table 2
Summary Statistics of Sovereign Bond Holdings

This table reports summary statistics of sovereign bond holdings as reported along with the EBA stress test results. Reporting dates are March 2010, December 2010, September 2011, December 2011 and June 2012.

Panel A

	Greece	Italy	Portugal	Spain	Ireland
March 2010	94,912	264,500	27,154	174,833	24,878
December 2010	85,558	303,999	30,799	200,283	18,221
September 2011	24,579	267,218	28,723	177,466	17,016
December 2011	19,939	223,208	22,267	137,874	16,327
June 2012	1,818	258,894	25,600	148,422	17,494

Panel B

	Greece	Italy	Portugal	Spain	Ireland
No GIPSI banks					
March 2010	34,814	115,472	14,776	29,190	18,677
December 2010	28,208	132,803	14,636	41,923	5,017
September 2011	21,832	103,137	13,975	30,039	3,845
December 2011	17,355	69,243	10,390	22,311	3,528
June 2012	1,672	69,344	10,169	20,615	2,961
GIPSI banks					
March 2010	56,148	144,856	5,176	143,869	5,322
December 2010	54,447	164,011	10,351	154,793	12,466
September 2011[1)]	NA	156,043	10,972	143,629	12,455
December 2011[1)]	NA	147,746	8,180	111,774	12,109
June 2012[1)]	NA	184,171	10,657	124,385	13,848

1) Greek banks were excluded from stress tests

Table 3
Increasing Sovereign Exposure

This table analyses changes in bond holdings between March and December 2010, January and December 2011 as well as between January and June 2012. Panel A reports the change in holdings in Italian and Spanish sovereign debt of Italian and non-Italian (Spanish and non-Spanish) banks as well as the percentage change. Panel B reports the change in Italian (Spanish) bond holdings scaled by total assets segregated by risk factors. High Tier 1 is an indicator variable equal to 1 if a bank's Tier 1 ratio is in the first quartile of the distribution among all banks. High RWA/Assets and High Loans/Assets are indicator variables equal to 1 if the bank's RWA/Assets ratio and Loans/Assets ratio are within the upper quartile of the distribution among all banks. Panel C reports changes in sovereign bond holdings by publicly listed European banks between Dec 31st, 2011 and June 30th, 2012 aggregated to the country level. Changes are reported by bond maturity. <= 3 years (> 3 years) denotes bonds that have a remaining maturity of below / equal to (greater than) 3 years.

Panel A. By Country (Holdings in million euros)

Italian Bank	Δ Italy March'10-Dec'10	Δ Italy Jan'11-Dec'11	Δ Italy Jan'12 – June'12	% Change (2010)	% Change (2012)
No	21,358	-19,345	-589	19.26%	-0.86%
Yes	19,155	-8,297	36,424	13.22%	24.65%
Spanish Bank	Δ Spain March'10-Dec'10	Δ Spain Jan'11-Dec'11	Δ Italy Jan'12 – June'12	% Change (2010)	% Change (2012)
No	16,762	-6,226	-1,758	66.34%	-7.69%
Yes	5,335	-2,464	12,611	3.71%	11.28%

Panel B. By Bank Risk (Holdings scaled by Total Assets)

	Δ Italy March'10-Dec'10	Δ Italy Jan'11-Dec'11	Δ Italy Jan'12 – June'12
High Tier 1	0.022	-0.084	0.365
Low Tier 1	0.491	0.100	0.002
High RWA/TA	0.696	0.145	0.685
Low RWA/TA	0.004	-0.135	0.180
High Loans/TA	0.387	-0.059	0.731
Low Loans/TA	-0.022	-0.031	-0.018

	Δ Spain March'10-Dec'10	Δ Spain Jan'11-Dec'11	Δ Spain Jan'12 – June'12
High Tier 1	-0.015	-0.023	-0.001
Low Tier 1	0.679	-0.100	0.303
High RWA/TA	0.543	-0.029	0.160
Low RWA/TA	0.072	-0.045	-0.032
High Loans/TA	0.505	-0.028	0.077
Low Loans/TA	-0.066	-0.050	-0.025

Panel C. Home Bias

	Italy		Spain	
	<= 3 years	> 3 years	<= 3 years	> 3 years
AT	-473	-4	-100	1
BE	-137	-232	-814	-189
CY	30	-27	0	-5
DE	-48	767	56	-588
DK	158	151	-31	8
ES	1,531	-2,450	6,032	6,579
FR	4,009	-881	345	231
GB	-1,468	-1,791	-956	528
HU	0	0	0	0
IE	1	15	-30	0
IT	28,643	7,782	-65	-271
MT	0	0	0	0
NL	230	-187	-319	142
NO	0	0	0	0
PT	-1	65	-19	27
SE	11	-6	-13	0

Table 4 Panel A
Summary Statistics of Factor Loadings and Bond Holdings

This table reports summary statistics of our carry trade estimates (Panel A), $\hat{\beta}_{\text{Italy}}$, $\hat{\beta}_{\text{Spain}}$ and $\hat{\beta}_{\text{Germany}}$. The carry trade estimates are measured on a quarterly basis for each bank for the pre-2007 as well as 2007-2012 periods.

