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Negative Basis in Crisis

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Josh Danziger
Ed Parcell

Negative basis in crisis

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- What is the CDS-bond basis and what drives it?
- How has the basis changed since the crisis struck?
- Does the bond market drive the CDS market or vice versa?
- Is the basis still mean-reverting?
- Can we observe the principal factors driving the credit markets?

CDS-bond basis

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- In simple terms the CDS-bond basis is the difference between the level at which a bond trades relative to swaps and the cost of buying protection against that credit through CDS.
- It's quoted as CDS minus bond spread, so if it's negative then it's possible to buy the bond and buy protection against it and for the whole package, once asset-swapped, to trade higher than LIBOR. This is a *negative basis package.*
- In principal a negative basis package might seem a risk-free asset, so you might expect arbitrageurs to keep the net spread of the package in a fairly tight range. (The hidden risks are discussed later.)
- Profiting from positive basis is harder: you need to maintain a short-position in the bonds to cover the risk of selling protection through CDS.
- Before the crisis, the average basis for high-grade bonds was around zero, with some bonds going perhaps as negative as -30, others trading at a positive basis. The typical behaviour when a name became distressed was that the basis became strongly positive as protection buyers bid up the cost of CDS protection to hedge against a perceived imminent default.
- But all this changed ...

CDS-bond basis in the crisis

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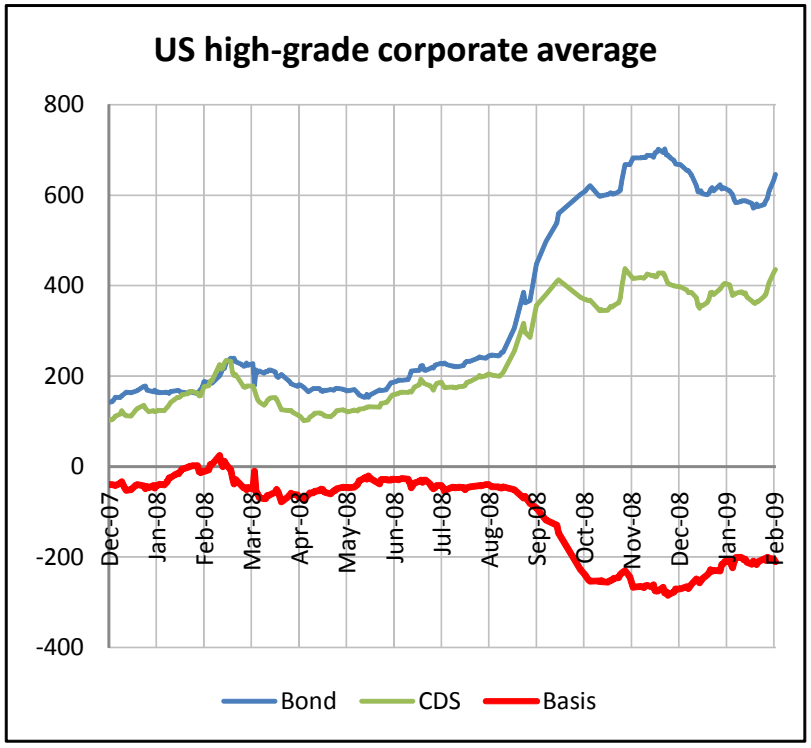

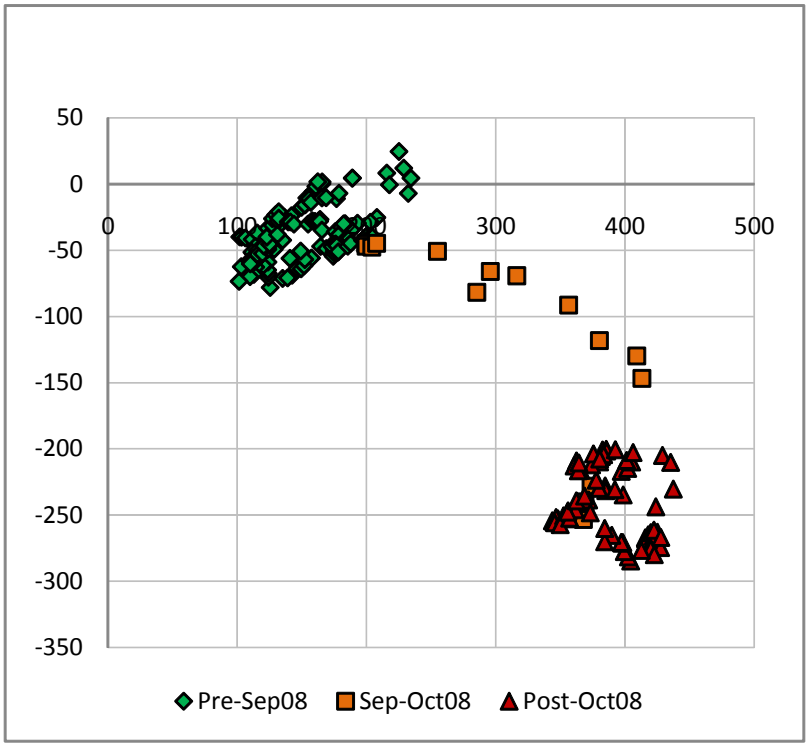

- In Sep 08, the average high-grade US corporate basis blew out through -200 as bond spreads exploded ...
- ... and the pattern of distressed names trading at positive basis seemed to disappear.
- What are the behaviour patterns of the basis now?

Factors affecting the CDS-bond basis

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- Simple approach is to calculate the bond Z-spread (discount margin over swaps), and to subtract this from the interpolated CDS for the bond maturity date.
- But this fails to take into account
  - The term structure of credit spreads;
  - The bond may be off-par ...
  - ...while CDS is often traded as a running spread (no points upfront);
  - And holders of basis packages usually lose accrued interest on default.
- We model the CDS-bond basis as if the bond is traded against the theoretical price of an off-par CDS, where the upfront points match the bond discount from par, and where the holder of protection can claim accrued interest at the time of default as well as reimbursement of principal.

Factors affecting the CDS-bond basis

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	Favours negative basis	Favours positive basis
Fundamentals	**Availability of funding & funding costs**	**Difficulty of repo/shorting cash bonds**
	Bonds with issuer options, eg, call feature	Bonds with lender options, eg, put feature
	Risk of non-deliverability	Cheapest-to-deliver option
	Counterparty default risk	Soft credit events
	Accrued interest foregone on default	CDS floored at zero
	Debt-for-equity swap may not be credit event	Bond covenants
	Negative correlation between rates & credit spreads	Positive correlation between rates & credit spreads
Supply & demand	**Heavy supply/issuance of bonds**	Shortage of bonds
	CSO issuance	**CSO unwinds**
	Liquidity premium: Bonds > CDS	Liquidity premium: CDS > Bonds
		Demand for hedging unsalable credit risk

CDS-bond basis behaviour: example 1

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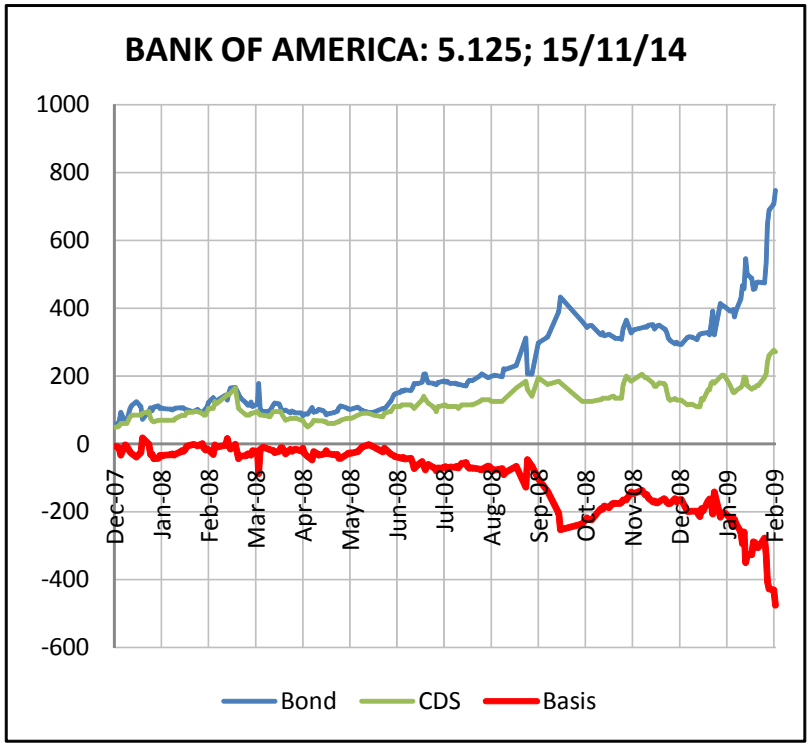

