Dealing with Dealers: Sovereign CDS Comovements in Europe*

Miguel Antón
IESE Business School

Sergio Mayordomo+
Universidad de Navarra

María Rodríguez-Moreno
Universidad de Navarra

First Draft: November 2013

* Antón: Department of Finance, IESE Business School, Av. Pearson 21, 08034 Barcelona, Spain. Email: manton@iese.edu. Mayordomo and Rodríguez-Moreno: Department of Economics and Business Administration, University of Navarra, Edificio Amigos, 31009 Pamplona, Spain. Email: smayordomo@unav.es and mrodriguezm@unav.es . This paper was partially drafted and circulated while Sergio Mayordomo was at the Spanish Securities and Exchange Commission under the title "Intraday credit risk spillovers in the European sovereign CDS market". We are very grateful for comments from Ana Babus, Xavier Freixas, Mireia Giné, Antonio Moreno, Fulvio Pegoraro, Tano Santos, Neal Stoughton, Carles Vergara, Xavier Vives, Pierre-Olivier Weill, Haoxiang Zhu, as well as conference participants at the 7th Financial Risks International Forum in Paris 2014, the Arne Ryde Workshop in Financial Economics in Lund 2014, and seminar participants at IESE Lunchtime workshop. Miguel Antón acknowledges the financial support of the European Commission, Marie Curie CIG (GA no. 303990), and the financial support of the Spanish Ministry of Economy and Competitiveness (Project ref: ECO2011-29533) at Public-Private Sector Research Center - IESE Business School, University of Navarra, Spain. Sergio Mayordomo acknowledges financial support from PIUNA (University of Navarra) and the Spanish Ministry of Economy and Competitiveness (grant ECO2012-32554).

+ Corresponding author.

Dealing with Dealers:
Sovereign CDS Comovements in Europe

ABSTRACT

A simple measure of commonality in the quotes that dealers give for Sovereign European CDS is a powerful predictor of cross-sectional variation in CDS return correlation, controlling for liquidity and default risks, and other country-pair characteristics and macro variables. We show that these results are consistent with a non-fundamental price pressure mechanism in two different ways. First, the predicting effect of the commonality is stronger for dealers that experience selling pressure, and secondly, we show that the effect comes primarily from uninformed dealers. An instrumental variable analysis and the use of the "CDS naked" ban from the German BaFin as exogenous shock confirm that our findings reflect indeed a causal relation between commonality in quotes and CDS return comovement.

JEL Classification: G12, G14.

Keywords: Sovereign CDS, comovements, commonalities, dealers.

I. Introduction

Credit Default Swap (CDS) spreads have been widely used as a measure of credit risk, because they provide insurance against the default of an underlying security. Regulators and academics continue to use them as a key tool to assess the creditworthiness of a bond or an entity. An increasing body of literature has shown, however, that CDS spreads not only convey information about credit risk, but also about liquidity and counterparty risk.[1] Much less attention has been given, however, to the sources of comovement in CDS spreads. Understanding the drivers of these correlations is central to regulatory and policy work, as they are at the heart of systemic risk by definition –stronger interlinks between different entities reveal a higher systemic risk. If this is important among corporate contracts, it is crucial with sovereign CDS, especially in Europe, as a credit event in one country can have a strong impact in the whole Euro area.

We focus on connecting countries through the CDS dealers they have in common. Specifically, we show that a simple measure of commonality in the quotes that dealers give for Sovereign European CDS is a powerful predictor of cross-sectional variation in CDS return correlation, controlling for liquidity and default risks, and other country-pair characteristics and macro variables.

The analysis also explores cross-sectional variation in the strength of the effect. In particular we show that the commonality in the quotes given by dealers has a stronger effect on subsequent correlation when the common dealers have excess inventory risk and face selling pressure. Dealers aiming to sell protection for the two countries at the same time leads to a larger comovement, due to the effect of forced selling at fire sale prices. We also find that commonality in quotes from dealers that are uninformed on the CDS prices leads to stronger comovements, given that they tend to review prices similarly for the two countries in the pair when they lack information.

[1] See Longstaff, Pan, Pedersen and Singleton (2005) for liquidity risk in CDS, and Arora, Gandhi, and Longstaff (2012) for counterparty risk.

CDS market dealers play a crucial role in providing liquidity to the market by disseminating bids and offers to potential clients, seeking to trade credit protection.[2] Although a few papers analyze the effect of the liquidity provision on CDS prices, not much is known about the effect of dealers' liquidity provisions on CDS price comovements. In this paper, we offer new insights on that issue by exploiting available data provided by CMA that consists of intraday quotes for 11 European Monetary Union countries. The reason for focusing in the EMU is threefold. First, the levels of contagion among these countries during the current European sovereign debt crisis have been very strong and have persisted for a long period of time. Second, the activity in the sovereign CDS has increased significantly. The gross notional amount outstanding by the end of 2008 was $405 billion, while by the end of our sample (October 2011) the gross notional amount outstanding for the 11 European countries was $1,047 billion. In fact, according to data provided by DTCC, France, Italy, and Germany where the top 3 reference entities in terms of the net notional amount outstanding by September 2011, including sovereign and corporate references, being Spain the 5th reference entity. Belgium, Austria and Portugal were in the 11th, 12th, and 14th place, respectively. Third, all the CDS have similar characteristics in terms of currency, restructuring clause, and timing.

CDS data vendors employ their methodologies to offer daily quotes that are obtained after combining the quotes received by different dealers. We test whether the common quotes reported by the same dealer for a given pair of countries affect the correlation of CDS spreads, and find that they do. The effect of the commonality in quotes is significant at any standard significance level and has a very strong forecasting power on the future comovements among sovereign CDS spreads. In fact, the economic impact of the commonality variable is stronger than the one attributable to the remaining explanatory variables, including the traditional fundamental variables.

[2] The importance of dealers' activity in the CDS market is remarkable. At the end of 2011, dealers accounted for 58% of notional amounts outstanding, and 64% of gross market values in the CDS market. Additional evidence is provided by Robert Pickel, CEO of ISDA, in his testimony to Congress in March 10, 2009, stating that 86% of the Depository Trust & Clearing Corporation (DTCC) trades were dealer-to-dealer trades. Finally, Tang and Yan (2010) also sustain that most CDS contracts are traded through dealers who either trade with other dealers directly or trade through an interdealer broker.

The relationship between commonality in quotes and CDS return correlation could also go the other way, so endogeneity is a key concern. For example, dealers could choose to give more quotes to countries whose CDS prices are more correlated. To address this concern we provide two pieces of evidence. We first implement an instrumental variable approach, and use the leverage of brokers and dealers as proxy for the commonality in quotes given by dealers. The mechanism through which the excess correlation is caused is the selling of CDS at fire sale prices, because some dealers reach their risk-bearing capacity. In this sense, brokers and dealers' leverage proxies well for the risk bearing appetite of dealers, as stated recently by Adrian, Etula, and Muir (2013). Also, a standard test shows that the instrument is valid. Secondly, we use an unexpected ban of naked CDS by the German Securities and Exchange Commission (BaFin) on May 18, 2010. This unexpected event resulted in the willingness of dealers to reduce their inventories, which in turn results in exogenous variation in commonality in quotes. These two pieces of evidence confirm that our finding comes indeed from a causal relation between commonality in quotes and CDS return comovement.

Finally we show that our finding is robust to the exclusion of Greece in the analysis, to the use of pre-crisis and crisis periods, to the use of filtered CDS returns to a market model, and to different definitions of commonality in quotes. The rest of the paper is organized as follows. In Section 2, we review the literature. In Section 3, we describe our methodology and data sources. Section 4 presents our results. In Section 5 we present our conclusions.

II. Literature Review

Our work links to papers studying the comovements or correlations between the CDS spreads of the EMU countries during the current European sovereign debt crisis. Independently of the econometric methodology employed to measure contagion, these papers document an increasing trend in the comovements of credit risk indicators in the EMU countries since the beginning of the crisis (see Andenmatten and Brill (2011), Zhang, Schwaab, and Lucas (2011), Alter and Schüler (2012), Kal-

baska and Gatkowski (2012), Gündüz and Kaya (2013), Manasse and Zavalloni (2013), among others). In this process of contagion, peripheral countries have become more vulnerable to the euro zone contagion and have exhibited stronger comovements between them.

In spite of the growing literature on the drivers of credit risk and CDS returns in European countries in the context of the European sovereign debt crisis; little is known about the determinants of the observed comovements and interlinkages of the countries' levels of credit risk and in CDS returns. The potential set of drivers could be relatively similar to the drivers that explain and predict corporate CDS prices: default, liquidity, risk premium, and counterparty risk factors (see Anderson (2012) or Pu and Zhao (2010)).[3] For example, the role of the default factors is documented by Manasse and Zavalloni (2013), who find that the country macro fundamentals during crisis period explain 80% of the vulnerability of a given country to contagion. Besides macro fundamentals, Alter and Schüler (2012) document that financial sector shocks also affect sovereign CDS spreads in the short-run. In the same line, Dieckmann and Plank (2012) show that the high correlations observed since the beginning of the financial crisis are explained by the state of a country's domestic financial system (it affects the expectations about bailouts and the burden of government intervention).

We share some of the objectives pursued by these previous papers by analyzing the effect of country specific and global variables referring to default risk, liquidity, and risk appetite on the correlations among EMU sovereign CDS spread changes. Given that previous literature has left a significant part of these correlations unexplained, our aim is to build on previous literature and test whether the CDS market structure and their dealers' activity helps improve the explanatory power on such correlations. The importance of dealers in the CDS market described above highlights the role of the dealers' activity in the CDS prices comovements.

[3] These factors have also been found to be significant determinants of the EMU sovereign bond and CDS spreads by Geyer, Kossmeier, and Pichler (2004), Beber, Brandt and Kavajecz (2009), Mayordomo, Peña, and Schwartz (2012), Favero, Pagano, and Von Thadden (2010), Bernoth, von Hagen, and Schuknecht (2012), or Badaoui, Cathcart, and El-Jahel (2013), among others.

The inability of fundamentals to fully explain these comovements links to Barberis and Schleifer's (2003) theory. They develop a theory where assets commove beyond fundamentals, because of market frictions or noise-trader sentiment. They provide evidence in Barberis, Schleifer, and Wurgler (2005) in support of the alternative friction-based view, using data on inclusions into the S&P 500.

Our analysis focuses on the effect of two specific market frictions on the CDS prices comovements. On the one hand, we consider the effect of asymmetric information from the prior that not all dealers are equally informed at every date. On the other hand, we consider the effect of the inventory risk that could cause that some dealers suffer selling pressure in the CDS contacts of a given set of countries.

Market liquidity can be provided by both informed and uninformed agents. Empirical literature has documented that market players in the stock market are asymmetrically informed about asset values and that financial market transactions may convey private information about fundamental values (see Hasbrouck (1991a), Hasbrouck (1991b), or Dufour and Engle (2000), among others). The phenomena of asymmetric information and its effect on the asset prices should be even more obvious in OTC markets. Dufour and Nguyen (2012) analyze the informational content of trading activity in the euro area sovereign bonds and find a strong evidence of information asymmetry in this market that explains the cross-sectional variation of bond yields.

Recent studies referred to the CDS market such as Acharya and Johnson (2007), Berndt and Ostrovnaya (2008), and Angelopoulos and Giamouridis (2012) document the existence of informed trading in the CDS market on the basis of the equity market as a benchmark for public information. The better informed dealers in the CDS market could be major banks that may have access to non-public information on CDS obligors, through their lending and investment banking activities, and can potentially trade on this information (Acharya and Johnson (2007)).

The information heterogeneity affects to the CDS prices (Gündüz, Nasev, and Trapp (2013), and Tang and Yan (2010)) and their liquidity (Qiu and Yu (2012)).

Gündüz, Nasev, and Trapp (2013) use a proprietary dataset of CDS transactions to show that CDS premia contain a significant non-default related component which CDS traders charge to protect themselves against informational and real frictions. Tang and Yan (2010) show that CDS net buying interest has information content for future corporate CDS price changes. Qiu and Yu (2012) study the determination of liquidity provision in the single-name CDS market as measured by the number of distinct dealers providing quotes and support the existence of endogenous liquidity provision by informed financial institutions. They conclude that the degree of information heterogeneity plays an important role in how liquidity is reflected in the CDS premium. They measure information flow from the CDS market to the stock market. In our approach, however, we only use information exclusively from the CDS market, because there is a lack of "sovereign equity prices".

Another friction affecting financial market is the existence of inventory risk that could derive in selling pressure. The probability that intermediaries face selling pressure increases remarkably during liquidity crisis as the ongoing financial crisis. As explored in Pedersen (2009), in August 2007 there was a significant liquidity event in which some quants were forced to unwind and others also reduced positions leading to a strong price pressure and liquidity spirals, in which selling leads to more selling and even forced selling. As stated by Mitchell, Pedersen, and Pulvino (2007), the continued selling pressure from the proprietary trading desks is caused by internal capital constraints that were likely imposed as a result of the large losses. In this vein, Brunnermeier and Pedersen (2009) provide a model that links a security's market liquidity and traders' funding liquidity. When dealers hit their capital constraints then they are forced to reduce their positions; this leads to an excess supply and so the price declines, which in turn leads to higher margins, further tightening the dealers' funding constraint, and so on.

Shachar (2013) documents a significant effect of inventory risk on corporate CDS prices. Using a proprietary dataset on transactions of CDS contracts on North American financial firms, she examines the role of liquidity provision by dealers in the

CDS market, and finds that order imbalances of end-users cause significant price impact.

Shocks to the funding constraint of the dealer sector affect all securities traded by a given dealer and so, they could propitiate cross-stock price pressure. Ho and Stoll (1983) show that when the dealer trades more than one stock, she not only lowers the bid and ask quotes in the stock he recently bought to reduce inventory levels but also adjusts quotes in other stocks to reduce his total inventory risk. The magnitude of quote adjustments in the other stocks depends on underlying correlations. In the same vein, Andrade, Chang, and Seasholes (2008) use data from the Taiwan Stock Exchange to document that an imbalance in one stock also affects the price of other stocks. They show that this cross-stock price pressure is higher among stocks with more correlated cash flows than among stocks with less correlated cash flows.