2007 -2012						
	Obs	Mean	Std-Dev	Min	P50	Max
Factor loadings						
$\hat{\beta}_{\text{Italy}}$	833	1.84	2.00	-3.17	1.40	16.42
$\hat{\beta}_{\text{Spain}}$	833	1.42	2.13	-9.45	0.95	18.64
$\hat{\beta}_{\text{Germany}}$	833	-2.76	2.13	-20.81	-2.44	5.97
No GIPSI banks						
$\hat{\beta}_{\text{Italy}}$	765	1.85	2.05	-3.17	1.39	16.42
$\hat{\beta}_{\text{Spain}}$	731	1.47	2.24	-9.45	0.97	18.64
$\hat{\beta}_{\text{Germany}}$	459	-2.86	2.14	-16.86	-2.54	2.14
GIPSI banks						
$\hat{\beta}_{\text{Italy}}$	68	1.75	1.14	-0.11	1.52	4.98
$\hat{\beta}_{\text{Spain}}$	102	1.02	0.84	-0.90	0.81	3.56
$\hat{\beta}_{\text{Germany}}$	374	-2.63	2.12	-20.81	-2.40	5.97
Pre 2007						
Factor loadings						
$\hat{\beta}_{\text{Italy}}$	769	0.38	3.82	-24.11	0.35	21.18
$\hat{\beta}_{\text{Spain}}$	769	-0.98	7.55	-108.21	-0.13	37.77
$\hat{\beta}_{\text{Germany}}$	769	-0.91	3.87	-19.71	-0.69	19.63
No GIPSI banks						
$\hat{\beta}_{\text{Italy}}$	707	0.29	3.85	-24.11	0.28	21.18
$\hat{\beta}_{\text{Spain}}$	673	-0.94	7.83	-108.21	-0.12	37.77
$\hat{\beta}_{\text{Germany}}$	448	-0.94	3.97	-19.71	-0.72	11.46
GIPSI banks						
$\hat{\beta}_{\text{Italy}}$	62	1.38	3.31	-3.54	1.14	12.85
$\hat{\beta}_{\text{Spain}}$	96	-1.23	5.24	-18.96	-0.24	9.55
$\hat{\beta}_{\text{Germany}}$	321	-0.87	3.72	-16.77	-0.67	19.63

Table 4 Panel B
Banks' Carry Trade Behavior Estimates

This table contains the results of a pooled OLS regression of banks' stock returns on sovereign bond returns. Columns (1) to (5) of Panel A show factor loadings on GIPSI sovereign bond returns individually for Greece, Italy, Spain, Portugal and Ireland and jointly in column (6). All regressions include ten-year German bond returns ($R_{Germany,t}$) as the "funding leg" of the carry trade. $R_{m,t}$ is the residual from the regression of the domestic stock market's daily returns on daily 10 year domestic sovereign bond and German bond returns. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

$$R_{i,t} = \beta_0 + \beta_{GIPSI} R_{GIPSI,t} + \beta_{Germany} R_{Germany,t} + \beta_m R_{m,t} + \varepsilon_{i,t}$$

	(1) R_{Greece}	(2) R_{Italy}	(3) $R_{Portugal}$	(4) R_{Spain}	(5) $R_{Ireland}$	(6) R_{GIPSI}
$\hat{\beta}_{Greece}$	0.095***					0.048***
	(5.73)					(2.73)
$\hat{\beta}_{\text{Italy}}$		0.432***				0.261***
		(5.12)				(2.93)
$\hat{\beta}_{\text{Portugal}}$			0.130***			0.007
			(3.05)			(0.57)
$\hat{\beta}_{\text{Spain}}$				0.427***		0.077
				(8.78)		(1.46)
$\hat{\beta}_{\text{Ireland}}$					0.267***	0.132**
					(5.32)	(2.49)
$\hat{\beta}_{\text{Germany}}$	-2.460***	-2.563***	-2.500***	-2.611***	-2.517***	-2.558***
	(-19.09)	(-23.64)	(-19.40)	(-23.07)	(-19.78)	(-22.70)
$\hat{\beta}_{\text{m}}$	1.359***	1.363***	1.373***	1.367***	1.371***	1.354***
	(14.98)	(15.17)	(15.02)	(15.27)	(15.30)	(15.25)
$\hat{\beta}_0$	-0.001**	-0.001***	-0.001***	-0.001***	-0.001**	-0.001***
	(-2.56)	(-2.94)	(-2.75)	(-2.64)	(-2.58)	(-2.73)
N	55,206	55,206	55,206	55,206	55,206	55,206
R^2	45.66%	45.88%	45.54%	45.86%	45.78%	46.22%