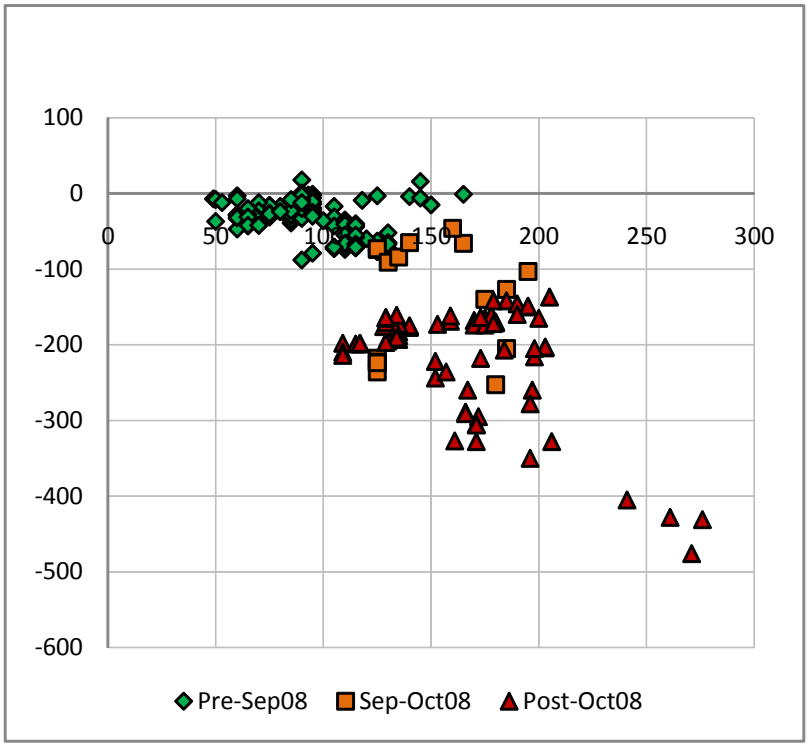

- As the crisis has intensified the basis has become more and more negative, a reversal of the of the pre-crisis distress behaviour.
- The scatter-plot illustrates this.

CDS-bond basis behaviour: example 2

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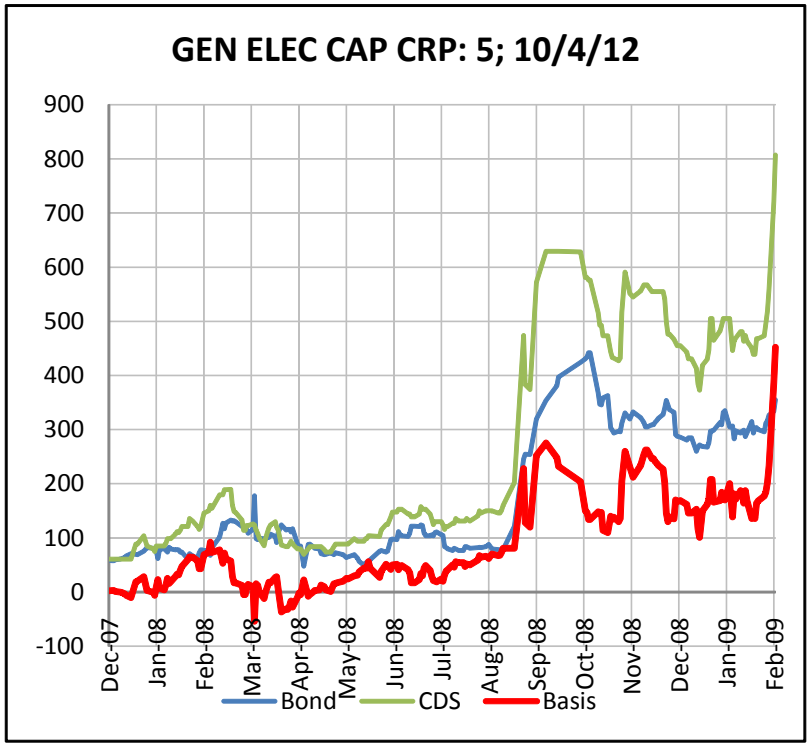
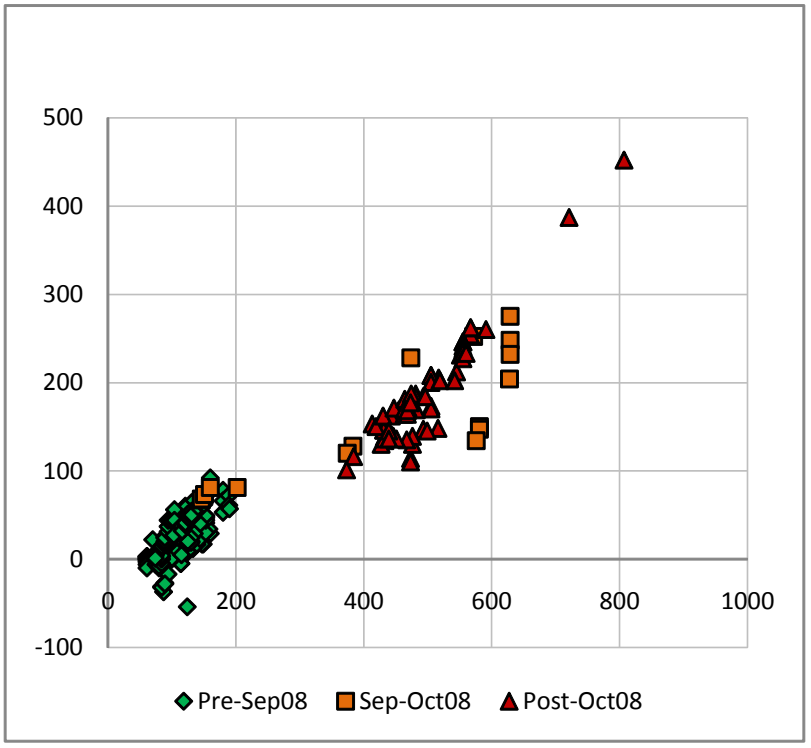
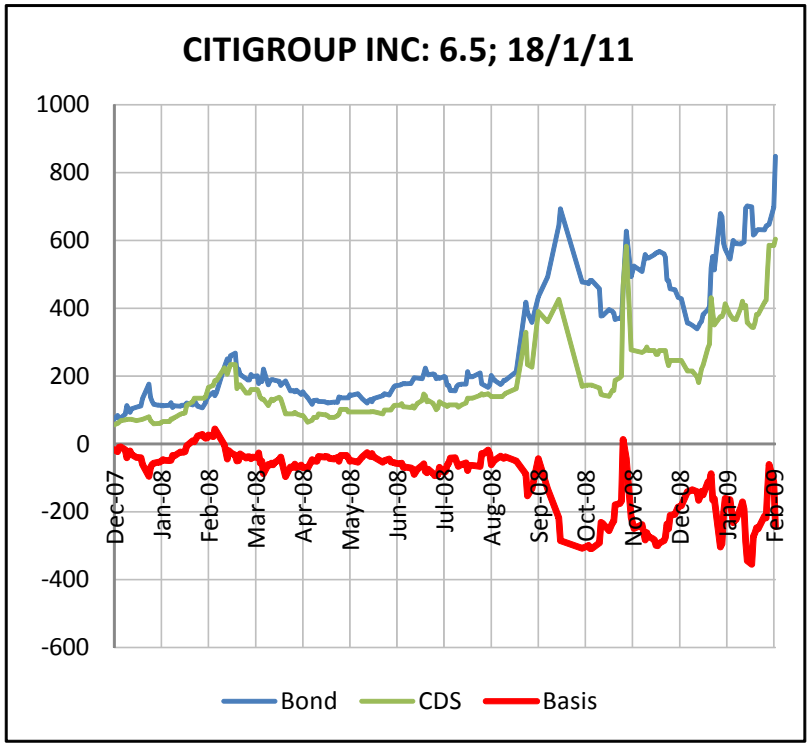




- As the crisis has intensified the basis has become more and more positive, just like the pre-crisis distress behaviour.

CDS-bond basis behaviour: example 3



- As the crisis has intensified the CDS-bond basis here appears to have stabilised around a mean of -200.

Do bond prices drive CDS or vice versa?

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- In addressing this question before the crisis in 2004, Blanco, Brennan & Marsh (*) concluded that the CDS market is the main forum for credit risk price discovery.
- Since then a number of commentators, including Soros, have suggested that the existence of CDS contracts adds no benefit to the financial system.
- The question of where price discovery takes place can be addressed by analysing whether bond price movements lead or lag those of CDS.
- The tool for this Granger causality analysis: take two time series

$$x_t = c_1 + \sum_{i=1}^{p} a_{1i} x_{t-i} + \sum_{i=1}^{p} b_{1i} y_{t-i} + \varepsilon_{1t}$$

$$y_t = c_2 + \sum_{i=1}^{p} a_{2i} x_{t-i} + \sum_{i=1}^{p} b_{2i} y_{t-i} + \varepsilon_{2t}$$

- We deduce that x **Granger-causes** y ($x \rightarrow y$) if the a_{2i} parameters deduced from least squares regression are significant ; and conversely that $y \rightarrow x$ if the b_{1i} parameters are significant.