The effect of liquidity shocks affecting financially constrained intermediaries on the comovements of fixed income instruments' returns has been documented by Acharya, Schaefer, and Zhang (2008). They document an increase of liquidity risk for market-makers around the episode of GM and Ford downgrades in May 2005 due to a wide-spread sell-off in their corporate bonds. This is shown by a significant imbalance in the dealer quotes towards sales. They show that this imbalance towards sales in the volume and frequency of quotes on GM and Ford bonds explains a significant portion of the excess comovement in the bond and CDS prices of all industries, not just in those of auto firms. The effect was stronger for firms with a sub-investment grade compared to investment-grade firms, consistent with the hypothesis that intermediaries withdrew liquidity more sharply from bonds with greater inventory risk.[4] In the same vein, Micu, Remolona, and Wooldridge (2006) show that the price impact of rating downgrades on CDS not only from their information content but also from selling pressure by restricted investors. The price pressure from restricted investors

[4] The stronger effect on sub-investment grade firms suggests that regulation could also cause some selling pressure on downgraded countries. Ellul, Jotikasthira, and Lundblad (2011) paper investigates fire sales of downgraded corporate bonds induced by regulatory constraints imposed on insurance companies. Thus, insurance companies that are relatively more constrained by regulation are, on average, more likely to sell downgraded bond that generates selling pressure around the downgrade which causes price pressures such that prices could deviate from fundamental values.

should have a temporary impact given that informed trader would drive price back to the fundamental value. Nevertheless, this mean reversal could not occur in poor liquidity conditions.

As discussed above, previous studies have employed transaction prices to document the effect of market frictions on the CDS prices. We provide evidence on the effect of these frictions on the comovements in CDS returns. CDS prices are constructed through a compilation of quotes collected from the participants in the CDS market. Nevertheless, the lack of information on quotes at the dealer level leaves a gap in the literature documenting the role of dealers' activity on CDS contracts. The access to the quotes reported for each specific dealer enables us to fill this gap in the literature and provide new evidence about the role of non-fundamental factors in explaining such comovements in periods in which market frictions in the CDS emerge. In a first stage, we find a significant role of the dealer commonalities in quotes across countries on the comovements of the changes in their CDS spreads. In a second stage, we document a significant effect of the information asymmetries and the inventory risk, which derives in selling pressure, faced by the CDS market dealers on the comovements of CDS spreads. These results are robust to a wide variety of alternative specifications.

III. Data and Methodology

A. Data and Sample

Intraday CDS quotes disaggregated at the contributor or dealer level come from a dataset provided by CMA, for 11 European countries (Austria, Belgium, Finland, France, Germany, Greece, Netherlands, Ireland, Italy, Portugal, and Spain), and spanning from January 2008 to October 2011. The intraday CDS dealer quotes (both executable and indicative) come from over-the-counter communication between CDS dealers and buy-side institutions, including hedge funds and investment banks' proprietary trading desks.[5] The daily data reported by CMA comes from these intra-

[5] As explained in Qiu and Yu (2012), the process of trading in the CDS market usually begins with clients receiving indicative quotes from dealers through information providers such as Bloomberg. They then initiate a request-for-quote with a single dealer or multiple dealers by phone, email, or through an electronic trading platform. Dealers can respond with competitive binding quotes that often

day quotes. CMA collects the buy-side data for every contract and aggregates it to a daily frequency (requiring at least three distinct dealers). CMA implements then several procedures to mitigate the influence of outliers.

CDS quotes employed in this study are 5-year maturity contracts (the most liquid one) denominated in US Dollars. For those observations for which we only have information on the CDS up-front prices but not for the CDS spreads, we calculate the spread following the ISDA CDS Standard Model to convert upfront payments into spreads.[6] To guarantee a minimum level of synchronicity, we exclude quotes outside the main working hours (7am to 8pm GMT+1) and quotes given on Saturdays and Sundays.[7] Information related to control variables comes from other sources, explained in subsequent subsections.

Table I reports the summary statistics of the final sample of CDS quotes and the share of quotes by dealers. Panel A disaggregates at country level the total number of quotes and dealers, as well as the daily average. We have more than half a million of quotes for every peripheral country over the whole sample period (i.e., more than 572 quotes on daily average). The total number of quotes in the core countries ranges from 469,751 (France) to 331,887 (Finland). Regarding the number of dealers giving quotes to a certain country we do not observe sizeable differences across countries. We observe that there are around 90 dealers providing quotes to the 11 European countries. Nevertheless, Panel B shows that not all dealers are equally active. Concretely, the 10 most active dealers provide 45.9% of the total number of quotes in our sample and the 30 most active dealers cover the 90.8% of the total number of quotes.

< Insert Table I here >

Comovements in the sovereign CDS are computed as the monthly correlation of daily sovereign CDS returns for countries i and j in month, $\rho_{ij,t}$, for the sample of 11

result in actual transactions. They can also respond with non-competitive quotes with wide bid-ask spreads or choose not to provide quotes if they do not wish to trade.

[6] http://www.cdsmodel.com/

[7] Quotes outside these hours, and in weekends, are scarce. In fact, they represent 2.25% of all observations. Due to the low percentage of excluded quotes, we find similar results when we include them in our analysis.

European countries (55 different country-pairs) and for the period of January 2008 to October 2011. Figure 1 shows the median of $\rho_{ij,t}$, jointly with the 5th and 95th percentiles. From the beginning of the sample to the Lehman Brothers collapse we observe a wide dispersion across correlation ranging from -0.45 to 0.96. Since September 2008, the median of the correlations fluctuates steadily between 0.5 and 0.9. The 5th and 95th bands show a small dispersion in March 2009, due to the implementation of the economic stimulus package in the US, and in May 2010, due to the Greek bailout request. However, we observe a greater dispersion since May 2010, where there is a sizeable decrease of correlations in the 5th percentile. This comes as a consequence of the disproportionately large increase of the Greek and other peripheral CDS premia in comparison to the core countries CDS premia. Table II reports the descriptive statistics of the monthly correlation of daily sovereign CDS returns for countries *i* and *j* in month *t* jointly with alternative specifications of this correlation.

<Insert Figure 1 and Table II here>

B. Measuring Commonality in Quotes

i. *Common quotes reported by the same dealer for a given pair of countries.*

Our main variable of interest measures the amount of common quotes given by different dealers to each pair of countries each month. We label this variable *Commonality in* Quotes, and define it as:

$$Commonality\ in\ Quotes_{abt} = \frac{\sum_{d=1}^{D} \min(NQ_{adt}, NQ_{bdt})}{TQ_{at} + TQ_{bt}} \quad \in [0,0.5] \qquad (1)$$

where NQ_{adt} and NQ_{bdt} are the number of quotes given to country a and country b respectively by dealer d in a given month t while TQ_{at} and TQ_{bt} are the total number of quotes given by all dealers to countries a and b at time t, respectively. This variable captures the connectivity of countries a and b due to commonality in quotes given by CDS dealers. If a dealer gives 1 quote to France, and 10 quotes to Spain, we say that France and Spain only share "1 common quote" from that dealer, the minimum of the

two. We then aggregate that value for all dealers giving quotes to both countries, and normalize it dividing it by the sum of total quotes given to France and Spain.

Figure 2 shows the median of the variable commonality in quotes, together with its 5th and 95th percentile bands. By construction, the variable ranges from 0 (no commonality in quotes) to 0.5 (strong commonality in quotes). We observe that from the beginning of the sample to May 2009 the median performs an upward trend increasing from 0.22 to 0.47 while the 5th and 95th percentiles tighten reaching the tightest point in May 2009. There is a clear and significant time-series, and cross-sectional variation in this variable.

< Insert Figure 2 here>

ii. *Commonality in quotes and selling pressure reported by the same dealer for a given pair of countries depending on her selling pressure*

We now turn to a more disaggregated version of the commonality in quotes. Dealers giving low ask prices are more willing to sell than dealers giving high ask prices. There are different reasons why a dealer could give a low ask price, and thus be willing to sell. If the dealer gives quotes based on information, then she could give low ask prices for one country and high ask prices for another country. If, however, the dealer is giving low ask prices in both countries, she might be facing some inventory-related problem, and might be willing or forced to sell part of it (Shachar (2013)).

To capture the effect of this selling pressure, we decompose the variable *Commonality in Quotes* in two variables. *Commonality from Selling Pressure* is defined as in Equation (1), but we only use the quotes whose ask price is in the first quartile for countries a and b relative to the total number of quotes of dealer *d.* A low ask price in the two countries at the same time would indicate that the dealer is aiming to sell protection for the two countries and so, it could lead to a larger comovement, due to the effect of forced selling at fire sale prices (see Antón and Polk (2013), and Lou (2013)). The second variable captures the combinations that do not come from selling pressure, i.e., where the ask price is not in the first quartile in any of the two countries, and we label it as *Commonality not from Selling Pressure*.

iii. *Commonality in quotes and market information*

To test the information channel in our analysis, we estimate the effect of the common quotes reported by dealers to two countries depending on their degree of information on the CDS price.

To define the dealers as informed/uninformed we employ the Gonzalo and Granger's (1995) model which is based on the following Vector Error Correction Model (VECM) specification and is used to study the effectiveness of the different dealers in terms of price discovery:

$$\Delta X_t = \alpha\beta' X_{t-i} + \sum_{i=1}^{p} \Gamma_t \Delta X_{t-i} + u_t \qquad (2)$$

where Equation (2) is a system of two equations constructed from a vector auto-regressive (VAR) and an error correction term (ECT). The vector X_t includes a pair of CDS quotes or prices of the same underlying country from a given dealer and the average CDS quote of the remaining dealers in the market. The ECT is defined by the product $\beta' X_{t-1}$ where $\beta' = (1, \beta_2, \beta_3)$ are estimated in an auxiliary cointegration regression. The series for the pair of CDS prices included in X_{t-1} must be cointegrated to develop this analysis and the cointegrating relation is defined by $\beta' X_{t-1} = (CDS_{DEALER\ 1,t-1} - \beta_2 - \beta_3 CDS_{DEALER\ 2,t-1})$ which can be interpreted as the long-run equilibrium. The parameter vector $\alpha' = (\alpha_1, \alpha_2)$ contains the error correction coefficients measuring each price's expected speed in eliminating the price difference and it is the base of the price discovery metrics. The parameter vector Γ_i for $i = 1, .. p$, with p indicating the total number of lags, contains the coefficients of the VAR system measuring the effect of the lagged first difference in the pair of CDS quotes on the first difference of such quotes at time t.[8] Finally, u_t denotes a white noise vector. The percentages of price discovery of the CDS quote i (where $i = 1, 2$) can be defined from the following metrics GG_i, $i = 1,2$ which are based on the elements of the vector α':

$$GG_1 = \frac{\alpha_2}{-\alpha_1 + \alpha_2};\ GG_2 = \frac{-\alpha_1}{-\alpha_1 + \alpha_2} \qquad (3)$$

[8] The optimal number of lags is determined by means of the Schwarz information criteria.

The vector α' contains the coefficients that determine contribution to price discovery by the individual dealer and the average dealer. Thus, given that GG_1+GG_2=1 we conclude that dealer 1 leads the process of price discovery with respect to average contributions of the remaining dealers whenever dealer 1 price discovery metric GG_1 is higher than 0.5. The closer to 1 (0) the higher (lower) the ability of the dealer is. We estimate the price discovery metric for each country, month, and dealer using all the possible pairs of CDS spreads. The price discovery metrics are estimated using intraday information over the period January 2008 – October 2011. In order to guarantee a minimum of synchronicity in quotes we group the quotes in ranges of two hours. Thus, for the range 7.00 AM to 9.00 AM (GMT+1) the CDS price to be employed in the price discovery analysis is the average price within such range. We estimate the price discovery metrics on a monthly basis using rolling windows of intraday prices in the last quarter. That is, we use a maximum of around 460 observations per estimation. We estimate the price discovery metric for a given dealer in a given month when the dealer has reported quotes in at least 22 working days in the last quarter.[9] The missing observations are replaced by the last available intraday quote in order to guarantee an adequate number of observations for the estimation. We use information for a total of 33 dealers that according to Panel B of Table I represent more than 91% of the total quotes in the CDS market.

Commonality in quotes depending on information is defined then as:

$$Commonality\ in\ Quotes_{iabt} = \frac{\sum_{d=1}^{D_i} \min(NQ_{iadt}, NQ_{ibdt})}{TQ_{iat} + TQ_{ibt}}\ where\ i = I, NI, R \qquad (4)$$

where *i* denotes the level of information of the dealer *d* in the CDS prices of countries *a* and *b*. We consider three possibilities about the degree of information of dealer *d*: (i) he is informed about both countries *a* and *b* (I), (ii) he is not informed about any of the two countries (NI), (iii) he is informed about one country but is not about the other country (R). Thus, we have a commonality variable for each one of the three previous

[9] We coincide with Longstaff (2010) and Arce, Mayordomo, and Peña (2013) on the affirmation that price-discovery process in financial markets may be state-dependent and perform a dynamic price discovery analysis on a monthly basis.

possibilities. The notation is similar to the one employed in the baseline commonality variable but now NQ_{iadt} and NQ_{ibdt} are the number of quotes given to country a and country b respectively by dealer d with a level of information i in a given month t. Regarding the denominator, TQ_{iat} and TQ_{ibt} are the total number of quotes given by all dealers in the category of information i to countries a and b at time t, respectively. D_i denotes the number of dealers in each of the three categories denoting the degree of information that will be determined on the basis of the price discovery methodology from Gonzalo and Granger (1995). This variable will enable us to know whether the comovements are affected by the activity of the more informed dealers or whether the non-informed dealers are pushing the levels of contagion with their quoted prices.

C. Modeling Cross-Sectional Variation in Sovereign CDS Comovement

The following equation represents the panel estimate of monthly cross-sectional regressions forecasting the monthly correlation of daily sovereign CDS returns for countries *i* and *j* in month t $(\rho_{ij,t})$ for the sample of 11 European countries (55 different country-pairs) and for the period of January 2008 to October 2011:

$$\rho_{ij,t} = a + b * CC^{*}_{ij,t-1} + \sum_{k=1}^{n} b_k * CONTROL_{ij,k} + \mu_{ij} + \varepsilon_{ij,t} \qquad (5)$$

where $CC^{*}_{ij,t-1}$ refers to a our measure of commonality in the quotes that dealers give to both countries in the pair at month $t-1$ as defined in Section III.B and $CONTROL_{ij,k}$ contains the set of k controls that include the dependent variable lagged one month, a group of macro controls, and a group of pair-level controls. All these controls are explained in the next subsection. The parameter μ_{ij} refers to the country-pair fixed effects that are included in the estimation. The standard errors are double-clustered at the country-pair and month level. In three different specifications we use the three different versions of *CC:* the baseline, the disaggregated in selling pressure faced by dealers, and the disaggregated in the degree of information of the dealers.