Table 5
Robustness

This table contains the results of a pooled OLS regression of banks' stock returns on sovereign bond returns. Model 1 includes *BondIndex*, the daily average return of sovereign bonds from Euro area members other than GIPSI countries or Germany or France. Model 2 reports factor loadings of home country bond returns (*Home*). Model 3 includes various macro variables: (1) *VSTOXX* is the return of the VSTOXX Index; (2) *TermStructure* is measured as the difference between the yield on a ten-year euro area government bond and the one-month Euribor; (3) *BondDefSpread* is the difference between the yield on ten-year German BBB bonds and yields on ten-year German government debt; (4) *1mEuribor* is measured as the one-month Euribor; (5) Δ*ESI* is the monthly change in the European economic sentiment indicator; (6*)* Δ*IndProd* is the monthly change in the level of industrial production; (7) Δ*CPI* is the change in inflation measured as the monthly change in the European Consumer Price Index. Model 4 reports the results of a principal component analysis (*PCA*); Model 5 uses French bond returns as the funding leg of the carry trade; Model 6 includes Fama-French factors (*SMB, HML*). Models 7 and 8 report the results of the cross-sectional analyses of bank CDS spread changes on GIPSI bond returns. The dependent variable in both models is Δ Log (Bank CDS). Standard errors are clustered at bank and quarter level. t-statistics are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Bond Index	Home Bias	Macro	PCA	Funding Leg	Fama-French	CDS 5 year	
$\hat{\beta}_{Greece}$	0.046***	0.008	0.052***		0.073***	0.046***	-0.150***	
	(2.66)	(0.49)	(3.07)		(4.50)	(2.77)	(-4.77)	
$\hat{\beta}_{\text{Italy}}$	0.247***	0.217**	0.256***		0.735***	0.253***	-0.161	
	(2.80)	(2.39)	(2.84)		(6.68)	(2.92)	(-0.93)	
$\hat{\beta}_{\text{Portugal}}$	0.048	0.029	0.095*		-0.009	0.076	-0.270*	
	(0.79)	(0.55)	(1.80)		(-0.06)	(1.38)	(-1.67)	
$\hat{\beta}_{\text{Spain}}$	0.008	-0.005	0.007		-0.007	0.008	-0.117*	
	(0.66)	(-0.46)	(0.62)		(-0.13)	(0.70)	(-1.94)	
$\hat{\beta}_{\text{Ireland}}$	0.129**	0.119**	0.135**		0.143**	0.132**	-0.203*	
	(2.47)	(2.42)	(2.57)		(1.99)	(2.57)	(-1.90)	
$\hat{\beta}_{\text{Germany}}$	-2.696***	-2.662***	-2.717***	-2.570***		-2.542***	2.913***	2.983***
	(-18.38)	(-23.74)	(-21.47)	(-21.77)		(-22.49)	(6.39)	(6.15)
$\hat{\beta}_{\text{m}}$	1.346***	1.365***	1.419***	1.357***	1.355***	1.348***	-0.745***	-0.755***
	(14.55)	(14.94)	(16.29)	(15.29)	(15.22)	(15.50)	(-7.61)	(-7.62)
$\hat{\gamma}_{BondIndex}$	0.284							
	(1.59)							
$\hat{\gamma}_{Home}$		0.295***						
		(8.34)						
$\hat{\gamma}_{VSTOXX}$			0.088***					
			(3.91)					
$\hat{\gamma}_{\Delta TermStructure}$			0.024					
			(0.24)					
$\hat{\gamma}_{BondDefSpead}$			0.014					
			(0.51)					
$\hat{\gamma}_{1mEuribor}$			0.043					
			(0.64)					
$\hat{\gamma}_{\Delta ESI}$			0.037**					
			(2.38)					
$\hat{\gamma}_{\Delta IndProd}$			0.044*					
			(1.84)					
$\hat{\gamma}_{\Delta CPI}$			-0.084					
			(-0.75)					
$\hat{\gamma}_{PCA}$				0.002***				-0.004***
				(8.60)				(-4.70)
$\hat{\gamma}_{France}$					-2.294***			
					(-8.21)			
$\hat{\gamma}_{SMB}$						0.002		
						(0.08)		
$\hat{\gamma}_{HML}$						0.054***		
						(4.50)		
$\hat{\beta}_0$	-0.001***	-0.001***	-0.002	-0.001***	-0.001***	-0.001***	0.002*	0.003**
	(-2.89)	(-2.80)	(-0.87)	(-3.11)	(-2.77)	(-2.94)	(1.80)	(2.27)
N	55,206	55,206	55,005	55,206	55,206	55,206	29,832	29,832
R^2	46.27%	46.88%	46.47%	46.17%	41.63%	46.34%	13.34%	13.19%

Table 6
Alternative Return Indices

This table reports the results from OLS regressions of daily returns on a value weighted index of EBA Banks (EBA Banks), UK banks (EBA UK Banks), US Banks, macro hedge funds (HFRX Macro), and various country specific industrial indices. There are: MSCI GIPSI, which is an equally weighted index formed from the underlying indices for Italy, Spain and Portugal, MSCI Germany, MSCI Non GIPSI, which is an equally weighted index of the most important countries in Europe other than Germany or the periphery (France, Netherlands, Norway, Denmark and Sweden), and MSCI UK. As market return, we include the Euro Stoxx 600 (STOXX 600) for European indices, the S&P 500 (S&P500) for the US index and MSCI World for the HFRX Macro Hedge Fund index. We also include the Fama-French Factors (SMB and HML). The standard errors were adjusted for heteroscedasticity and auto-correlation using Newey-West with 8 lags. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

	(1) EBA Banks	(2) EBA UK Banks	(3) US Banks	(4) HFRX Macro	(5) MSCI GIPSI	(6) MSCI Germany	(7) MSCI Non GIPSI	8 MSCI UK
$\hat{\beta}_{Greece}$	0.005	-0.004	-0.005	0.000	-0.009	-0.012**	0.002	0.004
	(0.62)	(-0.58)	(-1.29)	(0.05)	(-1.10)	(-1.99)	(0.40)	(0.88)
$\hat{\beta}_{\text{Italy}}$	0.234***	0.179	-0.005	-0.056***	-0.211**	0.095	0.029	0.170**
	(3.39)	(1.62)	(-0.06)	(-2.83)	(-2.19)	(0.97)	(0.61)	(2.43)
$\hat{\beta}_{\text{Portugal}}$	0.013	0.011	0.028	0.003	0.017	-0.037	-0.023	-0.036
	(0.74)	(0.42)	(1.40)	(0.54)	(0.71)	(-1.46)	(-1.62)	(-0.95)
$\hat{\beta}_{\text{Spain}}$	0.091	-0.160	-0.041	0.021	0.162*	-0.055	0.048	-0.112
	(1.26)	(-1.48)	(-0.49)	(0.94)	(1.79)	(-0.57)	(1.03)	(-1.48)
$\hat{\beta}_{\text{Ireland}}$	0.124**	0.144	-0.047	0.034**	0.086*	-0.001	0.019	-0.021
	(2.23)	(1.64)	(-0.84)	(2.19)	(1.79)	(-0.03)	(0.68)	(-0.40)
$\hat{\beta}_{\text{Germany}}$	-2.499***	-2.039***	-1.971***	0.128***	-0.052	-0.094	-0.044	0.069
	(-30.30)	(-16.09)	(-18.46)	(4.27)	(-0.67)	(-0.69)	(-0.73)	(0.72)
$\hat{\beta}_{\text{m}}$	1.406***	1.312***	1.646***	0.031**	0.176***	0.035	0.494***	0.002
	(29.66)	(19.64)	(22.15)	(2.18)	(7.43)	(0.67)	(19.45)	(0.04)
$\hat{\gamma}_{SMB}$	0.000	0.031	-0.012	0.010	-0.000	-0.000	0.000	-0.000
	(0.01)	(0.90)	(-0.39)	(1.46)	(-0.36)	(-0.34)	(0.67)	(-0.25)
$\hat{\gamma}_{HML}$	0.050***	0.045*	0.019	-0.000	0.000**	0.000*	-0.000	-0.000
	(3.15)	(1.77)	(0.78)	(-0.08)	(2.23)	(1.83)	(-0.47)	(-0.34)
$\hat{\beta}_0$	-0.000	-0.000	-0.000	-0.000	-0.001*	0.000	-0.000	-0.000
	(-1.20)	(-0.81)	(-0.14)	(-0.51)	(-1.70)	(0.22)	(-0.71)	(-0.03)
N	1,400	1,361	1,336	1,386	1,406	1,406	1,406	1,406
R^2	77.85%	53.48%	70.27%	2.18%	7.36%	0.63%	38.69%	0.43%