(*) *The Empirical Analysis of the Dynamic Relationship Between Investment-Grade Bonds and Credit Default Swaps.* 2004. Roberto Blanco, Simon Brennan & Ian W. Marsh.

Do bond prices drive CDS or vice versa?

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- We examined 582 high-grade US corporate bonds, from 220 different issuers, looking at daily prices from the Dec 07 to Feb 09 for the bonds and the CDS for the same entities to the relevant maturity dates (*).
- We tested pairwise (+), looking at each bond and the corresponding CDS, looking for leading or lagging behaviour.
- The results were sensitive to the choice of time lag, p. So we only ascribed significance where Granger causality could be demonstrated to the 1% level with all p from 1 to 10.
- In 15/582 cases we found that bond prices → CDS prices:

BEAR STEARNS CO : 4.65; 2/7/2018	LIBERTY MUTUAL : 5.75; 15/3/2014
BELLSOUTH CORP : 5.2; 15/12/2016	PITNEY BOWES INC : 4.875; 15/8/2014
COMCAST CORP : 6.5; 15/1/2015	SBC COMMUNICATIO : 5.625; 15/6/2016
CVS CAREMARK : 4.875; 15/9/2014	STARWOOD HOTELS : 6.25; 15/2/2013
DEERE & CO : 6.95; 25/4/2014	VIACOM INC : 5.625; 15/8/2012
EXELON CORP : 6.75; 1/5/2011	VIACOM INC : 6.625; 15/5/2011
HONEYWELL INTL : 7.5; 1/3/2010	WILLIAMS COS : 7.125; 1/9/2011
JP MORGAN CHASE : 6; 1/10/2017	

(*) Source: JP Morgan

(+) The R open source statistics system (including the *urca* package) was used for all the analysis presented here.

Do bond prices drive CDS or vice versa?

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- ... but in 134/582 cases we found that CDS prices → bond prices:

AMER GENL FIN : 4; 15/3/2011	DTE ENERGY CO : 7.05; 1/6/2011	HSBC FINANCE CRP : 5; 30/6/2015	PPL ENERGY SUPPL : 6.4; 1/11/2011	TXU CORP : 5.55; 15/11/2014
AMER GENL FIN : 5.4; 1/12/2015	DUKE CAP CORP : 6.25; 15/2/2013	INTL LEASE FIN : 5.45; 24/3/2011	PROLOGIS : 5.5; 1/4/2012	WACHOVIA CORP : 4.375; 1/6/2010
AMERICAN EXPRESS : 4.875; 15/7/2013	ELI LILLY : 6; 15/3/2012	INTL LEASE FIN : 5.65; 1/6/2014	PROLOGIS : 5.625; 15/11/2016	WACHOVIA CORP : 5.35; 15/3/2011
AMERICAN EXPRESS : 6.15; 28/8/2017	ENTERPRISE OP LL : 5.65; 1/4/2013	INTL LEASE FIN : 5.75; 15/6/2011	PRUDENTIAL FIN : 4.5; 15/7/2013	WAL-MART STORES : 4.5; 1/7/2015
AMERICAN EXPRESS : 7; 19/3/2018	ENTERPRISE PRODU : 4.95; 1/6/2010	ISTAR FINANCIAL : 5.15; 1/3/2012	PSEG POWER LLC : 6.95; 1/6/2012	WASH MUT BANK NV : 5.125; 15/1/2015
APACHE CORP : 6.25; 15/4/2012	ENTERPRISE PRODU : 6.3; 15/9/2017	ISTAR FINANCIAL : 5.65; 15/9/2011	PSEG POWER LLC : 7.75; 15/4/2011	WASH MUT BANK NV : 5.5; 15/1/2013
BANK OF AMER CRP : 5.375; 11/9/2012	EXELON CORP : 4.45; 15/6/2010	ISTAR FINANCIAL : 5.875; 15/3/2016	SEMPRA ENERGY : 6; 1/2/2013	WASH MUT BANK NV : 5.65; 15/8/2014
BANK OF AMERICA : 4.25; 1/10/2010	EXELON GENERATIO : 5.35; 15/1/2014	KINDER MORGAN EN : 5.125; 15/11/2014	SIMON PROP GP LP : 5.25; 1/12/2016	WASH MUT BANK NV : 6.875; 15/6/2011
BANK OF AMERICA : 4.75; 1/8/2015	EXELON GENERATIO : 6.2; 1/10/2017	KINDER MORGAN EN : 5.85; 15/9/2012	SIMON PROP GROUP : 4.875; 15/8/2010	WASH MUTUAL INC : 4.625; 1/4/2014
BANK OF AMERICA : 4.75; 15/8/2013	EXELON GENERATIO : 6.95; 15/6/2011	KINDER MORGAN EN : 5.95; 15/2/2018	SIMON PROP GROUP : 5.625; 15/8/2014	WASH MUTUAL INC : 5.25; 15/9/2017
BANK OF AMERICA : 4.875; 15/1/2013	FIRST UNION NATL : 7.8; 18/8/2010	KINDER MORGAN EN : 5; 15/12/2013	SLM CORP : 4.5; 26/7/2010	WELLS FARGO BANK : 6.45; 1/2/2011
BANK OF AMERICA : 7.4; 15/1/2011	FPL GROUP CAPTL : 5.625; 1/9/2011	KINDER MORGAN EN : 6; 1/2/2017	SLM CORP : 5.05; 14/11/2014	WELLS FARGO CO : 4.95; 16/10/2013
BOEING CAP CORP : 6.5; 15/2/2012	GEN ELEC CAP CRP : 4.25; 15/6/2012	LEHMAN BROS HLDG : 4.8; 13/3/2014	SLM CORP : 5.375; 15/1/2013	WELLS FARGO CO : 5.25; 23/10/2012
BOSTON PROP LP : 6.25; 15/1/2013	GEN ELEC CAP CRP : 4.875; 21/10/2010	LEHMAN BROS HLDG : 5.5; 4/4/2016	SLM CORP : 5.375; 15/5/2014	WELLS FARGO CO : 6.375; 1/8/2011
CIT GROUP INC : 5.125; 30/9/2014	GEN ELEC CAP CRP : 4.875; 4/3/2015	MACYS RETAIL HLD : 6.625; 1/4/2011	SLM CORP : 5.45; 25/4/2011	XEROX CORP : 5.5; 15/5/2012
CIT GROUP INC : 5.65; 13/2/2017	GEN ELEC CAP CRP : 5.45; 15/1/2013	MARATHON GLOBAL : 6; 1/7/2012	SLM CORP : 5; 1/10/2013	XEROX CORP : 5.65; 15/5/2013
CIT GROUP INC : 5; 1/2/2015	GEN ELEC CAP CRP : 5.875; 15/2/2012	MARRIOTT INTL : 5.625; 15/2/2013	SLM CORP : 5; 15/4/2015	XL CAPITAL LTD : 5.25; 15/9/2014
CIT GROUP INC : 5; 13/2/2014	GEN ELEC CAP CRP : 5; 10/4/2012	MBNA CORP : 6.125; 1/3/2013	SOUTHERN POWER : 4.875; 15/7/2015	XTO ENERGY INC : 4.625; 15/6/2013
CITIGROUP INC : 4.625; 3/8/2010	GEN ELEC CAP CRP : 5; 15/11/2011	MERCK & CO INC : 4.375; 15/2/2013	SOUTHERN POWER : 6.25; 15/7/2012	XTO ENERGY INC : 4.9; 1/2/2014
CITIGROUP INC : 5.125; 14/2/2011	GEN ELEC CAP CRP : 5; 8/1/2016	METLIFE INC : 5; 15/6/2015	SPRINT CAP CORP : 8.375; 15/3/2012	XTO ENERGY INC : 5.5; 15/6/2018
CITIGROUP INC : 5.25; 27/2/2012	GEN ELEC CAP CRP : 6.875; 15/11/2010	METLIFE INC : 5; 24/11/2013	SPRINT NEXTEL : 6; 1/12/2016	XTO ENERGY INC : 5.9; 1/8/2012
CITIGROUP INC : 5.5; 27/8/2012	GEN ELEC CAP CRP : 6; 15/6/2012	METLIFE INC : 6.125; 1/12/2011	SUNOCO INC : 5.75; 15/1/2017	XTO ENERGY INC : 6.25; 1/8/2017
CITIGROUP INC : 6.5; 18/1/2011	GOLDMAN SACHS : 6.6; 15/1/2012	MORGAN STANLEY : 5.25; 2/11/2012	TARGET CORP : 4; 15/6/2013	
CITIGROUP INC : 6; 21/2/2012	HARTFORD FINL : 6.3; 15/3/2018	MORGAN STANLEY : 5.3; 1/3/2013	TELECOM IT CAP : 5.25; 15/11/2013	
CONSTELLAT ENER : 7; 1/4/2012	HSBC FIN CORP : 7; 15/5/2012	NATL RURAL UTIL : 5.45; 1/2/2018	TEXTRON FIN CORP : 5.125; 3/2/2011	
CSX CORP : 6.25; 1/4/2015	HSBC FINANCE : 5.25; 15/4/2015	NATL RURAL UTIL : 5.45; 10/4/2017	TRANSOCEAN INC : 5.25; 15/3/2013	
DOMINION RES INC : 5.7; 17/9/2012	HSBC FINANCE CRP : 5.25; 15/1/2014	NATL RURAL UTIL : 7.25; 1/3/2012	TRANSOCEAN INC : 6; 15/3/2018	