D. Controls

D.1 Global variables

The use of global factors is motivated by Longstaff, Pan, Pedersen, and Singleton's (2012) study of the nature of sovereign credit risk on the basis of CDS spreads. Their results show that the majority of sovereign credit risk can be linked to global factors (a single principal component accounts for 64% of the variation in sovereign credit spreads). We focus on three variables that aim to proxy for funding liquidity, counterparty risk, and the European Central Bank (ECB) bond purchases through the Securities Market Program (SMP).

Financing costs of financial institutions: We use the spread between the uncollateralized interbank 3-months borrowing rate (Euribor) and the Overnight Interest Swap (OIS). The Euribor represents the unsecured interest rate at which banks lend money to other banks which satisfy certain creditworthiness criteria. Euribor rates comprise the expected risk free over a specific premium: the term premium, the credit risk premium of unsecured trading, and the liquidity risk premium in lieu of overnight (McAndrews, Sarkar, and Wang (2008)). On the other hand, OIS is equivalent to the average of the overnight interest rates expected until maturity. It is almost riskless and hence it is not subject to pressures associated with those risks. Therefore, Euribor-OIS spread over the same term quantifies the premium that banks pay when borrowing funds for a pre-determined period relative to the expected interest cost from a repeatedly rolling over funding in the overnight market (Aït-Sahalia, Andritzky, Jobst, Nowak, and Tamirisa (2012)). An adverse liquidity shock would reduce the amount of capital available for financial intermediaries which in turn lower the ability of their trading desk to provide liquidity. As liquidity in the market worsens, trading falls and the short-term cash inflows of these institutions drop too, since most of their profit arise from market-making revenues. The increase in the Euribor-OIS and so, in the cost of capital for financially constrained intermediaries is the common factor which influences both liquidity risk and correlation risk and due to this common factor the correlation between returns increases. This relation between liquidity and correlation risk is jointly addressed in Acharya and Schaefer (2006). For this reason,

we expect that higher financing costs would go hand in hand with stronger comovements in CDS spreads.

Counterparty risk: following Arora, Gandhi, and Longstaff (2012), we use the dealers' CDS spreads to construct the counterparty risk variable, and we follow Arce, Mayordomo, and Peña's (2013) methodology. We proxy counterparty risk in the CDS market through the first principal component obtained from the CDS spreads of the main 14 banks that act as dealers in that market.[10] The higher the counterparty risk, the lower the confidence among institutional investors in the CDS market and so, the more difficult to find a counterparty to buy or sell protection, the lower the market activity, and the higher should be the correlation risk. . Thus, we expect a positive effect of this variable on the dependent variable.

ECB bond purchases: Finally, we control by the purchases conducted by the ECB in the open market in the context of the Securities Market Program (SMP) that was launched in May 2010. It was designed to conduct outright interventions in the euro area public and private debt securities market with the objective of (a) addressing the malfunctioning of securities markets; and (b) restoring an appropriate monetary policy transmission mechanism. We consider this intervention as a global variable of interest due to the particular disclosure of the program in which the ECB did not disclose the set of targeted securities/countries, the time span of the program or the amount to be spent. Preliminary studies suggest that SMP purchases had a positive but short-lived effect on market functioning by reducing liquidity premia and lowering level and volatility of yields (Manganelli (2012)). Therefore, we expect a common decrease in the strain of the sovereign debt countries and hence an increase, at least temporary, in the comovements associated to those purchases.

Interaction terms with peripheral countries pairs: To take into account possible asymmetries (i.e., differential increasing/decreasing effects in the comovements

[10] The 14 main dealers are: Bank of America, Barclays, BNP Paribas, Citigroup, Credit Suisse, Deutsche Bank, Goldman Sachs, HSBC, JP Morgan, Morgan Stanley, Royal Bank of Scotland, Societé Generale, UBS, and Wachovia/Wells Fargo. These dealers are the most active global derivatives dealers and are known as the G14 (see, for instance, ISDA Research Notes (2010) on the Concentration of OTC Derivatives among Major Dealers).

between the CDS prices of countries in distress) we interact the three global variables with a dummy variable that takes value 1 when the two countries in the pair are peripheral countries (Greece, Ireland, Italy, Portugal, and Spain).

D.2 Pair/Country Specific Variables

This set of variables accounts for differences/similarities between two countries which potentially affect to the comovements in the CDS spreads. We control by four groups of county specific variables: credit risk of financial institutions, risk premium, CDS liquidity, and macroeconomic variables. For every pair of countries we introduce these variables as the monthly correlation computed using daily observations. However, given the lower frequency of the macroeconomic information, we use the absolute value of their difference to proxy for the divergence of the countries with respect to the corresponding variables.

Credit risk of financial institutions: Acharya, Drechsler, and Schnabl (2011) study the relationship between the financial and sovereign CDSs in the Eurozone countries for 2007-2011 and show that the announcement of financial sector bailouts was associated with an immediate, unprecedented widening of sovereign CDS spreads and narrowing of bank CDS spreads. However, post-bailouts there emerged a significant comovement between bank CDS and sovereign CDS. Thus, the stronger the relationship between the financial sectors of two given countries, the easiest is that the shocks to financial institutions in a given country affect the sovereign sector of the other country. To control for this comovements we consider the correlation between the log return of the CDS spreads of the banking sector of the corresponding countries. We expect a positive effect for this control variable.

Country specific risk premium: To control for the similarities of the countries in terms of their risk premium, we use the correlation between the squared returns of the country stock indexes. The country risk premiums have been found to have a positive effect in credit risk by the previous literature (Dieckmann and Plank, 2012). We therefore expect that the higher the correlation between the stock markets log returns, the higher the correlation between the sovereign CDS log returns.

CDS liquidity: To proxy for the effect of liquidity in the comovements we use the correlation between the sovereign CDS liquidity, proxied by the relative bid-ask spread (i.e., bid-ask spread relative to the mid-spread). Previous literature has documented the existence of a liquidity premium in sovereign CDS prices. We thus expect that the higher the correlation between the liquidity premium of two countries, the larger would be the correlation in the prices.

Macro variables: We consider two macro fundamentals in our analysis: the government debt and the government net deficit/surplus relative to GDP. These variables enable us to proxy for the stock of debt in the countries and the accumulated deficit and have been found to have significant effects on the sovereign credit spreads in Bernoth, von Hagen, and Schuknecht (2012) and Mayordomo, Peña, and Schwartz (2012) among others. To measure the similarities of a given pair of countries in terms of their macro fundamentals, we take the absolute difference in the value of the previous two variables. We expect a negative effect of the absolute differences in relative debt and deficit, meaning that higher differences are associated with lower correlations between the sovereign CDS log returns.

IV. Results

A. Forecasting Comovements

Panel A of Table III reports our baseline results. We employ three alternative specifications for which we report the results with and without the Commonality in Quotes variable to emphasize its power in forecasting comovements. Both columns (1) and (2) contain the dependent variable lagged one month to control for any possible autocorrelation or persistence in that variable. The results suggest a moderate persistence that discards any type of unit root in the dependent variable. Regarding the new variable included in column (2), we observe a positive and significant effect of the Commonality in Quotes variable: increases in the common quotes significantly increase the correlation between the sovereign CDS log returns. Apart from being statistically significant, the forecasting power of this variable seems to be sizeable because the R-squared increases by a 31% from 24.2% to 31.6% after the

inclusion of this variable in the regression. In columns (3) and (4) we add global control variables and check the forecasting power of the commonalities in quotes.

An increase in the financing costs of financial institutions leads to a significant increase in the comovements of CDS log returns in the pairs formed by peripheral countries with respect to the core countries. As said before, and increase in this variable would limit the ability of the financial intermediaries trading desk to provide liquidity and this effect could be more severe in the CDS of peripheral countries.

As expected, we find an overall positive and significant effect of the ECB sovereign bond purchases due its effectiveness to diminish the levels of credit risk, their volatility, and the liquidity premium documented by Manganelli (2012). Nevertheless, we find a negative significant differential effect in the group of peripheral countries that were targeted in the SMP with respect to the non-peripheral countries but still positive in aggregate terms (0.003-0.002 = 0.001).[11] The lower magnitude of this positive effect of the ECB SMP on the comovements among peripheral countries could be due to the pre-existent high levels before the intervention of the ECB. Thus, the ECB bond purchases make the peripheral countries more similar to the core countries in terms of the variation of their credit risk and weakens the flight-to-quality observed during the episodes with the highest levels of financial stress.

We observe that the coefficient for the Commonalities in Quotes variable remains positive and strongly significant after controlling by global effects that were simultaneously faced by the two countries in each pair. The forecasting power of this variable when considering global variables diminishes but it is also remarkable given that the R-squared increases by more than 21% from 27.6% to 33.5%.

In columns (5) and (6) we include the pair/country specific variables. Consistently with the existence of a significant liquidity premium in CDS spreads; we find that the stronger the relation between the liquidity of the CDS contracts of a given pair of

[11] The Governing Council of the ECB decided the 21st of February 2013 to publish the Eurosystem's holdings of securities acquired under the Securities Markets Program with the reporting the following country by country breakdown: Italy (103 billion euros), Spain (44 billion euros), Greece (34 billion euros), Portugal (23 billion euros) and Ireland (14 billion euros).

countries, the stronger the comovements in their prices. Results also show that among the macro fundamentals, the similarity in the degree of the countries' indebtedness play a significant role in comovements. Thus, if two given countries exhibit a high ratio of debt relative to GDP the market tends to push their CDS in the same direction. The coefficient for the Commonalities in Quotes variable remains positive and strongly significant after adding both global and local control variables. The forecasting power of commonalities also diminishes when we consider pair/country specific variables but it still exhibits a sizeable increase (18% from 29.2% to 34.5%).

Finally, we analyze the economic significance of the variables according to the baseline results obtained in column (6). The economic significance of the statistically significant variables is obtained from the ratio that measures the change in the dependent variable relative to its average value given a change in an explanatory variable equal to its standard deviation, ceteris paribus. The coefficient with the largest economic significance is the one for the commonality in quotes such that a change equal to its standard deviation would lead to a change in the dependent variable equal to 12.4% of its average value. The economic effect of the remaining significant variables in absolute terms, by order of relevance, is 7.91% for the lagged dependent variable, 5.16% the overall effect of the ECB bond purchases being such effect lower for the case of the peripheral countries (4.54%), 3.62% for the correlation in the CDS liquidity of each pair of countries, 1.1% for the absolute difference of debt to GDP, and 1.1% the differential effect of Euribor-OIS on the peripheral countries. All these effects are well below the effect of the commonality in quotes.

< Insert Table III here >

The revision in November 2009 of the misleading statistics of fiscal deficits by the Greek authorities was the immediate trigger of the current European sovereign debt crisis. We analyze the potential effect of the most influential event in the sample by excluding Greece from our analysis and splitting the sample in two sub-periods using as the break point such event. These results are reported in Table IV. Independently on the exclusion of Greece and the sample period employed in our analysis we find that the commonality in quotes has a positive and significant effect on the

comovement of sovereign CDS spreads, being the economic impact of this variable almost 15%. Some results are also worth mentioning. Comparing columns (1) and (2) of this table, we observe that the exclusion of Greece from our analysis weakens the effect of the ECB bond purchases, which is not significant at 5%, suggesting that these purchases were very effective in weakening the potential contagion originated in Greece. In fact the program started to be effective in May 2010 coinciding with the rescue of Greece and the first remarkable increase in the EMU sovereign CDS spreads. The effect of the Euribor-OIS variable interacted with the peripheral countries dummy and the correlation in the CDS relative bid ask spreads are not significant at 5% after excluding Greece from the estimation analysis. This result is consistent with a pre-dominant role of Greece in the liquidity risk channel leading to higher levels of contagion.

We find some worth mentioning differences between the pre-crisis (column (3)) and crisis (column (4)) periods. Although three of the country/pair specific variables had a significant effect on the CDS comovements in the pre-crisis period, no significant effect remains during the crisis period. The opposite effect is found for the global variables. These changes in the role of pair specific and global variables after the beginning of the crisis suggests that the country fundamentals were less relevant to explain comovements than global risk or market sentiment factors.[12]

< Insert Table IV here >

B. Comovements and Dealers Information

Informed traders can be defined as those agents who have non-public, market-sensitive information. Previous literature employs the stock market as a benchmark of public information to analyse the existence of informed traders. Nevertheless, our aim is to classify the agents as being more or less informed than the "average" dealer (i.e. the average CDS prices obtained through the contribution of all dealers) on the basis of price discovery metrics that are obtained using the Gonzalo and Granger's (1995) methodology. Given the data requirements for estimating the dealer's price discovery

[12] The variables related to the ECB bond purchases cannot be employed in the first part of the sample (column (3)).

metrics, we can estimate such metrics in 67% of the months in our sample. These metrics are estimated for a total of 33 dealers. The average price discovery metric is 0.28 and it indicates that, on average, each individual dealer is less informed than the average dealer. The average price discovery metric before November 2009 was 0.17. After that date the average metric increased to 0.33. Although the dealers' information quality could have improved due to the higher liquidity in the sovereign CDS contracts, dealers were on average less informed than the "average" dealer. The threshold of 0.5, which determines whether a dealer is informed or not, coincides with the third quartile of the distribution of the price discovery metrics (i.e. the probability that a given dealer is informed in both countries in a given month is 25%).

The effects of the commonalties in quotes depending on the degree of information of the dealers are reported in Table V. Column (1) reports the results obtained when we consider the commonality in quotes coming from dealers who are less informed than the average dealer ("uninformed" hereafter). Column (2) reports the results for the case in which the explanatory variable for the commonality in quotes only considers information from dealers who are more informed than the average dealer ("informed" hereafter). The commonality in quotes employed in column (3) is obtained using information from dealers who are informed about one country but are not about the other country. We observe that the three commonality variables exhibit a significant effect on dependent variable. Nevertheless, the explanatory power of the commonality of uniformed dealers (34.2%) is higher than the one observed in columns (2) and (3) (31.2 and 31.5%, respectively).