Table 7
Results from Seemingly Unrelated Regressions (SUR)

This table reports the results from seemingly unrelated regression. The sensitivity of equity to GIPSI sovereign bond returns $\hat{\beta}_{GIPSI}$ is taking the form $\alpha_0 + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}}$. The sensitivity of equity to German bond returns $\hat{\beta}_{Germany}$ is taking the form $\alpha_2 + \alpha_3 \frac{\Delta MMF_{i,t}}{Assets_{i,t-1}}$. $\hat{\alpha}_0$, $\hat{\alpha}_1$, $\hat{\alpha}_2$ and $\hat{\alpha}_3$ are point estimates under the constraints: $\alpha_{0,1} = \alpha_{0,2} = \cdots = \alpha_0$, $\alpha_{1,1} = \alpha_{1,2} = \cdots = \alpha_1$, $\alpha_{2,1} = \alpha_{2,2} = \cdots = \alpha_2$, $\alpha_{3,1} = \alpha_{3,2} = \cdots = \alpha_3$ and $\alpha_{4,1} = \alpha_{4,2} = \cdots = \alpha_4$.

$$R_{i,t} = \beta_{0,i} + \alpha_0 R_{GIPSI,t} + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}} R_{GIPSI,t} + \alpha_2 R_{Germany,t} + \alpha_3 \frac{\Delta MMF_{i,t}}{Assets_{i,t-1}} R_{Germany,t} + \beta_{m,t} R_{m,t} + \varepsilon_{i,t}$$

GIPSI	N	$\hat{\alpha}_0$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\alpha}_3$	Prob > chi2
Italy	161	0.296***	11.203***	-2.210***	-8.091***	<0.001
		(7.2)	(10.53)	(-25.47)	(2.58)	
Spain	161	0.399***	4.736***	-2.32***	-10.389***	<0.001
		(8.29)	(8.9)	(-32.48)	(3.45)	

Table 8
Non-Sovereign Cross-Border Exposure of Banks

This table reports the results from cross-sectional regressions of factor loadings ($\hat{\beta}_{\text{Italy}}$, $\hat{\beta}_{\text{Spain}}$) on sovereign bond and real sector holdings of European banks. $\frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}}$ are portfolio holdings by banks of Italian and Spanish government bonds scaled by lagged total assets. $\frac{Real_{GIPSI,i,t-1}}{Assets_{i,t-1}}$ are real sector holdings by banks in Italy, Spain or Greece scaled by lagged total assets. Real sector exposure is the sum of each banks' exposure to the corporate sector, retail sector and commercial real estate sector. All data are from December 2010 (reporting date) and disclosed in the July 2011 stress tests. t-statistics based on White's heteroscedasticity consistent standard errors are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

$$\hat{\beta}_{GIPSI.i,t} = \alpha_0 + \alpha_1 \frac{Real_{GIPSI,i,t-1}}{Assets_{i,t-1}} + \alpha_2 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}} + \omega_{i,t}$$

	$\hat{\beta}_{\text{Italy}}$				$\hat{\beta}_{\text{Spain}}$			
	All	*All*	*All*	*Non-Italian*	*All*	*All*	*All*	*Non-Spanish*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
$\hat{\alpha}_1$	1.148***		-0.602	4.990	0.657**		-0.808	-3.556
	(4.09)		(-0.63)	(0.73)	(2.66)		(-1.41)	(-0.81)
$\hat{\alpha}_2$		8.565***	12.091	36.248***		6.847***	13.158***	71.094
		(2.95)	(1.52)	(2.81)		(3.53)	(3.37)	(1.39)
$\hat{\alpha}_0$	0.845***	0.807***	0.799***	0.685***	0.691***	0.676***	0.676***	0.625***
	(6.84)	(6.38)	(6.20)	(5.14)	(9.53)	(9.36)	(9.32)	(6.56)
N	51	51	51	46	51	51	51	45
R^2	6.01%	8.26%	8.51%	8.47%	6.98%	10.80%	12.17%	5.40%

Table 9
Carry Trade Behavior and Bank Risk

This table reports the results from OLS regressions of banks' stock returns on GIPSI sovereign bond returns (Italy and Spain) and interaction terms of these returns with various bank characteristics: Log-Assets, ST-LVG, Loans-Assets, Tier 1 and RWA/Assets. Bank characteristics are lagged by 1 year and are also included as separate variables which are omitted for brevity. Standard errors are clustered at bank and quarter level. t-statistics are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