CDS market drives bond market

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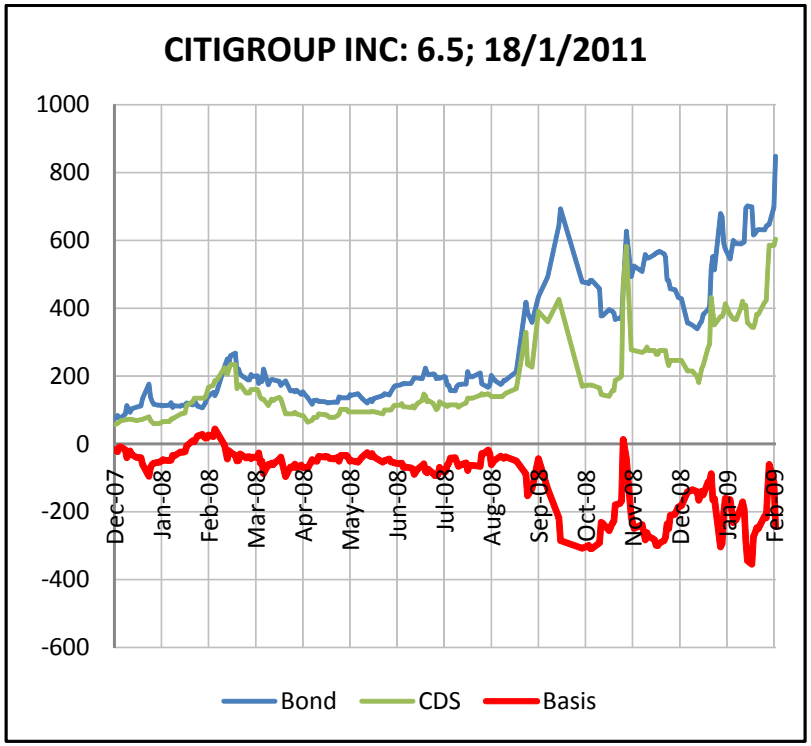

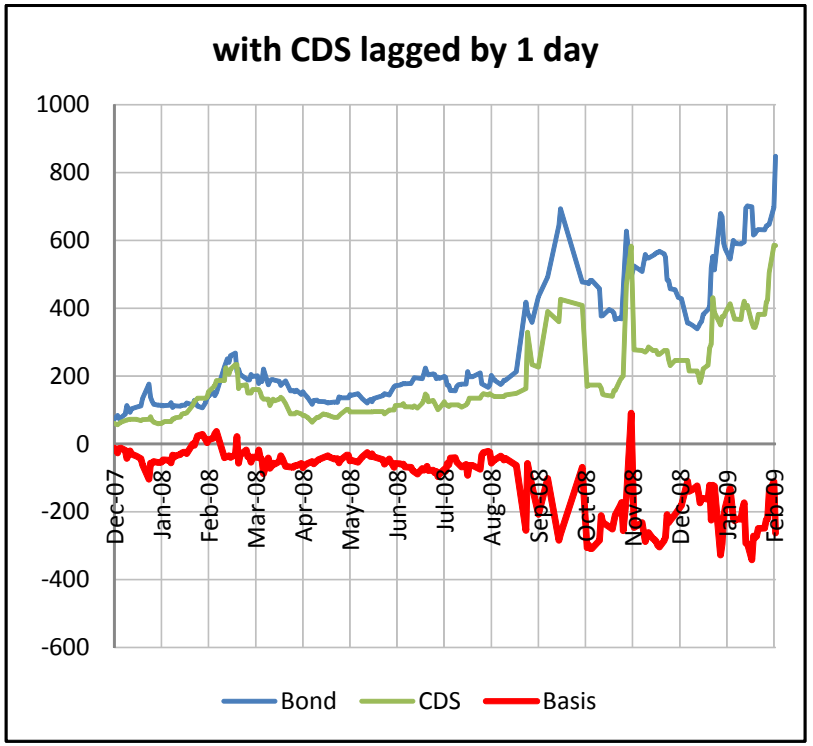

- In this example even by eye we can see that much of the time the bond spread more closely tracks the lagged CDS spread than the current CDS spread.

Is the basis mean-reverting?

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- Before the crisis a number of papers demonstrated that the CDS-bond basis was mean-reverting in 60%+ of cases: see for example De Wit(*).
- But at that time bases seemed stable and close to zero. What about now when the average basis is -200 and highly volatile?
- This is a question best addressed through the concept of **cointegration**.
- Most market observables do not produce a stationary time series ($I(0)$), but the first differences do; this means they have a unit root, written as $I(1)$. Two time series are cointegrated if they are both themselves $I(1)$, but there exists a stationary $I(0)$ linear combination. This requires that we can fit the data to

$$y_t = c + \alpha x_t + \varepsilon_t$$

  where the ε_t are stationary.
- In the case where the variables are cointegrated and α is 1 then the spread y_t-x_t is mean-reverting.

(*) *Working Paper Research 104: Exploring the CDS-Bond Basis.* 2006. Jan De Wit.

Is the basis mean-reverting?

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- We used the same data set as earlier: 582 high-grade US corporate bonds, from 220 different issuers, looking at daily prices from the Dec 07 to Feb 09 for the bonds and the CDS for the same entities to the relevant maturity dates. We looked for pairwise cointegration between the bond spreads and the corresponding CDS.
- 147/582 showed cointegration to the 5% level over the full period. This is far fewer than De Wit and the others oberved. Although only 274/582 of our bonds are financials, they dominate the list:

ACE INA HOLDINGS : 5.7; 15/2/2017	BEAR STEARNS CO : 7.25; 1/2/2018	GEN ELEC CAP CRP : 5.4; 15/2/2017	LEHMAN BROS HLDG : 5.75; 3/1/2017	SLM CORP : 4.5; 26/7/2010
ACE INA HOLDINGS : 5.875; 15/6/2014	BELLSOUTH CORP : 5.2; 15/12/2016	GEN ELEC CAP CRP : 5.625; 15/9/2017	LEHMAN BROS HLDG : 6.2; 26/9/2014	SPRINT CAP CORP : 7.625; 30/1/2011
AMER EXPR CENTUR : 5.2; 26/11/2010	BERKSHIRE HATHWY : 4.625; 15/10/2013	GEN ELEC CAP CRP : 5; 10/4/2012	LEHMAN BROS HLDG : 6.5; 19/7/2017	TEXTRON FIN CORP : 5.125; 3/2/2011
AMER EXPRESS CR : 5.3; 2/12/2015	BOEING CAP CORP : 5.8; 15/1/2013	GEN ELEC CAP CRP : 5; 8/1/2016	LIBERTY MUTUAL : 5.75; 15/3/2014	TRANSOCEAN INC : 5.25; 15/3/2013
AMER EXPRESS CR : 5; 2/12/2010	BOEING CAP CORP : 6.5; 15/2/2012	GEN ELEC CAP CRP : 6; 15/6/2012	LOCKHEED MARTIN : 4.121; 14/3/2013	TXU CORP : 5.55; 15/11/2014
AMER GENL FIN : 4.875; 15/5/2010	BOEING CO : 5.125; 15/2/2013	GENWORTH FINL : 5.75; 15/6/2014	MACYS RETAIL HLD : 5.75; 15/7/2014	UNITED TECH CORP : 5.375; 15/12/2017
AMER GENL FIN : 4.875; 15/7/2012	BOSTON PROP LP : 6.25; 15/1/2013	GOLDMAN SACHS : 4.75; 15/7/2013	MACYS RETAIL HLD : 6.625; 1/4/2011	UNITEDHEALTH GRP : 6; 15/2/2018
AMER INTL GROUP : 4.95; 20/3/2012	BOSTON SCIENTIFC : 5.45; 15/6/2014	GOLDMAN SACHS : 5.25; 1/4/2013	MBNA CORP : 6.125; 1/3/2013	WACHOVIA BANK NA : 4.8; 1/11/2014
AMER INTL GROUP : 5.375; 18/10/2011	CISCO SYSTEMS : 5.5; 22/2/2016	GOLDMAN SACHS : 5.25; 15/10/2013	MEDCO HEALTH SOL : 7.25; 15/8/2013	WACHOVIA BANK NA : 4.875; 1/2/2015
AMER INTL GROUP : 5.45; 18/5/2017	CIT GROUP INC : 5.4; 30/1/2016	GOLDMAN SACHS : 5.7; 1/9/2012	MERCK & CO INC : 4.375; 15/2/2013	WACHOVIA BANK NA : 5.6; 15/3/2016
AMER INTL GROUP : 5.6; 18/10/2016	CIT GROUP INC : 5.65; 13/2/2017	GOLDMAN SACHS : 6.6; 15/1/2012	MERRILL LYNCH : 5.7; 2/5/2017	WACHOVIA BANK NA : 5; 15/8/2015
AMER INTL GROUP : 5.85; 16/1/2018	CITIGROUP INC : 5.125; 14/2/2011	GOLDMAN SACHS : 6.875; 15/1/2011	MERRILL LYNCH : 5; 3/2/2014	WACHOVIA BANK NA : 6; 15/11/2017
AMERICAN EXPRESS : 6.15; 28/8/2017	CITIGROUP INC : 5.5; 15/2/2017	GOLDMAN SACHS GP : 4.5; 15/6/2010	METLIFE INC : 5; 15/6/2015	WACHOVIA CORP : 4.375; 1/6/2010
AMERICAN EXPRESS : 7; 19/3/2018	CITIGROUP INC : 6.125; 21/11/2017	GOLDMAN SACHS GP : 5.3; 14/2/2012	METLIFE INC : 5; 24/11/2013	WACHOVIA CORP : 4.875; 15/2/2014
APACHE CORP : 5.25; 15/4/2013	CITIGROUP INC : 6.5; 18/1/2011	GOLDMAN SACHS GP : 5.35; 15/1/2016	METLIFE INC : 6.125; 1/12/2011	WACHOVIA CORP : 5.25; 1/8/2014
AT&T INC : 5.5; 1/2/2018	CITIGROUP INC : 6; 15/8/2017	GOLDMAN SACHS GP : 5.45; 1/11/2012	MORGAN ST DEAN W : 6.6; 1/4/2012	WACHOVIA CORP : 5.3; 15/10/2011
BANK OF AMER CRP : 5.375; 11/9/2012	COUNTRYWIDE FINL : 4.5; 15/6/2010	GOLDMAN SACHS GP : 5.625; 15/1/2017	MORGAN ST DEAN W : 8; 15/6/2010	WACHOVIA CORP : 5.35; 15/3/2011
BANK OF AMER CRP : 5.75; 1/12/2017	COUNTRYWIDE FINL : 5.8; 7/6/2012	GOLDMAN SACHS GP : 5.95; 18/1/2018	MORGAN STANLEY : 4.25; 15/5/2010	WACHOVIA CORP : 5.625; 15/10/2016
BANK OF AMER CRP : 6; 1/9/2017	COUNTRYWIDE HOME : 4; 22/3/2011	GOLDMAN SACHS GP : 5; 15/1/2011	MORGAN STANLEY : 5.25; 2/11/2012	WACHOVIA CORP : 5.7; 1/8/2013
BANK OF AMERICA : 4.25; 1/10/2010	DTE ENERGY CO : 7.05; 1/6/2011	HALLIBURTON CO : 5.5; 15/10/2010	MORGAN STANLEY : 5.45; 9/1/2017	WACHOVIA CORP : 5.75; 1/2/2018
BANK OF AMERICA : 4.375; 1/12/2010	DUKE ENERGY CAR : 5.25; 15/1/2018	HARTFORD FINL : 6.3; 15/3/2018	MORGAN STANLEY : 5.55; 27/4/2017	WACHOVIA CORP : 5.75; 15/6/2017
BANK OF AMERICA : 4.75; 1/8/2015	ELI LILLY : 6; 15/3/2012	HCA INC : 5.75; 15/3/2014	MORGAN STANLEY : 5.95; 28/12/2017	WASH MUT BANK NV : 6.875; 15/6/2011
BANK OF AMERICA : 4.75; 15/8/2013	ENCANA CORP : 4.75; 15/10/2013	HCA INC : 6.375; 15/1/2015	PROLOGIS : 5.5; 1/4/2012	WASH MUTUAL INC : 4.625; 1/4/2014
BANK OF AMERICA : 4.875; 15/1/2013	EXELON CORP : 4.45; 15/6/2010	HCP INC : 6.7; 30/1/2018	PRUDENTIAL FIN : 4.5; 15/7/2013	WASH MUTUAL INC : 5.25; 15/9/2017
BANK OF AMERICA : 5.125; 15/11/2014	FIRST UNION NATL : 7.8; 18/8/2010	HONEYWELL INTL : 5.3; 1/3/2018	PRUDENTIAL FIN : 4.75; 1/4/2014	WELLPOINT INC : 5; 15/12/2014
BANK OF AMERICA : 5.3; 15/3/2017	FIRSTENERGY CORP : 6.45; 15/11/2011	JPMORGAN CHASE : 5.375; 15/1/2014	PRUDENTIAL FIN : 5.1; 20/9/2014	WILLIAMS COS : 6.375; 1/10/2010
BANK OF AMERICA : 5.375; 15/6/2014	GEN ELEC CAP CRP : 4.25; 1/12/2010	KINDER MORGAN EN : 5.125; 15/11/2014	PRUDENTIAL FIN : 6; 1/12/2017	WILLIAMS COS : 7.125; 1/9/2011
BANK OF AMERICA : 7.4; 15/1/2011	GEN ELEC CAP CRP : 4.75; 15/9/2014	KINDER MORGAN EN : 5.95; 15/2/2018	SCHERING-PLOUGH : 6; 15/9/2017	
BEAR STEARNS CO : 4.65; 2/7/2018	GEN ELEC CAP CRP : 4.875; 4/3/2015	LEHMAN BROS HLDG : 4.8; 13/3/2014	SEMPRA ENERGY : 7.95; 1/3/2010	
BEAR STEARNS CO : 5.35; 1/2/2012	GEN ELEC CAP CRP : 5.375; 20/10/2016	LEHMAN BROS HLDG : 5.5; 4/4/2016	SIMON PROP GROUP : 4.875; 15/8/2010	

Is the basis mean-reverting?

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- When we restricted ourselves to the last 100 days of our sample, covering the key crisis period, this fell to 77/582, also mostly financials. (By comparison, the first 100 days saw 144/582.) This supports the proposition that CDS and bonds became less cointegrated through the course of the crisis.