The individual use of the three types of commonalities exhibits always significant effects on the comovements. In fact, the correlation across these variables is high (e.g., the correlation between the commonality in quotes for the "informed" and "uninformed" dealers is 0.65; 0.44 between "informed" and "others"; and 0.74 between "uninformed" and "others") suggesting that dealers tend to follow a common pattern in terms of providing quotes for specific pairs of countries. Nevertheless, to compare the effect of the commonalities given by the dealers with different information we estimate their effects jointly in column (4). We find that the only significant

effect at 5 and 1% levels comes for the uninformed dealers while the role of the informed dealers is not significant and the effect of the remaining dealers is only significant at 10%. We perform a test to check whether the coefficient for the non-informed dealers is significantly higher than the coefficient for the informed dealers and find that it is at 5% significance level. According to Dornbusch, Park, and Claessens (2000), in the absence of better information to the contrary, investors may believe that a financial crisis in one country could lead to similar crises in other countries. This channel presumes that investors are imperfectly informed about the fair price of credit risk in a given country and thus make decisions on the basis of other reasons, which may or may not reflect the true credit risk of the country, such as the belonging to the same monetary union. This theory based on the existence of informational asymmetries could explain the stronger comovements when the less informed dealers give quotes to a given pair of countries at the same time.

The coefficient for the non-informed dealers is significantly higher than the coefficient for the dealers that are informed on a country but not on the other only at 10% significance level. In fact, this last result confirms the previous theory about why the commonalities in the non-informed dealers tend to increase comovements. Thus, when dealers have information on a given country but not on the other, they tend to infer the price of the country on which their information is poorer from the country on which they have better information.[13]

< Insert Table V here >

C. Comovements and Dealers Selling Pressures

In this section, we perform a test to check whether the coefficient for the dealers with selling pressure is significantly larger than the one for the rest of the dealers. We consider common low ask prices for a given pair of countries to define selling pressure because dealers will attempt to hedge their exposure to inventory risk by adjusting the ask spread. The effects of the commonalties in quotes depending on the degree of dealers selling pressure are reported in Table VI. Column (1) reports the

[13] Similar results are found when we use daily information instead of intraday information for estimating the price discovery metrics.

results obtained when we consider the commonality in quotes coming from dealers who face selling pressure while column (2) contains the results obtained using commonalities from dealers who do not face such pressure. We observe that the two commonality variables exhibit a significant effect at 5% level on dependent variable.

To compare the effect of the commonalities given by the dealers facing different degrees of selling pressure we estimate their joint effects in column (3). We find that when considered jointly both effects are significant at 1% level. We perform a test to check whether the coefficient for the dealers facing selling pressure is statistically significantly higher at 5% level than the coefficient for the dealers that do not suffer selling pressure and find that it is.[14] This result supports the theory that shocks to the funding constraint of a given dealer would force this dealer to reduce her positions in certain securities. This forced selling of securities would affect to their prices and propitiate cross-CDS contracts price pressure that would be reflected in the comovements of their prices.

< Insert Table VI here >

D. Dealing with Endogeneity

In our analysis we have regressed monthly CDS comovements on the dealers' quotes commonalities lagged one month. Nevertheless, endogeneity may be a concern here because it is plausible that CDS comovements' innovations may also affect the dealers' common quotes at the same time, through some behavior observed in such correlations that may persist for a given number of months. To conclude that the commonality in quotes is indeed causing CDS comovements to increase; we re-estimate the regressions reported in Equation (5) using two different methods: an instrumental variable approach and an exogenous shock to commonality in quotes.

We firstly consider the use of instrumental variables. We need an instrumental variable that affects exclusively all the participants in the CDS market. The channel through which we explain this effect of commonality in correlations is the variation in

[14] The selling pressure is obtained as the number of quotes by each dealer *d* in which the ask price is the first quartile for countries *a* and *b* relative to the total number of quotes of dealer *d*. We have used other cutting points such as the percentile 33% and results are similar to ones reported in Table VI.

the risk-bearing capacity of the dealers (as we have seen in the previous section). We proxy this risk-bearing capacity with the log changes in the leverage of securities brokers-dealers in the US (half of the most active participants in the CDS market, which are commonly known as the G14, are American banks). Following Adrian, Etula, and Muir (2013), the leverage for brokers and dealers (BD) is defined as the ratio of the securities broker-dealers total financial assets to net worth defined as the difference between total financial assets minus total liabilities. Thus, our instrument captures the time-varying balance sheet capacity of financial intermediaries and so, as funding costs tighten, balance sheet capacity falls and intermediaries are forced to deleverage by selling assets. In fact, Adrian, Etula, and Muir (2013) find that the exposures to the broker-dealer leverage factor can alone explain the average excess returns on a wide variety of assets including Treasury bonds. Although our instrument is also related to financing costs and global liquidity risk, it mainly reflects the securities broker-dealers activity and imbalances. The reason for focusing in dealers is obvious given their role in the CDS market (i.e. by the end of 2011 dealers accounted for 64% of gross market values in the CDS market). Additionally, Acharya, Schaefer, and Zhang (2008) document that a significant imbalance in the dealers quotes towards sales explain a significant portion of the excess comovements in bond and CDS prices around the GM and Ford downgrades. These authors show that "the effect of bond imbalance on CDS was stronger for firms with a sub-investment grade compared to investment-grade firms, consistent with the hypothesis that intermediaries withdrew liquidity more sharply from bonds with greater inventory risk". Thus, a liquidity shock would make liquidity to dry up more severely for sub-investment-grade securities than for investment-grade securities.

We run an instrumental variable regression with fixed effects and robust to heteroskedasticity in which the common quotes are instrumented through the log change in the leverage of market participants. Results are reported in column (1) of Table VII. We perform the Kleibergen-Paap Rank LM statistic to check whether the equation is identified that is, whether the excluded instrument (the securities brokers-dealers leverage) is "relevant" (correlated with the endogenous regressor). According to this under-identification test we reject the null hypothesis (equation is

under-identified) and so, the instrument is relevant and the model is identified. We also perform a weak identification test to analyze whether the brokers-dealers leverage is correlated with the common quotes but only weakly. For this test and given that the estimation is robust to heteroskedasticity, we use the Kleibergen-Paap Wald Rank F statistic. The statistic obtained in comparison with the corresponding critical values enables us to reject the hypotheses that the equation is weakly identified. As it can be inferred from the significant coefficient for the dealers' commonalities we conclude that the potential endogeneity of these commonalities does not bias our results.

The previous instrumental regression is exactly identified and so, we cannot check the validity of the instrument. We consider a new instrumental variable regression using the interaction of the log change in broker-dealer's leverage and the financing costs (Euribor-OIS) as an additional instrument. This new instrument captures the dealers' balance sheet capacity when funding costs tighten. The results are reported in column (2) of Table VII and confirm the significant effect of the dealers' commonality in quotes on the sovereign CDS returns comovements. In view of the Kleibergen-Paap Rank LM statistic and p-value we conclude that the instruments are relevant relevant. The use of the second instrument also enables us to employ the overindentification test based on Hansen J statistic and to confirm that the instruments are valid given that they are uncorrelated with the error term

In our second attempt to examine if the previous results are driven by endogeneity concerns, we consider the ban of naked transactions in CDS on Eurozone sovereign bonds imposed by the German Securities and Exchange Commission (BaFin) on May 18, 2010 as an exogenous shock. According to the European Commission - MEMO/11/713, the buyer of the CDS is "naked" if he does not have an exposure which he is seeking to hedge either to the sovereign debt itself, or to assets or liabilities whose value is correlated to the sovereign debt.[15] This constraint is of special relevance for the CDS market given that although there is no data on what portion of the market constitutes "naked" positions, some estimates put the number at around 80

[15] See European Commission - MEMO/11/713 "Regulation on Short Selling and Credit Default Swaps - Frequently asked questions".

percent of the market.[16] In fact, in many cases the contracts are used to hedge risks associated with a country that are not directly associated to its debt. Additionally, the use of this shock is motivated by the effect that it would have on the CDS market participants and activity given that it would reduce the liquidity available for investors looking hedge their positions, as well as make it harder for participants to exit existing trades. According to Darren Fox, a regulator lawyer who advises hedge funds at Simmons & Simmons in London "the way it's been announced […] it's sent many market participants into panic mode".[17] In similar terms, Johan Kindermann, a capital markets lawyer at Simmons & Simmons in Frankfurt said in an interview: "you cannot imagine what broke lose here after BaFin's announcement [..] this will lead to an uproar in the markets tomorrow. Short-sellers will now, even tonight, try to close their positions at markets where they can still do so -- if they find any possibilities left at all now". For all these reasons the relation to the common quotes variables is obvious since the ban could limit the potential number of counterparties and so the frequency of common quotes would depend on a lower number of institutions. This intervention also contributes to fear investors about further regulatory interventions in the market.

< Insert Table VII here>

We employ a difference-in-differences approach to analyze whether pairs of countries with different levels of commonalities in quotes suffer different degrees of comovements when they face the unexpected shock of the BaFin's ban on May 18, 2010. Accordingly, pairs of countries with high levels of commonalities in quotes are defined as the treatment group, and pairs with lower commonalities are the control or non-treated group. We rank all pairs of countries based on their average commonalities in quotes from 1 May to 12 May, 2010. The dummy variable of *Top-quintile* is set to unity if the average level of common quotes is in the top-quintile (80-percentile and above), and zero for the remaining pairs below the top-quintile (below 80-percentile). We then obtain the average correlation (dependent variable) for the three days after

[16] See http://www.reuters.com/article/2010/05/19/germany-swaps-idUSN196324520100519.
[17] See http://www.bloomberg.com/news/2010-05-18/germany-to-start-temporary-ban-on-naked-short-selling-of-euro-bonds-banks.html.

the establishment of the ban (19-21 May, 2010) and the same for the three banking days before the ban (13, 14, and 17 May) to perform the diff-in-diff in which we would have a pre-ban observation for the 55 pairs and a post-ban observation for the same pairs.[18] The dummy variable of *Post-BaFin Ban* is set to unity if the date is 19-21 May, 2010, and zero during the three banking days before the ban. A third dummy variable *Post-BaFin BanxTop-quintile* is the cross-product of the previous two dummy variables.

The diff-in-diff regression results are reported in Table VIII. Column (1) contains the results obtained when we do not include other explanatory variables but the three previous dummies while column (2) contains the control variables at country level with a daily frequency given that the effect of those variables that do not exhibit any change in May 2010 would be collected in the constant term while the effect of the global variables is collected in the BaFin dummy. The coefficient estimates of the cross-product dummy (*Post-BaFin BanxTop-quintile*) in the two diff-in-diff specifications are significantly positive, suggesting that a given pair of countries with stronger commonalities in quotes before the ban exhibited higher levels of comovements after the ban. Not surprisingly, we find that the BaFin ban increased the comovements by itself.

< Insert Table VIII here>

E. Extensions and Robustness tests

a. Other measures of sovereign CDS return correlation

In this section we first analyze the effect of the commonalities in quotes on the correlations among sovereign CDS filtered returns. These correlations can be interpreted as contagion according to Bekaert, Harvey, and Ng (2005) who define contagion as "excess correlation, that is, correlation over and above what one would expect from economic fundamentals." Like Bekaert, Harvey, and Ng (2005), we take an asset pricing perspective to measuring economic fundamentals and identify conta-

[18] There were many events in May 2010 related to the European sovereign debt crisis. To isolate the effect of the ban we focus in the above mentioned three days around the ban.

gion by the correlation of an asset pricing model's residuals. These residuals are obtained from a regression in which the dependent variable is the CDS log return of a given country and the explanatory variable is a market variable. We employ two different specifications of the market variable to estimate the filtered CDS returns for a given country *i*. In the first specification (column (2) of Table IX), we use the average daily CDS return of all countries in the sample except country *i*.[19] In the second specification (column (3) of Table IX), we use the daily return of the iTraxx Index, which is an index that consists of CDS on European corporations. We also compute the excess correlation in the sovereign CDS log-returns as the difference between the monthly correlation of the daily sovereign CDS log-returns and the monthly correlation of the daily percentage changes of the sovereign bond yields. Results are reported in column (4) of Table IX.

We observe that when we filter the CDS returns of a given country with the average CDS return of the remaining EMU countries there is a large decrease in the R-squared from 34.5% to 25.2%. The coefficient of the commonality in quotes is much lower than in the baseline analysis but still statistically significant at 5% level. In fact, the commonality in liquidity is the only significant regressor, besides the lagged dependent variable. This result is worth mentioning given that we are eliminating a high portion of the comovements across countries when filtering the CDS return. In fact, the R-squared obtained with the market model regression in the first stage is on average 0.64. When we filter the returns using the iTraxx returns, the explanatory power of the regressors also diminishes significantly (the R-squared decreases from 34.5% to 27%). Nevertheless, the coefficient for the commonalities in liquidity is similar to the one obtained in the baseline analysis and also significant at 1% significance level.

We next model the excess correlation as the difference between the correlations in the CDS and bond markets. If the hypothesis that CDS and bond spreads

[19] The only traded index on European sovereign CDS (SovX Western Europe) started trading on 28 September 2009. This index consists of 15 countries but its initial date is far away from the beginning of our sample and for this reason we decided to create an equality weighted index that is available for the whole period.

represent two measures of the same credit risk is true, then the difference between both correlations should cancel out the comovements driven by country fundamentals that are significant determinants of credit risk. Badaoui, Cathcart and El-Jahel's (2013) find that sovereign bond spreads are less subject to liquidity frictions than CDS spreads and so, we expect that the CDS market frictions have a stronger effect on such comovements. We find that the commonalities in quotes significantly explain the excess correlation while, as expected, country and global risk factors are not significant now given that they are also contained in the bond yields.