	Italy		Spain	
	(1)	(2)	(3)	(4)
$\hat{\beta}_{GIPSI}$	-1.567***	-0.576	-1.364***	-0.849*
	(-3.80)	(-1.19)	(-3.72)	(-1.72)
$\hat{\beta}_{GIPSIx\ Log\text{-}Assets}$	0.083***	0.073***	0.076***	0.081***
	(3.43)	(3.05)	(3.81)	(4.06)
$\hat{\beta}_{GIPSIx\ ST\text{-}LVG}$	0.828**	0.917***	0.610*	0.730**
	(2.31)	(2.84)	(1.81)	(2.15)
$\hat{\beta}_{GIPSIx\ Loans/Assets}$	1.229***		1.152***	
	(6.01)		(5.66)	
$\hat{\beta}_{GIPSIx\ Tier\ 1}$		-0.053***		-0.038
		(-3.47)		(-1.55)
$\hat{\beta}_{GIPSIx\ RWA/Assets}$		0.726***		0.870***
		(3.02)		(4.27)
$\hat{\beta}_{Germany}$	-0.734	0.150	-0.676	0.139
	(-0.47)	(0.09)	(-0.43)	(0.08)
$\hat{\beta}_{Germany\ x\ Log\text{-}Assets}$	-0.091	-0.129*	-0.096	-0.132*
	(-1.21)	(-1.68)	(-1.25)	(-1.73)
$\hat{\beta}_{Germany\ x\ ST\text{-}LVG}$	-1.257**	-1.249**	-1.243**	-1.271**
	(-2.08)	(-2.06)	(-2.06)	(-2.10)
$\hat{\beta}_{Germany\ x\ Loans/Assets}$	-0.507		-0.595	
	(-0.46)		(-0.54)	
$\hat{\beta}_{Germany\ x\ Tier\ 1}$		-0.053		-0.047
		(-1.10)		(-1.03)
$\hat{\beta}_{Germany\ x\ RWA/Assets}$		-0.528		-0.598
		(-0.53)		(-0.61)
$\hat{\beta}_{m}$	1.322***	1.321***	1.326***	1.326***
	(16.04)	(15.90)	(16.15)	(16.03)
$\hat{\beta}_{0}$	-0.001	-0.002	0	-0.002
	(-0.44)	(-1.08)	(-0.35)	(-0.55)
N	39,925	39,711	39,925	39,711
R^2	45.97%	46.08%	45.95%	46.03%

Table 10
Carry Trade Behavior and Bank Risk

This table reports the results from OLS regressions of bank's individual bond holdings on bank risk factors: Log-Assets, ST-LVG, Loans-Assets, Tier 1 and RWA/Assets. Holdings are scaled by banks' total assets. Panel A (Panel B) reports the results for exposures to Italian (Spanish) sovereign debt. All bank characteristics are lagged by 1 year (half-year if available). Standard errors are clustered at the bank level. t-statistics are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

Panel A. Italian bond holdings

$$\frac{Holdings_{GIPSI,i,t}}{Assets_{i,t}} = \beta_0 + \sum \beta_{Risk}\, Risk_{i,t-1} + \varepsilon_{i,t}$$

	Dependent Variable: Italy / Assets					
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}_{Tier\ 1}$	-0.310***			-0.317***	-0.278***	-0.229***
	(-4.42)			(-4.14)	(-3.37)	(-2.78)
$\hat{\beta}_{RWA/Assets}$		0.031***		0.005	-0.021	-0.006
		(3.19)		(0.49)	(-1.30)	(-0.30)
$\hat{\beta}_{Loans/Assets}$			0.028***		0.034**	0.041**
			(2.76)		(2.11)	(2.50)
$\hat{\beta}_{Log\text{-}Assets}$						0.003**
						(2.30)
$\hat{\beta}_0$	0.049***	0.000	-0.006	0.049***	0.034***	-0.023
	(5.06)	(0.10)	(-1.46)	(4.05)	(3.69)	(-0.90)
N	180	195	173	171	148	148
R^2	11.57%	3.13%	3.54%	13.10%	13.66%	15.53%

Panel B. Spanish bond holdings

	Dependent Variable: Spain / Assets					
	(1)	(2)	(3)	(4)	(5)	(6)
$\hat{\beta}_{Tier\ 1}$	-0.179***			-0.087**	-0.131***	-0.062
	(-4.08)			(-2.26)	(-2.75)	(-1.10)
$\hat{\beta}_{RWA/Assets}$		0.036***		0.034***	0.015	0.038**
		(3.87)		(3.19)	(1.24)	(2.08)
$\hat{\beta}_{Loans/Assets}$			0.032***		0.021**	0.031***
			(3.59)		(2.09)	(2.75)
$\hat{\beta}_{Log\text{-}Assets}$						0.004**
						(2.31)
$\hat{\beta}_0$	0.030***	-0.008***	-0.010**	0.004	0.006	-0.072**
	(4.47)	(-2.78)	(-2.57)	(0.62)	(0.98)	(-2.10)
N	180	195	173	171	148	148
R^2	5.22%	7.54%	4.82%	10.20%	10.66%	14%