ACE INA HOLDINGS : 5.7; 15/2/2017	ENTERPRISE PRODU : 6.3; 15/9/2017	MORGAN STANLEY : 5.3; 1/3/2013
ACE INA HOLDINGS : 5.875; 15/6/2014	FIRST UNION NATL : 7.8; 18/8/2010	NATL RURAL UTIL : 5.45; 1/2/2018
ALCOA INC : 5.375; 15/1/2013	FIRSTENERGY CORP : 6.45; 15/11/2011	NEW YORK LIFE GL : 4.625; 16/8/2010
AMER EXPRESS CR : 5.3; 2/12/2015	GENWORTH FINL : 5.75; 15/6/2014	PRUDENTIAL FIN : 4.75; 1/4/2014
AMER GENL FIN : 4.875; 15/5/2010	GOLDMAN SACHS : 6.6; 15/1/2012	PRUDENTIAL FIN : 5.1; 20/9/2014
AMER INTL GROUP : 4.95; 20/3/2012	GOLDMAN SACHS GP : 5.625; 15/1/2017	PRUDENTIAL FIN : 6; 1/12/2017
AMER INTL GROUP : 5.45; 18/5/2017	HARTFORD FINL : 6.3; 15/3/2018	SEMPRA ENERGY : 7.95; 1/3/2010
AMER INTL GROUP : 5.6; 18/10/2016	HONEYWELL INTL : 7.5; 1/3/2010	TXU CORP : 5.55; 15/11/2014
AMER INTL GROUP : 5.85; 16/1/2018	HSBC FINANCE : 4.75; 15/4/2010	UNITED TECH CORP : 4.375; 1/5/2010
AMERICAN EXPRESS : 6.15; 28/8/2017	INTL LEASE FIN : 5; 15/4/2010	WACHOVIA BANK NA : 4.8; 1/11/2014
AMERICAN EXPRESS : 7; 19/3/2018	LEHMAN BROS HLDG : 4.375; 30/11/2010	WACHOVIA BANK NA : 4.875; 1/2/2015
AT&T INC : 5.5; 1/2/2018	LEHMAN BROS HLDG : 4.5; 26/7/2010	WACHOVIA BANK NA : 5.6; 15/3/2016
BANK OF AMERICA : 7.4; 15/1/2011	LEHMAN BROS HLDG : 4.8; 13/3/2014	WACHOVIA BANK NA : 5; 15/8/2015
BEAR STEARNS CO : 4.5; 28/10/2010	LEHMAN BROS HLDG : 5.25; 6/2/2012	WACHOVIA BANK NA : 6; 15/11/2017
BEAR STEARNS CO : 4.55; 23/6/2010	LEHMAN BROS HLDG : 5.5; 4/4/2016	WACHOVIA CORP : 4.875; 15/2/2014
BEAR STEARNS CO : 5.35; 1/2/2012	LEHMAN BROS HLDG : 5.75; 3/1/2017	WACHOVIA CORP : 5.3; 15/10/2011
BEAR STEARNS CO : 5.55; 22/1/2017	LEHMAN BROS HLDG : 5; 14/1/2011	WACHOVIA CORP : 5.35; 15/3/2011
BEAR STEARNS CO : 5.7; 15/11/2014	LEHMAN BROS HLDG : 6.2; 26/9/2014	WACHOVIA CORP : 5.625; 15/10/2016
BOSTON SCIENTIFC : 5.45; 15/6/2014	LEHMAN BROS HLDG : 6.5; 19/7/2017	WACHOVIA CORP : 5.7; 1/8/2013
CAPITAL ONE BANK : 5.125; 15/2/2014	LEHMAN BROS HLDG : 6.625; 18/1/2012	WACHOVIA CORP : 5.75; 1/2/2018
CAPITAL ONE FINL : 6.75; 15/9/2017	LEHMAN BROS HLDG : 6; 19/7/2012	WACHOVIA CORP : 5.75; 15/6/2017
CITIGROUP INC : 6.5; 18/1/2011	LEHMAN BROS HLDG : 7.875; 15/8/2010	WASH MUT BANK NV : 5.125; 15/1/2015
COUNTRYWIDE FINL : 4.5; 15/6/2010	MBNA CORP : 6.125; 1/3/2013	WASH MUT BANK NV : 5.5; 15/1/2013
COUNTRYWIDE FINL : 5.8; 7/6/2012	MORGAN ST DEAN W : 6.6; 1/4/2012	WASH MUT BANK NV : 5.65; 15/8/2014
COUNTRYWIDE HOME : 4; 22/3/2011	MORGAN ST DEAN W : 8; 15/6/2010	XL CAPITAL LTD : 5.25; 15/9/2014
DTE ENERGY CO : 7.05; 1/6/2011	MORGAN STANLEY : 5.25; 2/11/2012	

A basis spread or a ratio basis spread

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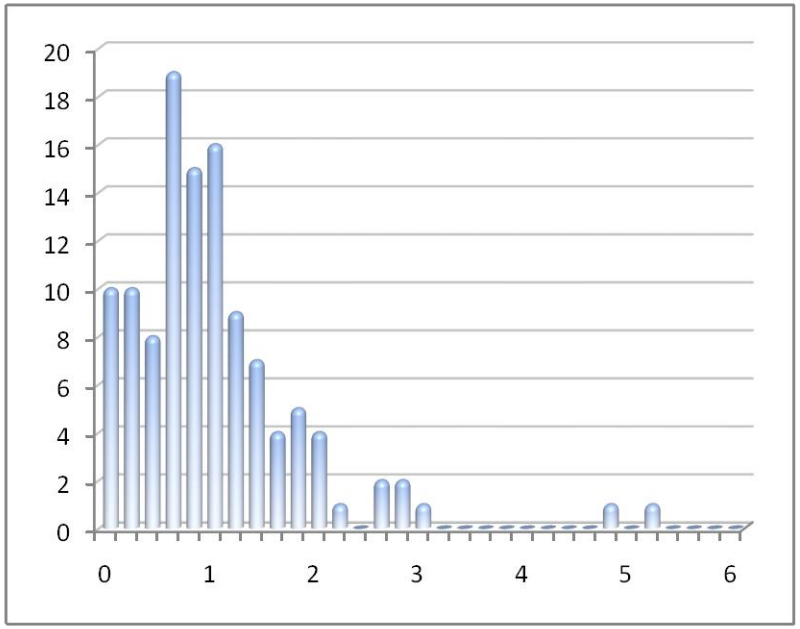
- The coefficient α in the cointegration relationship is expected to be 1 if the spread is mean-reverting.

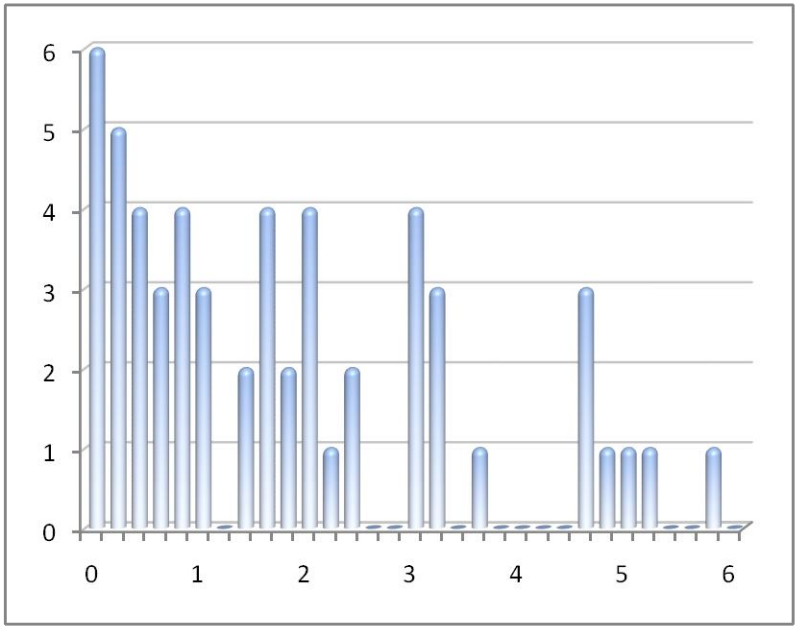
$$y_t = c + \alpha x_t + \varepsilon_t$$

- But other values are possible: α represents the amount of CDS needed to hold against a unit bond holding to create a mean-reverting package.

This histogram gives the distribution of α for the first 100 days of the data set, prior to the September crisis ...



... whereas this chart covers the last 100 days, a period which includes September and its aftermath.



Ratio basis spread: example 1 revisited

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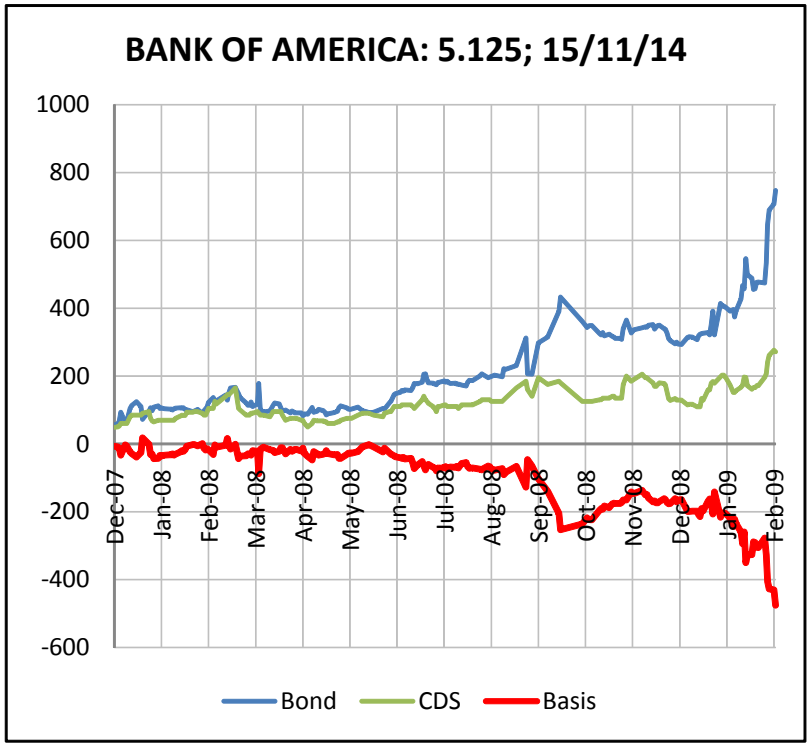