< Insert Table IX here >

b. Other measures of commonality in quotes

Alternatively to the baseline commonality measure we consider three other variations of such measure. The first variation is defined as:

$$Commonality\ in\ Quotes2_{abt} = \frac{\sum_{d=1}^{NCD} \min(NQ_{adt}, NQ_{bdt})}{\sum_{d=1}^{NCD} sum(NQ_{adt}, NQ_{bdt})} \in [0,0.5] \qquad (6)$$

where NQ_{adt} and NQ_{bdt} are the number of quotes given to country *a* and country *b* respectively by dealer *d*, who is among the dealers giving common quotes to countries *a* and *b* in a given month. The novelty of this measure is that it ignores the quotes that are given by dealers only reporting CDS prices for a single country. The results for this measure are reported in column (2) of Table X and are qualitatively similar to the ones obtained for the baseline specification (column (1)) and so, the results are not biased by restricting our analysis to the dealers giving prices to a given pair of countries.

The second variation for the measure of commonalities is defined as follows:

$$Commonality\ in\ Quotes3_{abt} = \sum_{d=1}^{NCD} \frac{\min(NQ_{adt}, NQ_{bdt})}{sum(NQ_{adt}, NQ_{bdt})} \in [0,0.5 * NCD] \qquad (7)$$

where NCD is the number of common dealers giving quotes to a pair of countries. The difference of this measure with respect to $Commonality\ in\ Quotes2$ is that it aggregates the commonality ratio at dealer level. Contrary to $Commonality\ in\ Quotes2$, in which dealers reporting a higher number of quotes have a higher weight in the computation of the measure, this new measure considers all dealers equally. The value of this measure depends on the number of dealers giving common quotes in a given month and its values span from zero to 0.5*NCD. On the one hand, the dependence on the number of dealers enables us to assign higher values to the commonality measure as the market participants activity increases. On the other hand, this procedure could make this measure dependent on market activity. The lower magnitude for the coefficient of this variable as reported in column (3) is due to the different scale that depends on NCD. Nevertheless, the commonality measure is still significant at 1% level confirming that the results are not driven but the most active dealers in the CDS market. Regarding the coefficients for the remainder variables, the main difference with respect to the baseline specification is that the correlation between the CDS relative bid-ask spreads is not significant now. This effect is due to the fact that the commonality defined in this way is also a measure of liquidity as it depends on market activity (i.e. NCD).

To avoid the dependence of the commonality measure on market activity, we rescale it to construct a new measure with potential outcomes spanning from 0 to 1:

$$Commonality\ in\ Quotes4_{abt} = \frac{Commonality\ in\ Quotes3_{abt}}{0.5 * NCD} \in [0,1] \qquad (8)$$

Results are similar to the ones reported in columns (1) and (2) of Table X supporting the statement that the results are not driven but the most active dealers in the CDS market.

< Insert Table X here >

c. Other frequencies for defining sovereign CDS return correlation

To show that the effect of the commonality does not depend on the data frequency employed we repeat our analysis using daily data (964 trading days). To implement the daily analysis we need to define the correlation between sovereign CDS on a daily basis. For such aim, we take advantage of the intraday quotes to calculate hourly CDS returns. We aggregate the quotes per hour using those reported from 7.00 to 19.00 (GMT+1) such that we use 13 observations to compute the daily correlation.[20] We consider four different specifications to define the daily correlation between the hourly CDS returns reported in Table XI. First, we estimate the daily correlation using CDS quotes such that when there is a missing value for a given dealer in a given hour we impute the previous quote available for this dealer (column (2)). The second specification (column (3)) is similar to the previous one but we exclude the observations for which the hourly CDS return is 0 to discard any arbitrary imputation beyond our scope. To avoid any bias due to the effect of the imputed observations we compute the daily correlation leaving the missing values without replacement (column (4)). In the last specification (column (5)) we leave the missing values without replacement and additionally exclude observations for which the hourly return is 0 for the same reason explained in specification contained in column (3). Regarding the remaining independent variables, the absolute differences for a given pair of countries in the ratios of debt and deficit to GDP are the ones used in Table III and have a quarterly frequency. The variables referred to the ECB Bond Purchases are updated weekly due to the information availability. The remaining explanatory variables are updated on a daily basis.

< Insert Table XI here >

V. Conclusion

CDS data vendors employ their methodologies to offer daily quotes that are obtained after combining the quotes received by different dealers. We test whether the

[20] The lower frequency of quotes for the years 2008 and 2009 impedes to increase the number of intraday observations employed to obtain the observations given that we need to use the same time span for all the years in the sample.

common quotes for a given pair of countries, reported by the same dealer, affect the correlation between CDS spreads and find that they do.

We find that the effect of the commonality in quotes is significant at any standard significance level and has very strong forecasting power on the future comovements between sovereign CDS spread. In fact, the economic impact of the commonality variable is much stronger than the one attributable to the remaining explanatory variables considered in our analysis, including the traditional fundamental variables. This result is robust to the inclusion or not of Greece in the analysis, the pre-crisis and crisis periods, the data frequency, the use of abnormal CDS returns on the basis of a market model to compute the comovements, or considering different specifications for liquidity commonality in quotes.

The strong effect of this commonality in quotes is explained by the strategy adopted by the dealers to deal with two market frictions: inventory risk and asymmetric information. The comovements among sovereign CDS are stronger when the dealers have excess inventory risk and face selling pressure. Dealers aiming to sell protection for the two countries at the same time could lead to a larger comovement, due to the effect of forced selling at fire sale prices. Finally, we find that those dealers are not better informed than the "average dealer" on the CDS prices also lead to stronger comovements, given that the lack of information lead them to review prices similarly for the two countries forming the pair.

Besides contributing to the academic literature on CDS market comovements, our findings will be informative to regulators and investors and present a series of relevant policy implications.

The intensity of the two main channels increasing the comovements over and above the effect of fundamentals (selling pressure and lack of information by dealers) could be weakened by improving the transparency and initiating the central clearing. A proper level of transparency would lead to a lower adverse selection, to improve dealer risk sharing, and to better information for investors. Thus, higher transparency would contribute to a better functioning of the CDS market and to a better informa-

tional content in CDS prices about the real credit risk of a given country. The more realistic and fairer prices of credit risk would propitiate a proper measuring and monitoring of comovements and contagion across countries through the CDS market. On the other hand, higher level of transparency could diminish trading profits for market participants and could deter the more informed dealers from placing quotes that could reduce their informational advantage and so, their opportunities for arbitrage. As a consequence, it could lead to a lower liquidity or to a change in the quoting practices of market participants.

Finally, the new evidence on the determinants of the comovement among sovereign CDS spreads has important implications for risk diversification of the euro zone debt portfolios given that investors should understand that an important part of the comovements in their portfolios is not due to fundamentals but to commonalities in the dealers' quotes. A proper understanding of comovements across fair prices of credit risk would contribute to improve the hedging and diversification strategies.

References

Acharya V.V., I. Drechsler and Schnabl, P. (2011). "A Pyrrhic Victory? Bank Bailouts and Sovereign Credit Risk", NBER Working Paper No. 17136.

Acharya, V. V., and Johnson, T. C. (2007). "Insider trading in credit derivatives", Journal of Financial Economics 84, 110-141.

Acharya, V. and Schaefer, S. (2006). "Liquidity Risk and Correlation Risk: Implications for Risk Management", London Business School, Working Paper.

Acharya, V., S. Schaefer, S. and Zhang, Y. (2007). "Liquidity risk and correlation risk: A clinical study of the General Motors and Ford Downgrade of May 2005", Working Paper.

Adrian, T., Etula, E., and Muir, T. (2013). "Financial Intermediaries and the Cross-Section of Asset Returns". Federal Reserve Bank of New York. Staff Report No. 464

Aït-Sahalia, Y., Andritzky, J., Jobst, A., Nowak, S., and Tamirisa, N. (2012). "Market response to policy initiatives during the global financial crisis", Journal of International Economics 87, 162-177.

Alter, A., and Schüler, Y. S. (2012). "Credit Spread Interdependencies of European States and Banks during the Financial Crisis", Journal of Banking and Finance, 36, 3444-3468.

Andenmatten, S., and Brill, F. (2011). "Measuring Comovements of CDS Premia during the Greek Debt Crisis", University of Bern, Department of Economics Discussion Paper 11-04.

Anderson, M. (2012). "Contagion and Excess Correlation in Credit Default Swaps", Working Paper SSRN 2023043.

Andrade, S. C., Chang, C., Seasholes, M. S. (2008). "Trading imbalances, predictable reversals, and cross-stock price pressure", Journal of Financial Economics 88, 406–423.

Angelopoulos, G., and Giamouridis, D. (2012). "Dissecting insider trading in credit derivatives", Working Paper.

Antón, M. and Polk C. (2013). "Connected Stocks", *Journal of Finance*, forthcoming.

Arce, O., Mayordomo, S., and Peña, J. I. (2013). "Credit-risk valuation in the sovereign CDS and bond markets: evidence from the euro area crisis", Journal of International Money and Finance, 35, 124-145.

Arora, N., Gandhi, P., and Longstaff, F. (2012). "Counterparty Credit Risk and the Credit Default Swap Market", Journal of Financial Economics 103, 280-293.

Badaoui S., Cathcart L., and El-Jahel L. (2013). "Do sovereign credit default swaps represent a clean measure of sovereign default risk? A factor model approach", Journal of Banking & Finance, 37, 2392-2407.

Barberis, N. and Shleifer, A. (2003). "Style investing", Journal of Financial Economics 68, 161-199.

Barberis, N., Shleifer, A. and Wurgler, J. (2005). "Comovement", Journal of Financial Economics 75, 283–317.

Beber, A., Brandt, M.W. and Kavajecz, K.A. (2009). "Flight-to-quality or flight-to-liquidity? Evidence from the Euro-area bond market", Review of Financial Studies, 22, 925-957.

Bekaert G., Harvey, C.R., and Ng, A. (2005). "Market integration and contagion", Journal of Business, 78, 39-70.

Berndt, A., and Ostrovnaya, A. (2008). "Do Equity Markets Favor Credit Market News Over Options Market News?", Working Paper SSRN 972806.

Bernoth, K., von Hagen J. and Schuknecht, L. (2012). "Sovereign Risk Premiums in the European Government Bond Market", Journal of International Money and Finance, 31, 975–995.

Brunnermeier, M. K., and Pedersen, L. H. (2009). "Market Liquidity and Funding Liquidity", Review of Financial Studies, 22, 2201-2238.

Cathcart, L, El-Jahel, L., and Evans, L. (2010). "The Correlation Structure of the CDS Market: An Empirical Investigation", The Journal of Fixed Income, 22, 53-74.

Dieckmann, S. and Plank, T. (2012). "Default Risk of Advanced Economies: An Empirical Analysis of Credit Default Swaps during the Financial Crisis", Review of Finance, 16, 903-934.

Dornbusch, R., Park, Y. C., and Claessens, S. (2000). "Contagion: Understanding how it spreads", The World Bank research observer, 15(2), 177-198.

Dufour, A., and Engle, R. F. (2000). "Time and the price impact of a trade", Journal of Finance 55, 2467-2498.

Dufour, A., and Nguyen, M. (2012). "Permanent Trading Impacts and Bond Yields", European Journal of Finance, 18, 841-864.

Ellul, A., Jotikasthira, C., and Lundblad, C. T. (2011). "Regulatory Pressure and Fire Sales in the Corporate Bond Market", Journal of Financial Economics, 101, 596–620.

Favero, C., Pagano, M. and Von Thadden E.-L. (2010) "How Does Liquidity Affect Government Bond Yields?", Journal of Financial and Quantitative Analysis, 45, 107-134

Forbes, K., and Rigobon, R. (2001). "Contagion in Latin America: Definitions, measurement, and policy implications", Economia, 1, 1-46.

Forbes, K., and Rigobon, R. (2002) "No contagion, only interdependence: Measuring stock market comovements", Journal of Finance, 57, 2223-2261.

Geyer, A. Kossmeier, S. and Pichler, S. (2004). "Measuring Systematic Risk in EMU Government Yield Spreads", Review of Finance, 8, 171–197.

Gündüz, Y., and Kaya, O. (2013). "Long Memory and Correlation Dynamics of Eurozone Sovereign CDSs", Working Paper SSRN 2248559.

Gündüz, Y., Lüdecke, T., and Uhrig-Homburg, M. (2007). "Trading Credit Default Swaps via Interdealer Brokers", Journal of Financial Services Research, 32, 141–159.

Gündüz, Y., Nasev, J., and Trapp, M. (2013). "The Price Impact of CDS Trading", Working Paper.

Hasbrouck, J. (1991a). "Measuring the information content of stock trades", Journal of Finance 46, 179-207.

Hasbrouck, J. (1991b). "The summary informativeness of stock trades: An econometric analysis", Review of Financial Studies 4, 571-595.

Ho, T., Stoll, H., (1983). "The dynamics of dealer markets under competition", Journal of Finance, 38, 1053–1074.

Kalbaska, A. and Gatkowski, M. (2012). "Eurozone Sovereign Contagion: Evidence from the CDS Market (2005-2010)", Journal of Economic Behavior and Organization, 83, 657-673.

King, M. A., and Wadhwani, S. (1990). "Transmission of volatility between stock markets", The Review of Financial Studies, 3, 5-33.

Levene, D. B. (2012). "Credit Default Swaps and Insider Trading", Working Paper.

Longstaff, F. A., Pan, J., Pedersen, J. P., and Singleton, K. J. (2005). "How Sovereign Is Sovereign Credit Risk?", American Economic Journal: Macroeconomics, 3, 75-103.

Longstaff, F. A (2010). "The Subprime Credit Crisis and Contagion in Financial Markets", Journal of Financial Economics, 97, 436–450.

Manasse, P. and Zavalloni, L. (2013). "Sovereign Contagion in Europe: Evidence from the CDS Market", The Rimini Centre for Economic Analysis. WP 13-08.

Manganelli, S. (2012). "The impact of the securities market programme", Research Bulletin 17,2-5.

Mayordomo, S., Peña, J. I., and Schwartz, E. (2012). "Towards a Common European Monetary Union Risk Free Rate", Working Paper.

McAndrews, J., A. Sarkar and Z. Wang (2008). "The effect of the term auction facility on the London Inter-Bank Offered rate". Federal Reserve Bank of New York Staff Reports No. 335

Micu, M., Remolona, E., Wooldridge, P. (2006). "The price impact of rating announcements: which announcements matter?", BIS Working Papers No 207.