Table 11
Home Bias and LTROs

This table reports the results of OLS regressions of bank stock returns on GIPSI bond returns interacted with time indicator variables (Before March'10, March'10 – Dec'10, Dec'10 – Sept'11, and After Sept'11). Individual time indicator variable are included but not reported. t-statistics are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
	Italy	Italy non-Italian banks	Italy Italian banks	Spain	Spain non-Spanish banks	Spain Spanish banks
$\hat{\beta}_{GIPSI}$	0.345***	0.286***	0.808***	0.321***	0.320***	0.311***
	(8.00)	(7.63)	(10.84)	(7.88)	(6.81)	(10.87)
$\hat{\beta}_{GIPSI\,x\ Before\ March'10}$	0.261**	0.349***	-0.399**	0.389***	0.446***	0.017
	(2.51)	(3.32)	(-2.25)	(3.75)	(3.90)	(0.08)
$\hat{\beta}_{GIPSI\ x\ March'10\text{-}Dec'10}$	0.162**	0.229***	-0.324**	0.109*	0.131*	0.136
	(2.61)	(3.82)	(-2.13)	(1.80)	(1.95)	(1.18)
$\hat{\beta}_{GIPSI\ x\ Dec'10-Sept'11}$	0.105**	0.128***	-0.042	0.141***	0.142***	0.191
	(2.27)	(2.72)	(-0.37)	(3.28)	(3.01)	(1.99)
$\hat{\beta}_{Germany}$	-2.748***	-2.800***	-2.426***	-2.908***	-3.088***	-1.800***
	(-19.45)	(-18.76)	(-13.95)	(-19.92)	(-21.00)	(-7.98)
$\hat{\beta}_{Germany\ x\ Before\ March'10}$	0.077	0.065	0.222	0.072	0.113	-0.194
	(0.59)	(0.47)	(1.00)	(0.48)	(0.65)	(-1.59)
$\hat{\beta}_{Germany\ x\ March'10\text{-}Dec'10}$	0.146	0.161	0.072	0.356***	0.422***	-0.160
	(1.46)	(1.55)	(0.36)	(3.41)	(3.71)	(-1.46)
$\hat{\beta}_{Germany\ x\ Dec'10-Sept'11}$	0.310***	0.337***	0.092	0.497***	0.559***	0.062
	(4.66)	(4.96)	(0.42)	(7.25)	(7.65)	(0.91)
$\hat{\beta}_{M}$	1.361***	1.378***	1.215***	1.368***	1.421***	1.025***
	(26.20)	(24.64)	(44.65)	(26.15)	(27.58)	(7.58)
$\hat{\beta}_{0}$	-0.001**	-0.001*	-0.001	-0.001**	-0.001**	0.001*
	(-2.11)	(-1.90)	(-0.79)	(-2.06)	(-2.59)	(2.14)
N	55,206	49,063	6,143	55,206	47,745	7,461
R^2	45.91%	44.85%	60.17%	45.93%	45.38%	63.64%

Appendix I
Variable Definitions

Variable	Definition
Greece, Italy, Spain, Portugal, Ireland (GIPSI)	Daily returns on 10-year government bonds issued by Greece, Italy, Spain, Portugal and Ireland
Home	Home is the return from the 10-year government bond of the country in which the bank is headquarters.
BondIndex	BondIndex is the daily average return of sovereign bonds from Euro area members other than GIPSI countries or Germany or France.
PC1	The first principal component (PC1) is the linear combination of GIPSI bond returns with the highest eigenvalue.
Germany	Daily returns on ten-year government bonds issued by Germany.
France	Daily returns on ten-year government bonds issued by France.
Log-Assets	Log-Assets is the natural logarithm of total book assets.
ST-LVG	ST-LVG is short-term debt divided by total debt.
ST-Debt	ST-Debt is short-term debt in million euros.
RWA/TA	RWA/TA is risk-weighted assets divided by total assets.
Loans/Assets	Loans/Assets is customers' loans divided by total assets.
Tier 1	Tier1 is Tier 1 capital divided by risk-weighted assets.
Bank Stock Return (%)	Realized Return is the bank's equity return.
Bank CDS (bps)	Bank CDS is the five-year CDS spread of European banks.
ΔLog(Bank CDS)	Δ Log (Bank CDS) is the change in the log of daily CDS spreads.
$\beta_{Italy}, \beta_{Spain}$	Estimated factor loadings from cross-sectional regressions from banks' stock returns on ten-year government bond returns from Italy and Spain.
ΔMMF	ΔMMF is the monthly withdrawal by US Money Market Mutual Funds in million euros.
Macro-State Variables & Indices	
Stock Index "m"	Stock Index is the residual from the regression of the domestic stock market's daily log returns on daily domestic sovereign bond and German bund returns.
STOXX600	STOXX600 is the daily return of the Euro STOXX 600 Index
S&P 500	S&P 500 is the daily return of the S&P 500 Index.
VSTOXX	VSTOXX is the daily return of the VSTOXX Index for the European stock market.
TermStructure	Term Structure is the slope of the term structure of interest rates measured as the difference between the yield on a ten-year euro area government bond and the one-month Euribor.
BondDefSpread	Bond Default Spread is the difference between the yield on ten-year German BBB bonds and yields on ten-year German government debt.
1 month EURIBOR	One-month EURIBOR is level of the short-term risk-free interest rate measured as the one-month Euribor.
ΔESI	ΔEuropean Economic Sentiment is the monthly change in the economic sentiment indicator obtained from opinion surveys conducted by the European Central Bank.
ΔIndProd	ΔLevel of Industrial Production is the monthly change in the level of industrial production.
ΔCPI	European Consumer Price Index is the change in inflation measured as the monthly change in the European Consumer Price Index.
Fama-French Factor	
SMB	Fama-French-Factor: Small-minus-Big
HML	Fama-French-Factor: High-minus-Low
Time Indicator	
Before March'10	Indicator variable equal to 1 if banks' equity return is observed before March 2010.
March'10 – Dec'10	Indicator variable equal to 1 if banks' equity return is observed between March and December 2010.
Dec'10 – Sept'11	Indicator variable equal to 1 if banks' equity return is observed between December 2010 and September 2011.
After Sept'11	Indicator variable equal to 1 if banks' equity return is observed after September 2011.