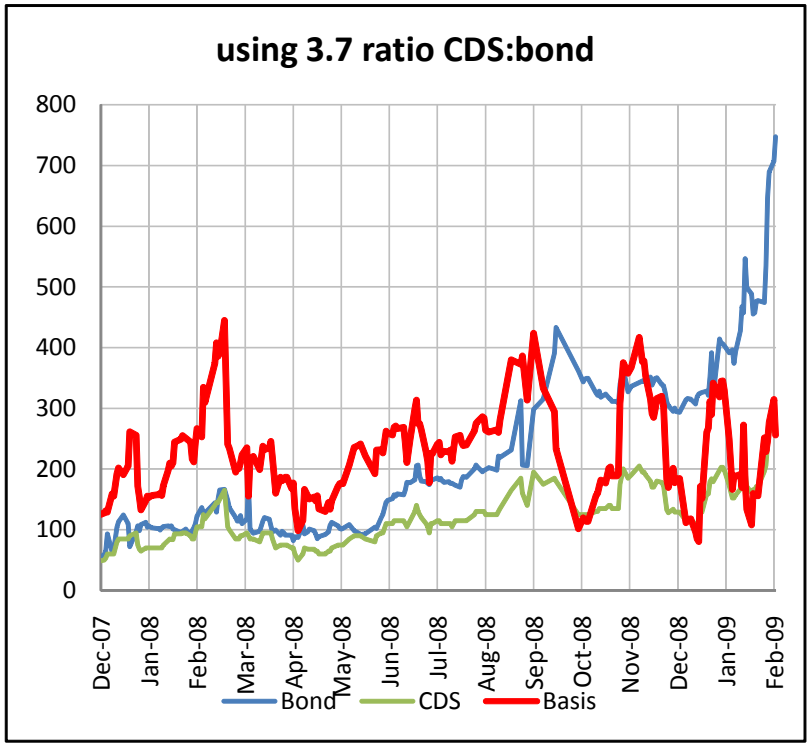

- Cointegration gives best estimate for α as 3.7
- Right-hand plot illustrates effective basis using 3.7 ratio CDS:bond.

Ratio basis spread: example 2 revisited

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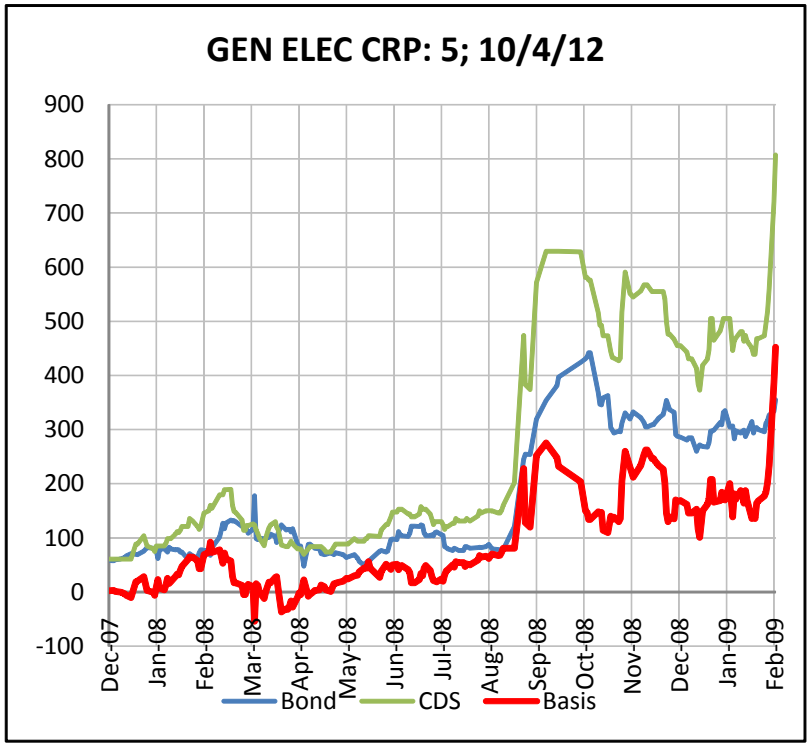

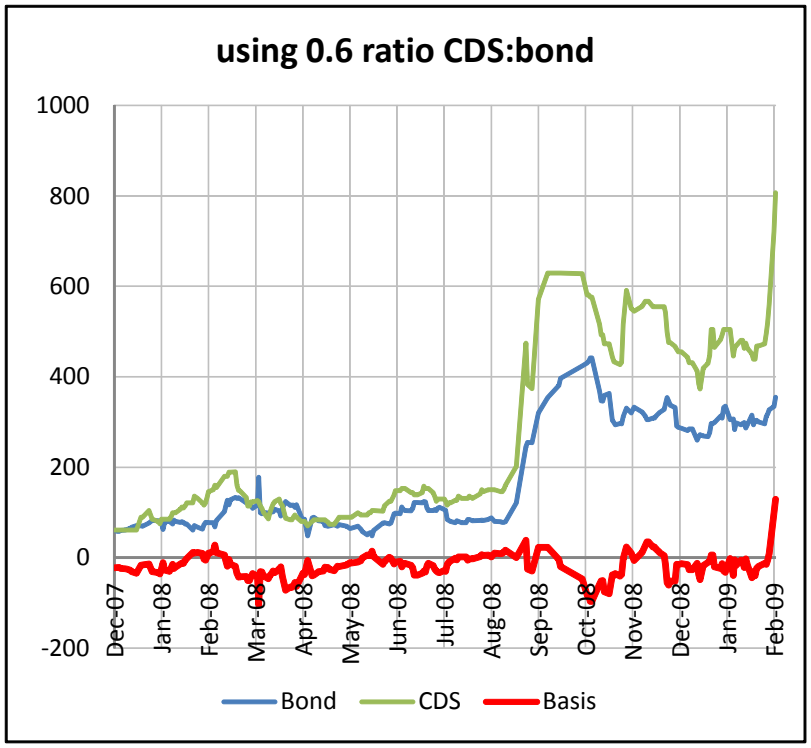

- Cointegration gives best estimate for α as 0.6
- Right-hand plot illustrates effective basis using 0.6 ratio CDS:bond.

Principal factors driving the credit markets

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- Principal components analysis allows us to identify factors driving a complex system, such as our system of 582 bonds and CDS (1164 variables) observed over 233 days.
- If our data is normalised so that each data series is $N(0,1)$, we can store n observations of m data series in a matrix $\mathbf{X}=(x_{ij})$ where x_{ij} is the ith observation of the jth data series. The correlation matrix for this data is simply $\mathbf{C}=\mathbf{X'X}/n$.
- Matrix decomposition of $\mathbf{C}$ yields an orthonormal matrix of eigenvectors $\mathbf{V}$ and and a diagonal matrix of eigenvalues $\mathbf{\Lambda}=diag(\lambda_j)$ (sorted in descending order) satisfying $\mathbf{CV}=\mathbf{V\Lambda}$.
- Consider the transformed data $\mathbf{P}=\mathbf{XV}$: each column represents a data series that is a weighted linear combination of columns of $\mathbf{X}$; these are the **principal components;** and we know their covariance is $\mathbf{P'P}/n=\mathbf{V'X'XV}/n=\mathbf{V'CV}=\mathbf{V'V\Lambda}=\mathbf{\Lambda}$. So the principal components are orthogonal , with the first having the most variance, and the others progressively less.
- Given that $\mathbf{P}=\mathbf{XV}$, we can multiply both sides by $\mathbf{V'}$ to deduce that $\mathbf{X}=\mathbf{PV'}$. Thus we can recreate the original data by taking a weighted linear combination of principal components. The factor weights that allow us to do this are found in $\mathbf{V'}$.

Principal factors driving the credit markets

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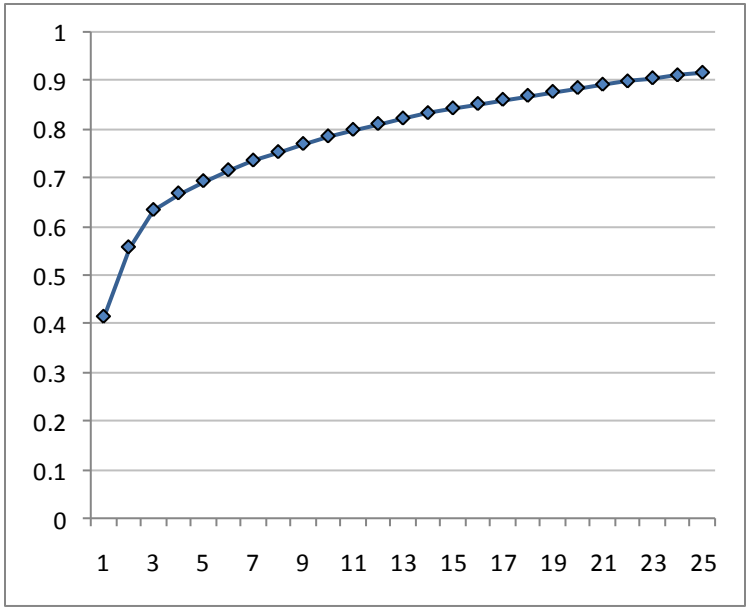
- The chart shows the cumulative sum of eigenvalues, up to the first 25.
- 5 principal components are sufficient to explain 70% of the variance of the data.
- These were calculated from differenced data (working in log space). Trial and error showed that using a differencing lag greater than 1 filtered out some of the noise due to lagging effects and improved the predictive power of the principal components. In the end we used a differencing lag of 10 days.