Mitchell, M., Pedersen, L. H., Pulvino, T. (2007). "Slow Moving Capital", American Economic Review, 97, 215-220,

Pedersen, L. H. (2009). "When Everyone Runs for the Exit", International Journal of Central Banking, 5, 177-199.

Pu, X., and Zhao, X. (2010). "Correlation in Credit Risk", Office of the Comptroller of the Currency Economics Working Paper 2009-5.

Qiu, J., and Yu, F. (2012). “Endogenous Liquidity in Credit Derivatives”, Journal of Financial Economics, 103, 611–631.

Rigobon, R. (2002). “Contagion: How to measure it?”, In S. Edwards & J. A. Frankel (Eds.), Preventing currency crises in emerging markets (269-334). University of Chicago Press.

Shachar, O. (2013). “Exposing the exposed: Intermediation capacity in the credit default swap market”. Working Paper.

Tang, D. Y., and Yan, H. (2010). “Does the Tail Wag the Dog? The Price Impact of CDS Trading”, Working Paper.

Zhang, X., Schwaab, B., and Lucas, A. (2011). “Conditional Probabilities and Contagion Measures for Euro Area Sovereign Default Risk”, Tinbergen Institute Discussion Paper No. 11-176/2/DSF29.

Table I: Summary Statistics

This table reports summary statistics on the quotes and dealers reporting quotes per country. Panel A contains information on the total number of quotes and the daily average number of quotes per country as well as the total and the daily average number of dealers giving quotes for each country. Panel B summarizes the total number of quotes per dealer and the dealer's market share.

PANEL A: Descriptive statistics. Sample: January 2008 - Oct 2011

Country	Number of Quotes		Number of Dealers	
	Aggregate	Daily Average	Aggregate	Daily Average
Austria	448773	458	90	23.5
Greece	598638	593	93	24.5
Italy	581538	572	91	24.4
Portugal	624875	621	92	24.2
Spain	682032	673	93	24.6
Finland	331887	355	90	22.1
Germany	386181	391	89	22.5
Belgium	449147	446	90	23.3
Ireland	606506	604	92	24.1
France	469751	472	91	23.0
Netherlands	347764	365	89	22.6

PANEL B: Share of quotes by dealers

Dealer	Number of Quotes	
Top 15	Total	Share
1	303851	5.5%
2	298052	5.4%
3	274772	5.0%
4	268195	4.9%
5	264496	4.8%
6	262095	4.7%
7	240076	4.3%
8	221383	4.0%
9	204477	3.7%
10	200736	3.6%
11	183192	3.3%
12	183031	3.3%
13	182606	3.3%
14	166659	3.0%
15	164469	3.0%
1-10	2538133	45.9%
11-20	1609411	29.1%
21-30	873379	15.8%
31-40	335378	6.1%
41-50	110119	2.0%
51-95	60672	1.1%

Table II: Summary Statistics (cont'd)

This table reports summary statistics on the CDS spread level (CDS), the hourly and daily CDS spread log return (cCDS), the daily (CORR_d) and monthly (CORR_hm and CORR_dm) correlation between the CDS log return for all the pairs of EMU countries, and the daily (CC_d) and monthly (CC_m) commonality in quotes for such countries. CORR_d, CORR_hm, and CC_d are obtained using hour-level data while CORR_dm is calculated from daily data. Panel A reports the information for the 11 EMU countries listed in Table 1 while Panel B excludes Greece. Panels C and D break down the mean and std. dev. per year. Panel C refers to the 11 EMU countries and Panel D excludes Greece.

PANEL A: ALL COUNTRIES

Variable	Freq	mean	Std	pctl_0	pctl_1	pctl_5	pctl_50	pctl_95	pctl_99	pctl_100
CDS	Hour	203	421	5	9	23	85	800	1631	8533
cCDS	Hour	0.00	0.02	-0.48	-0.04	-0.02	0.00	0.02	0.04	0.40
cCDS	Daily	0.00	0.06	-0.63	-0.14	-0.08	0.00	0.09	0.18	0.64
CORR_d	Daily	0.34	0.47	-1.00	-1.00	-0.61	0.44	0.93	1.00	1.00
CORR_hm	Monthly	0.38	0.27	-1.00	-0.39	-0.10	0.41	0.77	0.88	1.00
CORR_dm	Monthly	0.65	0.26	-0.58	-0.29	0.10	0.72	0.91	0.95	0.98
CC_d	Daily	0.38	0.09	0.01	0.05	0.17	0.41	0.48	0.48	0.50
CC_m	Monthly	0.37	0.09	0.04	0.11	0.18	0.40	0.47	0.48	0.48

PANEL B: ALL COUNTRIES but GREECE

Variable	Freq	mean	Std	pctl_0	pctl_1	pctl_5	pctl_50	pctl_95	pctl_99	pctl_100
CDS	Hour	143	179	5	8	22	78	547	927	1251
cCDS	Hour	0.00	0.02	-0.48	-0.04	-0.02	0.00	0.02	0.04	0.39
cCDS	Daily	0.00	0.06	-0.63	-0.14	-0.08	0.00	0.09	0.18	0.64
CORR_d	Daily	0.35	0.47	-1.00	-1.00	-0.60	0.45	0.93	1.00	1.00
CORR_hm	Monthly	0.39	0.28	-1.00	-0.41	-0.09	0.41	0.78	0.88	1.00
CORR_dm	Monthly	0.66	0.26	-0.58	-0.29	0.11	0.73	0.91	0.95	0.98
CC_d	Daily	0.38	0.09	0.01	0.05	0.17	0.41	0.48	0.48	0.50
CC_m	Monthly	0.37	0.09	0.04	0.11	0.18	0.40	0.46	0.48	0.48

PANEL C: SUBPERIODS		2008		2009		2010		2011	
Variable	Freq	Mean	std	mean	std	mean	std	mean	std
CDS	Hour	45	42	93	65	181	201	414	727
cCDS	Hour	0.00	0.03	0.00	0.01	0.00	0.01	0.00	0.01
cCDS	Daily	0.01	0.08	0.00	0.05	0.00	0.05	0.00	0.04
CORR_d	Daily	0.12	0.72	0.22	0.44	0.47	0.34	0.46	0.35
CORR_hm	Monthly	0.14	0.31	0.32	0.16	0.55	0.16	0.52	0.20
CORR_dm	Monthly	0.41	0.34	0.76	0.12	0.71	0.17	0.70	0.18
CC_d	Daily	0.28	0.12	0.41	0.05	0.41	0.06	0.40	0.07
CC_m	Monthly	0.27	0.09	0.41	0.03	0.41	0.05	0.39	0.06

PANEL D: SUBPERIODS (All b Gr)		2008		2009		2010		2011	
Variable	Freq	Mean	std	mean	std	mean	std	mean	std
CDS	Hour	41	37	85	61	132	117	260	271
cCDS	Hour	0.00	0.04	0.00	0.01	0.00	0.01	0.00	0.01
cCDS	Daily	0.01	0.08	0.00	0.05	0.00	0.05	0.00	0.04
CORR_d	Daily	0.12	0.73	0.22	0.44	0.46	0.34	0.50	0.34
CORR_hm	Monthly	0.14	0.31	0.32	0.17	0.55	0.16	0.56	0.17
CORR_dm	Monthly	0.41	0.35	0.76	0.12	0.73	0.15	0.73	0.15
CC_d	Daily	0.28	0.12	0.41	0.05	0.42	0.06	0.41	0.06
CC_m	Monthly	0.27	0.08	0.41	0.02	0.41	0.04	0.40	0.06

Table III: Commonality in Quotes Predicts CDS Return Correlation

This table reports the estimates of monthly panel regressions forecasting the correlation of daily Sovereign CDS log Returns in month t for the sample of 11 European countries listed in Table I, Panel A. The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to November 2011 (47 months). The independent variables include the Commonality in Quotes, which refers to the quotes given by dealers to both countries in the pair, and a set of controls, all of them in t-1. $Commonality\ in\ Quotes_{abt} = \sum_{d=1}^{D} \min(NQ_{adt}, NQ_{bdt}) / (TQ_{at} + TQ_{bt})$, where *NQadt* and *NQbdt* are the number of quotes given to country *a* and country *b* respectively by dealer *d* in a given month t while *TQat* and *TQbt* are the total number of quotes given by all dealers to countries *a* and *b* at time *t*, respectively. The set of controls include the dependent variable lagged one month, a group of global controls, and a group of pair-level controls. The global controls are the change in the log of counterparty risk, the change in the log of Euribor-OIS, and ECB Bond Purchases. These three variables are also interacted with the variable *Peripheral*, a dummy that takes vale *1* when the two countries in the pair are peripheral countries (Greece, Ireland, Italy, Portugal, and Spain). The five pair-level controls are self-explanatory in the way they are labeled in the table, and in the body of the text. Country-pair fixed effects are included in the six specifications. Time effects are not included given that the majority of specifications (3 to 6) contain macro controls. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

PANEL A	Dependent Variable: Correlation of daily CDS log-returns $_t$					
	(1)	(2)	(3)	(4)	(5)	(6)
Commonalities in Quotes $_{t-1}$		1.228***		1.140***		1.087***
		[0.197]		[0.178]		[0.180]
Correlation of CDS Log Ret. $_{t-1}$	0.400***	0.227**	0.375***	0.225**	0.343***	0.205*
	[0.116]	[0.108]	[0.118]	[0.110]	[0.118]	[0.109]
Δ Log Counterparty Risk $_{t-1}$			-0.144	-0.077	-0.132	-0.071
			[0.133]	[0.109]	[0.137]	[0.113]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*			-0.056	-0.109	-0.068	-0.114
			[0.070]	[0.072]	[0.071]	[0.071]
Δ Log Euribor-OIS $_{t-1}$			-0.125	-0.084	-0.108	-0.072
			[0.085]	[0.075]	[0.084]	[0.075]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*			0.171**	0.175**	0.156**	0.163**
			[0.070]	[0.070]	[0.074]	[0.072]
ECB Bond Purchases $_{t-1}$			0.004***	0.003***	0.004***	0.003**
			[0.001]	[0.001]	[0.001]	[0.001]
ECB Bond Purchases $_{t-1}$ *x Peripheral*			-0.003***	-0.002**	-0.003***	-0.002**
			[0.001]	[0.001]	[0.001]	[0.001]
Corr. Country Banks CDS Log Ret. $_{t-1}$					-0.016	0.005
					[0.021]	[0.016]
Corr. Country Stock Indexes Vola. $_{t-1}$					-0.008	-0.012
					[0.030]	[0.023]
Corr. CDS Relative Bid-Ask $_{t-1}$					0.086**	0.066**
					[0.035]	[0.033]
Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$| $_{t-1}$					-0.001	-0.001
					[0.001]	[0.001]
Abs|Debt to GDP$_i$ - Debt to GDP$_j$| $_{t-1}$					-0.001***	-0.001**
					[0.001]	[0.001]
Constant	0.369***	-0.021	0.373***	0.006	0.475***	0.113
	[0.085]	[0.106]	[0.085]	[0.102]	[0.102]	[0.116]
Observations	2,370	2,370	2,370	2,370	2,370	2,370
R-squared	0.242	0.316	0.276	0.335	0.292	0.345

Table IV: Commonality in Quotes Predicts CDS Return Correlation (cont'd)

Panel B of this Table shows the estimates of the regressions similar to column (6) in Panel A, but when Greece is excluded from the sample (column (2)), and two different subperiods are analyzed, corresponding to the first and second part of the sample: January 2008 to November 2009 in column (3), and December 2009 to October 2011 in column (4). Everything else remains as in Panel A. Column (1) replicates column (6) of Panel A for comparison purposes.

PANEL B	Dependent Variable: Correlation of daily CDS log-returns			
	(1)	(2)	(3)	(4)
	All	No Greece	Jan08-Nov09	Dec09-Nov11
Commonalities in Quotes $_{t-1}$	1.087***	1.296***	1.400***	0.866***
	[0.180]	[0.175]	[0.199]	[0.237]
Correlation of CDS Log Ret. $_{t-1}$	0.205*	0.179*	0.103	-0.069
	[0.109]	[0.107]	[0.125]	[0.060]
Δ Log Counterparty Risk $_{t-1}$	-0.071	-0.051	-0.071	0.487***
	[0.113]	[0.107]	[0.119]	[0.101]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.114	-0.059	-0.075	-0.138
	[0.071]	[0.065]	[0.069]	[0.090]
Δ Log Euribor-OIS $_{t-1}$	-0.072	-0.067	-0.025	-0.100
	[0.075]	[0.068]	[0.073]	[0.084]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.163**	0.165*	0.148	0.125**
	[0.072]	[0.089]	[0.131]	[0.051]
ECB Bond Purchases $_{t-1}$	0.003**	0.004***		-0.001
	[0.001]	[0.001]		[0.001]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.002**	-0.002*		-0.001
	[0.001]	[0.001]		[0.001]
Corr. Country Banks CDS Log Ret. $_{t-1}$	0.005	0.001	-0.028	-0.004
	[0.016]	[0.014]	[0.023]	[0.027]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.012	-0.020	-0.040	-0.018
	[0.023]	[0.035]	[0.081]	[0.031]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.066**	0.057*	0.161***	0.021
	[0.033]	[0.033]	[0.062]	[0.034]
Abs|Deficit to GDP$_i$ *- Deficit to GDP*$_j$*|* $_{t-1}$	-0.001	-0.001	-0.007**	-0.001
	[0.001]	[0.001]	[0.003]	[0.001]
Abs|Debt to GDP$_i$ *- Debt to GDP*$_j$*|* $_{t-1}$	-0.001**	-0.001**	-0.003	-0.001
	[0.001]	[0.001]	[0.002]	[0.001]
Constant	0.113	0.140	-0.028	0.436***
	[0.116]	[0.114]	[0.135]	[0.106]
Observations	2,370	1,935	864	1,071
R-squared	0.345	0.370	0.420	0.345