Appendix II
List of Banks

This table provides a list of all public banks included in the EBA stress tests sorted by asset size as of December 31, 2011. We provide the identifier used to match the banks to SNL Financial, Bloomberg and the EBA stress test data.

Bank	SNL ID	Ticker	Ticker-Exchange	EBA-ID	Country	Total Assets
Deutsche Bank AG	113830	DBK	DBK-ETR	DE017	Germany	2,164,103
HSBC Holdings Plc	113876	HSBA	HSBA-LON	GB089	United Kingdom	1,967,796
BNP Paribas SA	3001689	BNP	BNP-PAR	FR013	France	1,965,283
Barclays Plc	114508	BARC	BARC-LON	GB090	United Kingdom	1,871,469
Royal Bank of Scotland Group Plc	3001937	RBS	RBS-LON	GB088	United Kingdom	1,803,649
Crédit Agricole SA	4085960	ACA	ACA-PAR	FR014	France	1,723,608
ING Groep N.V.	113837	INGA	INGA-AMS	NL047	Netherlands	1,273,580
Banco Santander SA	113983	SAN	SAN-MAD	ES059	Spain	1,251,525
Société Générale SA	113818	GLE	GLE-PAR	FR016	France	1,181,372
Lloyds Banking Group Plc	4041848	LLOY	LLOY-LON	GB091	United Kingdom	1,161,698
UniCredit SpA	4055762	UCG	UCG-MIL	IT041	Italy	926,769
Nordea Bank AB	4108919	NDA	NDA-OME	SE084	Sweden	716,204
Commerzbank AG	113985	CBK	CBK-ETR	DE018	Germany	661,763
Intesa Sanpaolo SpA	4100801	ISP	ISP-MIL	IT040	Italy	639,221
Banco Bilbao Vizcaya Argentaria, SA	113904	BBVA	BBVA-MAD	ES060	Spain	597,688
Danske Bank A/S	4080954	DANSKE	DANSKE-CSE	DK008	Denmark	460,832
Dexia SA	4024522	DEXB	DEXB-BRU	BE004	Belgium	412,759
Bankia	4280116	BKIA	BKIA-MAD	ES061	Spain	312,343
KBC Group NV	4145062	KBC	KBC-BRU	BE005	Belgium	285,382
Svenska Handelsbanken AB	4144846	SHBA	SHB.A-OME	SE086	Sweden	275,514
DNB ASA	4142645	DNB	DNB-OSL	NO051	Norway	274,216
Skandinaviska Enskilda Banken AB	4144847	SEBA	SEB.A-OME	SE085	Sweden	264,852
Banca Monte dei Paschi di Siena SpA	4182766	BMPS	BMPS-MIL	IT042	Italy	240,702
Hypo Real Estate	4145051	HRX	HRX.ETR	DE023	Germany	236,586
Erste Group Bank AG	4089743	EBS	EBS-WBO	AT001	Austria	210,006
Swedbank AB	4153551	SWEDA	SWED.A-OME	SE087	Sweden	208,464
Bank of Ireland	4041921	BIR	BIR-DUB	IE038	Ireland	154,880
Raiffeisen Bank International AG	4145042	RBI	RBI-WBO	AT002	Austria	146,985
Allied Irish Banks, Plc	4002079	AIB	AIB-DUB	IE037	Ireland	136,651
Banco Popolare Società Cooperativa	4183874	BP	BP-MIL	IT043	Italy	134,127
SNS Real	4185803	SR	SR-AMS	NL050	Netherlands	132,174
Landesbank Berlin Holding AG	4087940	BEB2	BEB2-ETR	DE027	Germany	131,175
Banco Popular Español SA	4144838	POP	POP-MAD	ES064	Spain	130,926
Unione di Banche Italiane SCpA	4238420	UBI	UBI-MIL	IT044	Italy	129,804
National Bank of Greece SA	4048999	ETE	ETE-ATH	GR031	Greece	106,732
Banco Sabadell SA	4151699	SAB	SAB-MAD	ES065	Spain	100,437
Banco Comercial Português SA	4150602	BCP	BCP-LIS	PT054	Portugal	93,482
Espirito Santo Financial Group SA	4050944	ESFN	ESFN-LIS	PT055	Luxembourg	84,020
EFG Eurobank Ergasias SA	4145113	EUROB	EUROB-ATH	GR030	Greece	76,822
Permanent TSB Group Holdings Plc	4332442	IL0	IL0-DUB	IE039	Ireland	72,037
Bankinter SA	4144839	BKT	BKT-MAD	ES069	Spain	59,491
Alpha Bank AE	4080963	ALPHA	ALPHA-ATH	GR032	Greece	59,148
Piraeus Bank SA	4145110	TPEIR	TPEIR-ATH	GR033	Greece	49,352
Banco BPI SA	4182795	BPI	BPI-LIS	PT056	Portugal	42,956
Österreichische Volksbanken AG	4155879	VBPS	VBPS-WBO	AT003	Austria	41,135
Bank of Cyprus Public Company Limited	4055628	BOCY	BOCY-CYP	CY007	Cyprus	37,474
Jyske Bank A/S	4145097	JYSK	JYSK-CSE	DK009	Denmark	36,364
Cyprus Popular Bank Public Co. Ltd.	4238370	CPB	CPB-CYP	CY006	Cyprus	33,762
OTP Bank Nyrt.	4145030	OTP	OTP-BUD	HU036	Hungary	32,413
Banco Pastor SA	4182796	PAS	PAS-MAD	ES074	Spain	30,376
ATEbank SA	4145105	ATE	ATE-ATH	GR034	Greece	28,818
Sydbank A/S	4145111	SYDB	SYDB-CSE	DK010	Denmark	20,649
TT Hellenic Postbank SA	4185792	TT	TT-ATH	GR035	Greece	16,396
Bank of Valletta Plc	4186075	BOV	BOV-MAL	MT046	Malta	6,623
FHB Jelzalogbank Nyrt	4186091	FHB	FHB-BUD	HU111	Hungary	2,593
Caja de Ahorros del Mediterráneo	4120096	CAM	CAM-MAD	ES083	Spain	