Factor weight heat map

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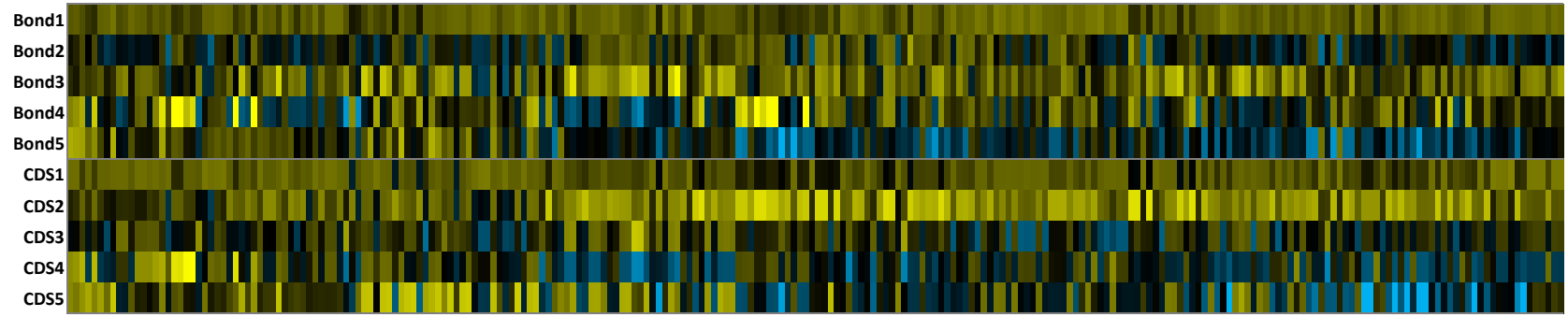
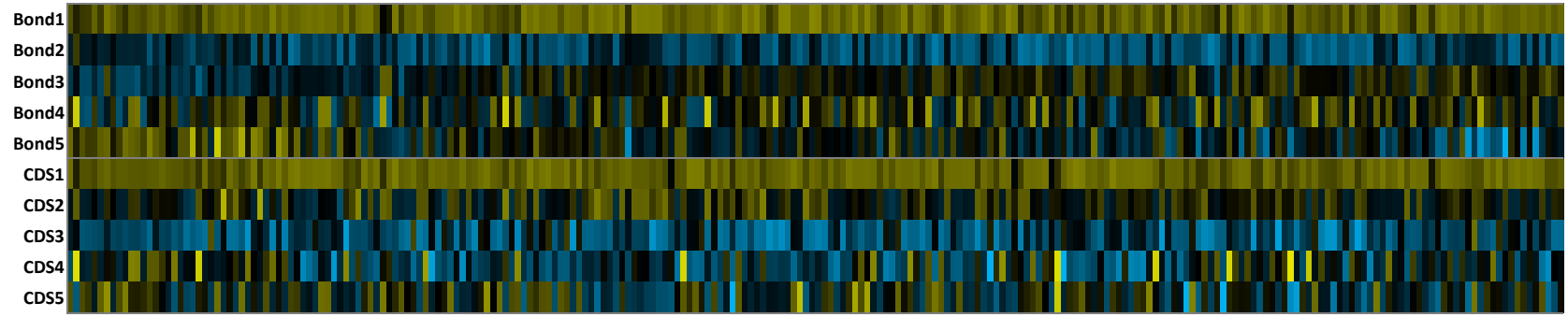
Financials



Non-Financials



- *Bond1-5* give the factor weights on the first principal components for each bond, and *CDS1-5* give the factor weights for each CDS.
- Yellow is positive and blue is negative
- High spread names are on the left, low spread names on the right. The chart has been truncated on the right.

Factor weight heat map

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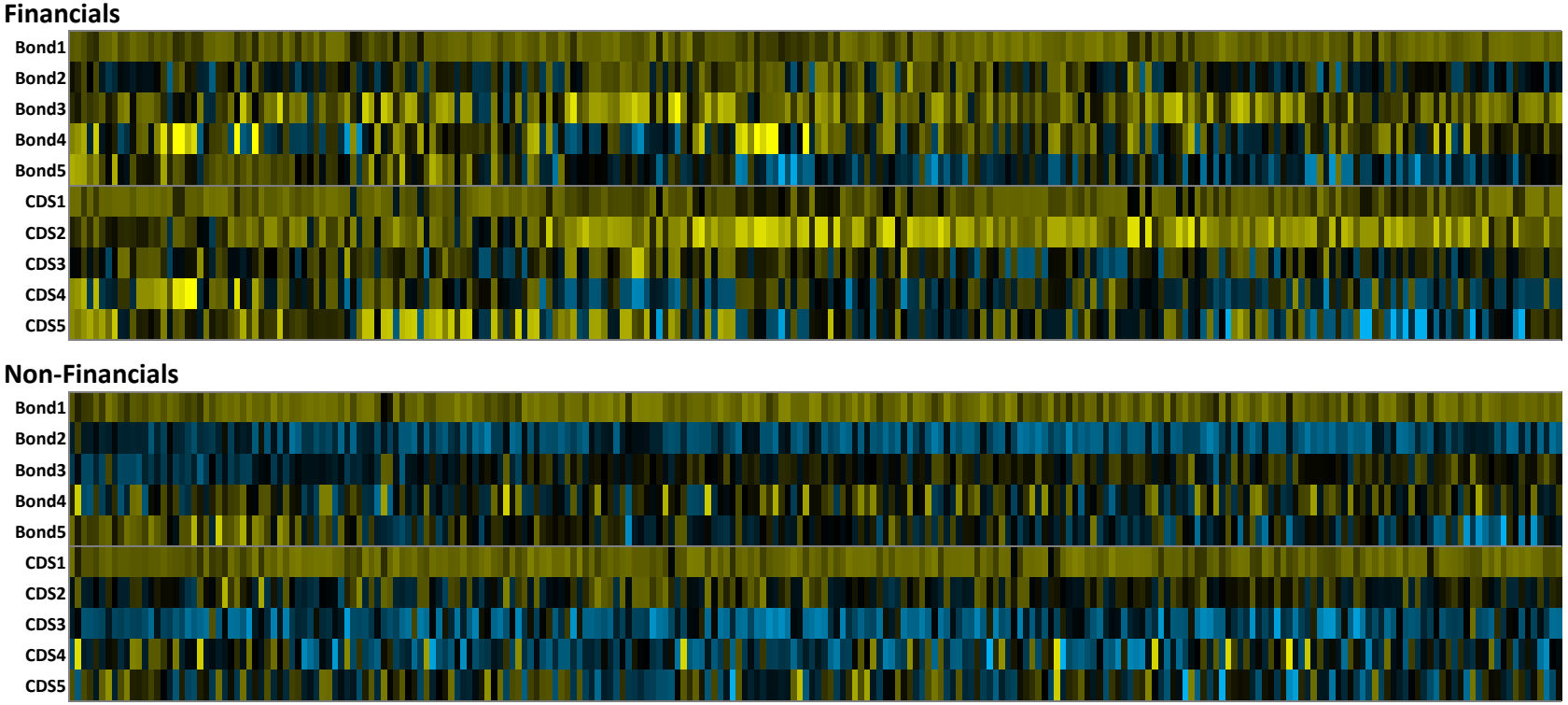

	P1	P2	P3	P2+P3	P2-P3
Financial bond	+	0	+	+	–
Financial CDS	+	+	0	+	+
Non-financial bond	+	–	0	–	–
Non-financial CDS	+	0	–	–	+

When P2 and P3 combine in the same direction the financials/non-financials spread moves; when in opposite directions, the CDS-bond basis moves.

Negative basis in crisis

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- What is the CDS-bond basis and what drives it?
- How has the basis changed since the crisis struck?
- Does the bond market drive the CDS market or vice versa?
- Is the basis still mean-reverting?
- Can we observe the principal factors driving the credit markets?

Contacts

Josh Danziger josh.danziger@valere-capital.com

Josh Danziger is a Principal of Valere Capital Partners LLP, a new asset manager expecting to launch the Valere Credit Opportunities Fund in 1H09. Prior to this he was Head of Structured Products at Royal Bank of Canada, responsible for structured rates, inflation, credit derivatives and principal finance. His PhD at Cambridge University concerned the computer modeling of the chemical interactions between proteins and drugs at a molecular level.

Ed Parcell (*) edparcell@gmail.com

(*) Ed Parcell is not affiliated with Valere Capital Partners LLP.