Table V: Commonality in Quotes from Uninformed Traders

This table reports panel estimates of monthly cross-sectional regressions forecasting the correlation of daily Sovereign CDS Returns in month *t* for the sample of 11 European countries listed in Table I, Panel A. The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011 (47 months). The independent variables in this table are similar to those in Table III. The novelty here is that we now look independently at the common quotes for dealers depending on their degree of information that is determined on the basis of the Gonzalo and Granger's (1995) price discovery methodology. Thus, *Commonality from Uninformed Traders* measures the variable *Commonality in Quotes* for dealers who are less informed than the average on the CDS prices of the two countries forming the pair. Similarly, *Commonality from Informed Traders* measures the variable *Commonality in Quotes* for dealers with price discovery metrics indicating that they are more informed than the average dealer on the CDS prices of the two countries in the pair. Finally, *Commonality from Other Traders* measures the common quotes for dealers informed on a country but not on the other. All other controls are as in Table III. Country-pair fixed effects are included in the three specifications. Time effects are not included given that all specifications contain macro controls. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dep Var: Corr of daily CDS log-returns $_t$			
	(1)	(2)	(3)	(4)
Commonality from Uninformed Traders $_{t-1}$	1.188***			1.009***
	[0.278]			[0.255]
Commonality from Informed Traders $_{t-1}$		1.000***		0.279
		[0.297]		[0.234]
Commonality from Other Traders $_{t-1}$			0.788**	0.448*
			[0.314]	[0.239]
Correlation of CDS Log Ret. $_{t-1}$	0.205*	0.290***	0.254**	0.160
	[0.111]	[0.111]	[0.103]	[0.103]
Δ Log Counterparty Risk $_{t-1}$	-0.076	-0.104	-0.078	-0.046
	[0.111]	[0.126]	[0.120]	[0.106]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.059	-0.062	-0.065	-0.057
	[0.068]	[0.073]	[0.069]	[0.067]
Δ Log Euribor-OIS $_{t-1}$	-0.108	-0.109	-0.081	-0.093
	[0.074]	[0.079]	[0.077]	[0.071]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.146**	0.170**	0.147**	0.146**
	[0.064]	[0.080]	[0.070]	[0.063]
ECB Bond Purchases $_{t-1}$	0.004***	0.003**	0.003**	0.003**
	[0.001]	[0.001]	[0.001]	[0.001]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.003**	-0.004***	-0.003***	-0.003***
	[0.001]	[0.001]	[0.001]	[0.001]
Corr. Country Banks CDS Log Ret. $_{t-1}$	-0.025	-0.016	-0.016	-0.024
	[0.021]	[0.020]	[0.021]	[0.020]
Corr. Country Stock Indexes Vola. $_{t-1}$	0.001	-0.006	0.000	0.005
	[0.019]	[0.025]	[0.024]	[0.016]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.085***	0.097***	0.094***	0.093***
	[0.033]	[0.035]	[0.034]	[0.033]
Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$| $_{t-1}$	-0.002	-0.002	-0.002	-0.002
	[0.001]	[0.001]	[0.001]	[0.001]
Abs|Debt to GDP$_i$ - Debt to GDP$_j$| $_{t-1}$	-0.001***	-0.001***	-0.001***	-0.001***
	[0.000]	[0.001]	[0.001]	[0.000]
Constant	0.363***	0.455***	0.417***	0.342***
	[0.107]	[0.104]	[0.114]	[0.115]
Observations	2,370	2,370	2,370	2,370
R-squared	0.342	0.312	0.315	0.353

Table VI: Commonality in Quotes from Selling Pressure

This table reports panel estimates of monthly cross-sectional regressions forecasting the correlation of daily Sovereign CDS Returns in month *t* for the sample of 11 European countries listed in Table I, Panel A. The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011 (47 months). The independent variables in this table are similar to those in Table III. The novelty here is that the variable *Commonality in Quotes* is defined in a different way. Instead of *Commonality in Quotes* for all dealers, we now look independently at the common quotes for dealers that experience selling pressure in both countries of the pair, and those that do not experience selling pressure. To capture the effect of this selling pressure, we decompose the variable Commonality in Quotes in two variables. To construct the *Commonality from Selling Pressure* we only use the quotes by a given dealer whose ask price is in the first quartile for the two countries forming the pair relative to the total number of quotes. Similarly, *Commonality not from Selling Pressure* measures the variable *Commonality in Quotes* for dealers whose *offer* or *ask* quotes are not in the first quartile in any of the two countries. All other controls (macro, and country-pair) are as in Table III. Country-pair fixed effects are included in the three specifications. Time effects are not included given that all specifications contain macro controls. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dep Var: Corr of daily CDS log-returns $_t$		
	(1)	(2)	(3)
Commonality from Selling Pressure $_{t-1}$	1.113**		1.724***
	[0.432]		[0.415]
Commonality not from Selling Pressure $_{t-1}$		0.801***	1.024***
		[0.202]	[0.186]
Correlation of CDS Log Ret. $_{t-1}$	0.323***	0.256**	0.201*
	[0.115]	[0.116]	[0.108]
Δ Log Counterparty Risk $_{t-1}$	-0.115	-0.100	-0.064
	[0.131]	[0.121]	[0.111]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.063	-0.105	-0.108
	[0.073]	[0.069]	[0.071]
Δ Log Euribor-OIS $_{t-1}$	-0.087	-0.097	-0.061
	[0.085]	[0.079]	[0.076]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.162**	0.157**	0.166**
	[0.073]	[0.074]	[0.072]
ECB Bond Purchases $_{t-1}$	0.004***	0.004***	0.003**
	[0.001]	[0.001]	[0.001]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.003***	-0.003**	-0.002***
	[0.001]	[0.001]	[0.001]
Corr. Country Banks CDS Log Ret. $_{t-1}$	-0.016	-0.001	0.004
	[0.019]	[0.019]	[0.015]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.021	-0.002	-0.019
	[0.028]	[0.025]	[0.022]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.078**	0.076**	0.062*
	[0.034]	[0.034]	[0.032]
Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$| $_{t-1}$	-0.001	-0.001	-0.001
	[0.001]	[0.001]	[0.001]
Abs|Debt to GDP$_i$ - Debt to GDP$_j$| $_{t-1}$	-0.001**	-0.001***	-0.001**
	[0.001]	[0.001]	[0.001]
Constant	0.448***	0.228**	0.117
	[0.106]	[0.105]	[0.117]
Observations	2,370	2,370	2,370
R-squared	0.305	0.322	0.350

Table VII: Commonality Instrumented by Broker-Dealers' Leverage

This table reports panel estimates of monthly cross-sectional regressions forecasting the correlation of daily Sovereign CDS Returns in month *t* for the sample of 11 European countries listed in Table I, Panel A. The variable *Commonality in Quotes* is instrumented with the log change of broker-dealer's leverage in column (1) and the log change of broker-dealer's leverage joint with the interaction of this leverage and the financing costs proxy (Euribor-OIS) in column (2) . The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011 (47 months). Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Panel A	Dep. Variable: Correlation of daily CDS log-returns	
	(1)	(2)
Commonalities in Quotes $_{t-1}$	1.839***	1.876***
	[0.336]	[0.222]
Correlation CDS Log Ret. $_{t-1}$	0.110***	0.105***
	[0.042]	[0.033]
Corr. Country Banks CDS Log Ret. $_{t-1}$	0.023	0.024
	[0.021]	[0.019]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.013	-0.013
	[0.017]	[0.017]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.050***	0.050***
	[0.014]	[0.013]
Δ Log Counterparty Risk $_{t-1}$	-0.030	-0.028
	[0.026]	[0.027]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.146***	-0.147***
	[0.048]	[0.048]
Δ Log Euribor-OIS $_{t-1}$	-0.050**	-0.049**
	[0.025]	[0.022]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.165***	0.165***
	[0.040]	[0.041]
ECB Bond Purchases $_{t-1}$	0.003***	0.003***
	[0.000]	[0.000]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.002**	-0.002**
	[0.001]	[0.001]
Abs|Deficit to GDPi - Deficit to GDPj| $_{t-1}$	-0.000	-0.000
	[0.001]	[0.001]
Abs|Debt to GDPi - Debt to GDPj| $_{t-1}$	-0.001*	-0.001*
	[0.001]	[0.001]
Observations	2,380	2,380
Number of country-pair	55	55
R-squared	0.261	0.258
Underidentification test (Kleibergen-Paap rk LM statistic)	30.595	31.601
Chi-sq(1) P-val	0.006	0.000
Overidentification test (Hansen J statistic)	Equation exactly identified	0.030
Chi-sq(1) P-val		0.863
Instrumented:	Commonalities in Quotes $_{t-1}$	
Excluded instruments:	Δ Log Leverage	Δ Log Leverage; Δ Log Leverage x Financing Cost

Table VIII: Exogenous Shock: "Naked CDS" banned, BaFin

This table reports a difference-in-difference analysis using the BaFin's ban on May 18, 2010 as an exogenous shock. We use the information for the three days before and the three days after the announcement and analyse the effect of commonalities on the average correlations considering as the treatment group those pairs of countries with high levels of commonalities in quotes according to the average commonalities in quotes from 1 May to 12 May, 2010. The dependent variable consists of one observation per pair before and after the establishment of the man. Thus, we calculate the average correlation for the three days after the ban (19-21 May, 2010) and for the three banking days before the ban (13, 14, and 17 May). The sample consists of 55 observations for the pre-ban period and 55 observations for the post-ban period. The variable *Top-quintile* is a dummy variable that takes 1 if the average level of common quotes is in the top-quintile (80-percentile and above), and zero for the remaining pairs below the top-quintile (below 80-percentile). The variable *Post-BaFin Ban* is a dummy that takes 1 if the date is 19-21 May, 2010, and zero during the three banking days before the ban. A third dummy variable *Post-BaFin BanxTop-quintile* is the cross-product of the previous two dummy variables. Column (2) also contains the control variables at country level with a daily frequency. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dependent Variable: Average Correlation of daily CDS log-returns$_t$	
	(1)	(2)
Post-Bafin's Ban	0.043	0.069*
	[0.026]	[0.040]
Post-Bafin's Ban x Top-quintile	0.254***	0.292***
	[0.026]	[0.037]
Top-quintile	-0.001	-0.022
	[0.025]	[0.023]
Corr. Country Banks CDS Log Ret. $_{t-1}$		0.403***
		[0.110]
Corr. Country Stock Indexes Vola. $_{t-1}$		-0.201
		[0.135]
Corr. CDS Relative Bid-Ask $_{t-1}$		0.005
		[0.217]
Constant	0.598***	0.442
	[0.025]	[0.272]
Observations	110	110
R-squared	0.031	0.178

Table IX: Other measures of CDS Return Correlation

This table reports panel estimates of monthly cross-sectional regressions forecasting the correlation of daily Sovereign CDS Returns (in column (1)), as well as correlation of residuals of Sovereign CDS Returns in different specifications, in month *t* for the sample of 11 European countries listed in Table I, Panel A. Column (1) just replicates column (6) of Table III for comparison purposes. Column (2) shows the specification where the dependent variable is the correlation of residuals from the regression: $CDSRet_{it} = \alpha + \beta AvgCDSRet_t + \varepsilon$, where *AvgCDSRet* is the average daily CDS Return of all countries in the sample except *i* at *t-1*. Column (3) shows a similar specification, but replacing the *AvgCDSRet* with *iTraxxRet,* which is the daily return on the iTraxx Index. Column (4) shows the specification in which the dependent variable is the difference between the monthly correlation of daily sovereign CDS log-returns and the monthly correlation of daily percentage changes of sovereign bond yields. The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011 (47 months). The independent variables in this table are similar to those in Table III. Country-pair fixed effects are included in all four specifications. Time effects are not included given that all specifications contain macro controls. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dependent Variable t:	Corr of CDS Log-returns	Corr of Residual MA	Corr of Residual MI	Excess of Corr btw. CDS Log-returns and Bond
	(1)	(2)	(3)	(4)
Commonalities in Quotes $_{t-1}$	1.089***	0.180**	0.965***	0.945***
	[0.179]	[0.078]	[0.185]	[0.325]
Dependent Variable $_{t-1}$	0.205*	0.122***	0.128	0.567***
	[0.109]	[0.033]	[0.084]	[0.080]
Δ Log Counterparty Risk $_{t-1}$	-0.072	0.023	-0.099	-0.117
	[0.113]	[0.039]	[0.106]	[0.155]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.114	-0.112	-0.119	0.069
	[0.071]	[0.079]	[0.081]	[0.137]
Δ Log Euribor-OIS $_{t-1}$	-0.075	0.004	-0.115	-0.170
	[0.075]	[0.031]	[0.085]	[0.152]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.160**	0.119	0.211**	0.220
	[0.070]	[0.074]	[0.082]	[0.134]
ECB Bond Purchases $_{t-1}$	0.003**	0.000	0.002	0.008***
	[0.001]	[0.001]	[0.001]	[0.003]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.002**	-0.002	-0.003**	-0.002
	[0.001]	[0.002]	[0.002]	[0.004]
Corr. Country Banks CDS Log Ret. $_{t-1}$	0.009	-0.018	0.010	-0.026
	[0.015]	[0.027]	[0.025]	[0.058]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.011	0.028	0.050	-0.021
	[0.023]	[0.020]	[0.032]	[0.057]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.064*	-0.011	0.044	-0.070
	[0.033]	[0.013]	[0.037]	[0.068]
Abs|Deficit to GDP$_i$ *- Deficit to GDP*$_j$*|* $_{t-1}$	-0.001	-0.000	-0.001	-0.001
	[0.001]	[0.001]	[0.001]	[0.002]
Abs|Debt to GDP$_i$ *- Debt to GDP*$_j$*|* $_{t-1}$	-0.001**	-0.002	-0.002***	0.001
	[0.000]	[0.001]	[0.001]	[0.001]
Constant	0.106	-0.056	0.155	-0.250
	[0.114]	[0.074]	[0.108]	[0.167]
Observations	2,380	2,390	2,349	2,380
R-squared	0.345	0.252	0.270	0.512

Table X: Robustness to other measures of Commonality in Quotes

This table reports panel estimates of monthly cross-sectional regressions forecasting the correlation of daily Sovereign CDS Returns in month t for the sample of 11 European countries listed in Table I, Panel A. The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011 (47 months). The independent variables in this table are similar to those in Table III, but each of the 4 specifications uses a different definition of the variable *Commonality in Quotes*. The first column is similar to column (6) of Table III, our benchmark definition of *Commonality in* Quotes. Columns (2) to (4) correspond to the following definitions of *Commonality in Quotes:*