Appendix III
Descriptive Statistics

This table reports descriptive statistics of bank characteristics, bond portfolio holdings and short-term funding exposure (Panel A) and of time-series variables (Panel B). All bank characteristics are calculated at the bank level. Variables are defined in Appendix I.

Panel A. Cross-Section

	Obs	Mean	Std-Dev	Min	P50	Max
Log-Assets	56	12.03	1.51	7.91	11.92	14.53
ST-LVG	44	0.33	0.11	0.00	0.32	0.63
RWA / Assets	56	0.49	0.17	0.17	0.52	0.76
Loans / Assets	56	0.59	0.15	0.19	0.63	0.80
Tier 1 Ratio (%)	56	10.15	2.80	5.97	9.63	23.98
Bond Holdings						
Italy / Assets (%)	52	1.12	2.67	0.00	0.14	12.57
Spain / Assets (%)	52	1.00	2.45	0.00	0.05	9.56
ST Funding Exposure						
ΔMMF / Assets (%)	25	0.12	0.73	-1.52	0.18	1.44

Panel B. Time Series

	Obs	Mean	Std-Dev	Min	P50	Max
Daily returns January 2007 - March 2012						
Bank Stock Return (bps)	1,326	-13.21	228.30	-1178.07	-13.38	1338.71
Bank CDS (bps)	1,316	185.22	152.23	6.35	138.53	654.37
Δ Log (Bank CDS) (bps)	1,316	33.92	392.54	-2086.89	15.52	2433.56
Daily Time Series Variables						
STOXX 600 (bps)	1,312	-2.47	153.40	-793.00	3.00	941.00
VSTOXX (bps)	1,304	2.75	630.82	-2491.90	-52.45	3276.70
S&P 500 (bps)	1,245	-0.48	166.83	-946.97	8.39	1095.79
TermStructure (%)	1,315	1.53	1.29	-1.12	1.85	3.41
BondDefSpread (%)	1,326	2.14	1.15	0.74	1.82	5.67
1mEuribor (%)	1,315	2.16	1.66	0.40	1.31	5.20
Monthly Time Series Variables						
SMB	62	-0.08	2.17	-4.64	-0.09	4.85
HML	62	-0.33	2.44	-4.61	-0.47	7.45
ΔESI	62	-0.29	2.35	-6.60	-0.30	4.80
ΔIndProd	62	-0.12	1.23	-4.10	0.04	1.85
ΔCPI	62	0.01	0.32	-1.10	0.00	0.80

Appendix IV
Factor Loadings, Portfolio Holdings and Funding Risk

This table contains the results regressing factor loadings ($\hat{\beta}_{\text{Italy}}$, $\hat{\beta}_{\text{Spain}}$, $\hat{\beta}_{\text{Greece}}$) on sovereign bond holdings. $\frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}}$ are portfolio holdings by banks of Italian, Spain or Greek government bonds scaled by lagged total assets. Scale variables are total assets (TA) and book value of equity (BV). Factor loadings are estimated 60 days before and 60 days after the reporting date for each bank. Quarterly fixed effects are included. t-statistics based on White's heteroscedasticity consistent standard errors are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

Panel A. Sovereign bond exposures

$$\hat{\beta}_{GIPSI.i,t} = \alpha_0 + \alpha_1 \frac{Holdings_{GIPSI,i,t-1}}{Assets_{i,t-1}} + \omega_{i,t}$$

GIPSI	**N**	$\hat{\alpha}_0$	$\hat{\alpha}_1$	R^2
Scaled by Total Assets				
Italy	194	0.756***	7.845***	7.41%
		(11.10)	(5.26)	
Spain	194	0.653***	6.161***	4.31%
		(13.10)	(2.70)	
Scaled by Book Value of Equity				
Italy	194	0.753***	0.468***	6.53%
		(10.91)	(4.46)	
Spain	194	0.650***	0.372***	4.18%
		(12.96)	(2.66)	

Panel B. Money Market Fund Withdrawals

Panel B reports the results from cross-sectional regressions of factor loadings ($\hat{\beta}_{Germany}$) on measures of US MMF withdrawals of European banks. We use total assets (*TA*), lagged MMF exposure (MMF_{t-1}) and short term debt (*ST-LVG*) as scale variables. Quarterly fixed effects are included. T-statistics based on White's heteroscedasticity consistent standard errors are given in parentheses. ***,** and * indicate significance at 1, 5 and 10% levels respectively.

$$\hat{\beta}_{Germany.i,t} = \alpha_2 + \alpha_3 \frac{\Delta MMF_{i,t}}{MMF_{i,t-1}} + \omega_{i,t}$$

	N	$\hat{\alpha}_2$	$\hat{\alpha}_3$	R^2
ΔMMF / MMF_{t-1}	135	-2.451***	-0.538***	6.54%
		(-33.65)	(2.98)	
ΔMMF / $Assets_{t-1}$	135	-2.467***	-12.391***	10.81%
		(-34.59)	(3.92)	
ΔMMF / ST-$Debt_{t-1}$	89	-2.486***	-1.580***	14.51%
		(-31.86)	(3.71)	