Column (1), $Commonality\ in\ Quotes = \sum_{d=1}^{D} \min(NQ_{adt}, NQ_{bdt}) / (TQ_{at} + TQ_{bt}) \in [0,0.5]$

Column (2), $Commonality\ in\ Quotes2 = \sum_{d=1}^{NCD} \min(NQ_{adt}, NQ_{bdt}) / \sum_{d=1}^{NCD} \text{sum}(NQ_{adt}, NQ_{bdt}) \in [0,0.5]$

Column (3), $Commonality\ in\ Quotes3 = \sum_{d=1}^{NCD} [\min(NQ_{adt}, NQ_{bdt}) / \text{sum}(NQ_{adt}, NQ_{bdt})] \in [0,0.5 * NCD]$

Column (4), $Commonality\ in\ Quotes4 = Commonality\ in\ Quotes3/(0.5 * NCD) \in [0,1]$

where NQ_{adt} and NQ_{bdt} are the number of quotes given to country a and country b respectively by dealer d in a given month t while TQ_{at} and TQ_{bt} are the total number of quotes given by all dealers to countries a and b at time t, respectively, and NCD is the number of common dealers giving quotes to a pair of countries. Country-pair fixed effects are included in the three specifications. Time effects are not included given that all specifications contain macro controls. Standard errors in brackets are double-clustered at the country-pair and month level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

	Dep Var: Corr of daily CDS log-returns $_t$			
	(1)	(2)	(3)	(4)
Commonality in Quotes $_{t-1}$	1.087***	1.032***	0.031***	0.586***
(Different variable for each column)	[0.180]	[0.181]	[0.005]	[0.104]
Correlation of CDS Log Ret. $_{t-1}$	0.205*	0.220**	0.144	0.214**
	[0.109]	[0.110]	[0.107]	[0.105]
Δ Log Counterparty Risk $_{t-1}$	-0.071	-0.077	-0.052	-0.078
	[0.113]	[0.117]	[0.103]	[0.114]
Δ Log Counterparty Risk $_{t-1}$ *x Peripheral*	-0.114	-0.109	-0.122*	-0.106
	[0.071]	[0.072]	[0.065]	[0.074]
Δ Log Euribor-OIS $_{t-1}$	-0.072	-0.078	-0.012	-0.074
	[0.075]	[0.077]	[0.073]	[0.076]
Δ Log Euribor-OIS $_{t-1}$ *x Peripheral*	0.163**	0.165**	0.165**	0.165**
	[0.072]	[0.074]	[0.066]	[0.078]
ECB Bond Purchases $_{t-1}$	0.003**	0.004**	0.003*	0.003**
	[0.001]	[0.001]	[0.001]	[0.001]
ECB Bond Purchases $_{t-1}$ *x Peripheral*	-0.002**	-0.002**	-0.002***	-0.003**
	[0.001]	[0.001]	[0.001]	[0.001]
Corr. Country Banks CDS Log Ret. $_{t-1}$	0.005	0.002	-0.025	0.002
	[0.016]	[0.017]	[0.018]	[0.018]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.012	-0.012	-0.002	-0.014
	[0.023]	[0.024]	[0.022]	[0.023]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.066**	0.067**	0.040	0.067**
	[0.033]	[0.033]	[0.031]	[0.033]
Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$| $_{t-1}$	-0.001	-0.001	-0.001	-0.001
	[0.001]	[0.001]	[0.001]	[0.001]
Abs|Debt to GDP$_i$ - Debt to GDP$_j$| $_{t-1}$	-0.001**	-0.001**	-0.001**	-0.001**
	[0.001]	[0.001]	[0.001]	[0.001]
Constant	0.113	0.126	0.183	0.097
	[0.116]	[0.119]	[0.112]	[0.132]
Observations	2,370	2,370	2,370	2,370
R-squared	0.345	0.338	0.380	0.345

Table XI: Commonality in Quotes and CDS Correlation using Daily Data

This table reports panel estimates of daily cross-sectional regressions forecasting the correlation of intra-daily Sovereign CDS Returns. The specification is similar to column (6) in Table III (replicated here in column (1) for comparison purposes). The regressions are at the country-pair level (55 different country-pairs), and for the period of January 2008 to October 2011, but using daily data (964 trading days). The independent variables in this table are similar to those in Table III, but updated daily, except *ECB Bond Purchases*, *Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$|* and *Abs|Debt to GDP$_i$ - Debt to GDP$_j$|*, that are updated less frequently (*ECB Purchases* weekly, and those related to GDP, quarterly). The four specifications for daily analysis correspond to four different ways of defining the dependent variable (the daily correlation of Sovereign CDS Return) using hourly changes in CDS. Column (2) corresponds to the specification where if there is a missing CDS quote for a dealer in a given hour, we impute the previous quote. Column (3) is as column (2), but we exclude the observations for which the hourly CDS return is 0. Column (4) leaves the missing values without replacement for the previous value, and column (5) leaves the missing values, and excludes the observations for which the hourly CDS return is 0. Country-pair fixed effects are included in all five specifications. Time effects are not included given that all specifications contain macro controls. Standard errors in brackets are double-clustered at the country-pair and day level. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% levels, respectively.

Dep. Var: Corr of CDS Log Returns $_t$	Monthly	Daily			
		Fill	Fill, no zeros	No fill	No fill, no zeros
	(1)	(2)	(3)	(4)	(5)
Commonality in Quotes $_{t-1}$	1.087***	0.829***	0.886***	0.759***	0.752***
	[0.180]	[0.080]	[0.096]	[0.124]	[0.129]
Correlation of CDS Log Returns $_{t-1}$	0.205*	0.181***	0.155***	0.145***	0.143***
	[0.109]	[0.016]	[0.014]	[0.015]	[0.015]
Δ Log Counterparty Risk $_{t-1}$	-0.071	0.085	0.217*	0.138	0.158
	[0.113]	[0.114]	[0.117]	[0.155]	[0.159]
Δ Log Counterparty Risk $_{t-1}$ x Peripheral	-0.114	-0.073	-0.142	-0.241***	-0.248***
	[0.071]	[0.063]	[0.100]	[0.064]	[0.087]
Δ Log Euribor-OIS $_{t-1}$	-0.072	0.231**	0.253***	0.233**	0.235**
	[0.075]	[0.090]	[0.092]	[0.093]	[0.094]
Δ Log Euribor-OIS $_{t-1}$ x Peripheral	0.163**	0.013	-0.002	-0.021	-0.044
	[0.072]	[0.077]	[0.080]	[0.092]	[0.096]
ECB Bond Purchases $_{t-1}$	0.003**	0.012***	0.012***	0.008***	0.008***
	[0.001]	[0.002]	[0.002]	[0.002]	[0.002]
ECB Bond Purchases $_{t-1}$ x Peripheral	-0.002**	-0.007***	-0.007***	-0.006**	-0.006**
	[0.001]	[0.002]	[0.002]	[0.003]	[0.003]
Corr. Country Banks CDS Log Ret. $_{t-1}$	0.005	0.037***	0.044***	0.049***	0.049***
	[0.016]	[0.008]	[0.009]	[0.009]	[0.009]
Corr. Country Stock Indexes Vola. $_{t-1}$	-0.012	-0.005	-0.009	-0.013	-0.013
	[0.023]	[0.014]	[0.014]	[0.014]	[0.014]
Corr. CDS Relative Bid-Ask $_{t-1}$	0.066**	-0.000	-0.003	-0.009	-0.009
	[0.033]	[0.007]	[0.007]	[0.007]	[0.007]
Abs|Deficit to GDP$_i$ - Deficit to GDP$_j$| $_{t-1}$	-0.001	-0.001	-0.001	-0.001	-0.001
	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Abs|Debt to GDP$_i$ - Debt to GDP$_j$| $_{t-1}$	-0.001**	-0.001	-0.001	-0.001	-0.001
	[0.001]	[0.001]	[0.001]	[0.002]	[0.002]
Constant	0.113	-0.013	-0.025	0.013	0.023
	[0.116]	[0.099]	[0.111]	[0.127]	[0.131]
Observations	2,370	35,220	34,101	32,798	32,440
R-squared	0.345	0.134	0.108	0.094	0.091

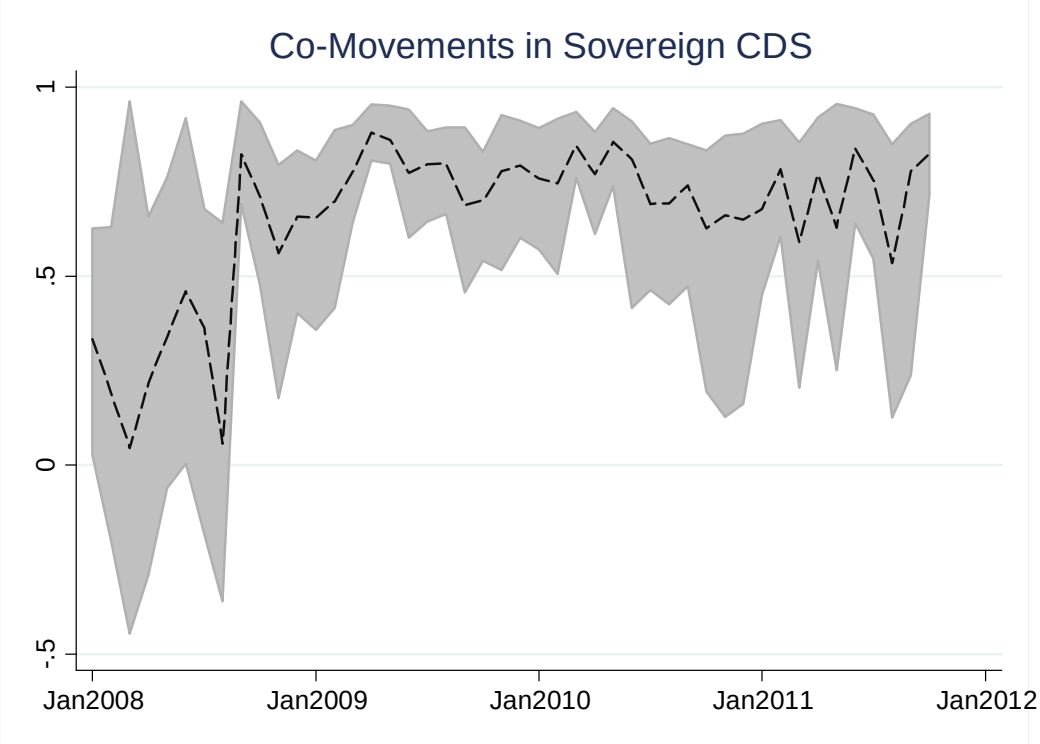

Figure 1: Comovements in Sovereign CDS

This figure depicts the comovements in sovereign CDS log-returns (ρ_{ij}). It represents the monthly correlation of daily sovereign CDS log returns for the 11 EMU countries considered (i.e., 55 different country-pairs) for the period of January 2008 to November 2011. The chart shows the median correlation (dashed line), together with their 5th and 95th percentile (shaded area).

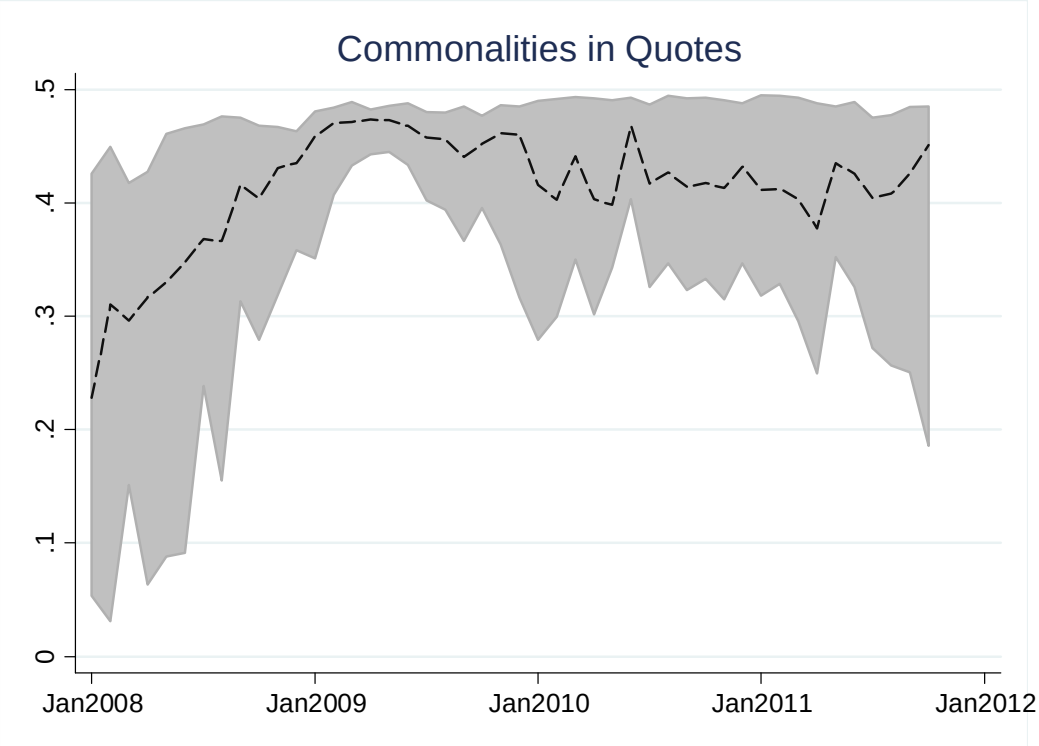

Figure 2: Commonalities in Quotes

This figure depicts the commonalities in quotes (CC_{ij}) defined on the basis of Equation (1). It refers to the quotes given by dealers to both countries in the pair. $Commonality\ in\ Quotes_{abt} = \sum_{d=1}^{D} \min(NQ_{adt}, NQ_{bdt}) / (TQ_{at} + TQ_{bt})$, where $NQ_{adt}$and NQ_{bdt} are the number of quotes given to country a and country b respectively by dealer d in a given month t while TQ_{at} and TQ_{bt} are the total number of quotes given by all dealers to countries a and b at time t, respectively. The chart shows the median correlation (dashed line), together with their 5th and 95th percentile (shaded area).