Financial Sector Bailouts, Sovereign Bailouts and the Transfer of Credit Risk

Data Supplement

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Contents

A Construction and Properties of the Dataset

This section provides details of the data sources that we consulted to build our dataset as well as a thorough description of our data cleansing routine. In addition, pairwise correlations, descriptive statistics and unit root test results are reported for each series.

A.1 Credit Default Swap Spreads

All of our CDS spread data — both for sovereigns and for financial institutions — is obtained from Markit, which is the leading provider of CDS data. The following characteristics of CDS contracts are particularly important:

(i) The tenor of the contract

The Markit dataset quotes CDS spreads for tenors (terms) of $\frac{1}{2}$, 1, 2, 3, 4, 5, 7, 10, 15, 20 and 30 years. It is widely believed that the 5 year tenor is the most liquid, and it is the most frequently quoted part of the credit curve (Markit, 2008). Consequently, we use 5 year CDS spreads throughout our analysis.

(ii) The transaction currency

CDS contracts can be denominated in a variety of currencies, although the US dollar, the Euro and the Japanese yen account for the large majority of contracts by both value and volume. Of these currencies, US dollar CDS are the most widespread so we use US dollar data throughout with the exception of CDS for the US sovereign where we follow Bai and Wei (2012) and use Euro CDS. The authors note that sovereign CDS contracts are usually traded in a foreign currency in order to protect the protection buyer against inflation risk and foreign exchange risk (p. 2).

(iii) The applicable restructuring clause

The restructuring clause or 'doc clause' defines the credit events that trigger the swap under a CDS agreement. In 2003, the International Swaps and Derivatives Association (ISDA) published Credit Derivatives Definitions detailing the four doc clauses listed in Table 1. In February 2014, the ISDA updated its credit derivatives definitions. Among other changes,

Clause	Contract Details
CR	*Complete/full restructuring* Any restructuring event is classed as a credit event. The protection seller may deliver any bond with a maturity of up to 30 years.
MR	*Modified restructuring* Restructuring agreements are considered as credit events. The protection seller may only deliver bonds with a maturity of up to 30 months after the end date of the CDS contract or the reference obligation that is restructured, irrespective of its maturity.
MM	*Modified-modified restructuring* Similar to the MR clause but the protection seller may deliver bonds with a maturity of up to 60 months. MM contracts are commonly used in Europe.
XR	*No restructuring* Restructuring events are not classed as credit events which can trigger the swap.

Table 1: Doc Clauses Defined in the ISDA's 2003 Credit Derivatives Definitions

the new definitions added provisions for government-initiated bail-ins, broadened the settlement options for CDS contracts on sovereign reference entities and introduced standardised reference obligations. Trading commenced under the new definitions on September 22$^{\text{nd}}$, 2014. To differentiate contracts using the updated doc clauses from the earlier clauses, a '14' suffix is appended in the Markit data (i.e. CR14 vs. CR).[1]

In practice, the change from the 2003 definitions to the 2014 definitions does not appear to introduce any material discontinuities in our dataset so we simply combine data for both definitions to construct complete time series that span our sample period (e.g. we may construct a time series using 'CR' data for the period up to and including September 21$^{\text{st}}$ 2014 and 'CR14' data thereafter).

(iv) The seniority level of the debt within the capital structure of the reference entity

The Markit dataset contains data for CDS contracts on four different tiers of debt: senior, subordinated, junior and preferred. We use data for senior unsecured debt in all cases.

[1] A useful discussion of the 2003 definitions is available from Markit via https://www.markit.com/news/Credit%20Indices%20Primer.pdf while the ISDA provides a helpful FAQ document relating to the 2014 definitions at http://www2.isda.org/attachment/NjU5Nw==/ISDA20201420Credit20Definitions20FAQ20v12_Clean.pdf.

A.1.1 Sovereign CDS Spreads

Bai and Wei (2012) provide a useful discussion of CDS market conventions regarding restructuring clauses and transaction currencies. They note that sovereign CDS contracts typically trade under a CR convention. As noted above, they consider US dollar contracts for all cases apart from the US sovereign, where they use the Euro contract. We adopt their conventions with a single exception. The 'CR/CR14' data for the Australian sovereign has many missing observations but the 'MR/MR14' data is complete. Consequently, we use the US dollar denominated 5 year 'MR/MR14' contract in the case of Australia.

Selecting the data in this way yields substantially complete series for 15 sovereigns. In some cases, there are small gaps which we fill by assuming that the CDS spread remains unchanged from the previous day. However, in the following 3 cases, there are larger gaps:

GR Greek data is missing from 09–Mar–2012 until 06–Jun–2013 inclusive (this is the period during which Greek sovereign CDS switched from trading under a running spread to trading on a points upfront basis).

SE Swedish data is missing from 02–Jan–2006 to 03–Feb–2006 inclusive.

UK Data for the UK is missing from from 02–Jan–2006 until 17–Mar–2006 inclusive and from 20–Apr–2006 to 16–Jun–2006 inclusive.

For Sweden and the UK, given that the gaps occur at the beginning of the sample where the CDS spreads for all of our sovereigns are low and stable, we fill the missing observations by assuming that the CDS spreads are constant. This approach is consistent with the properties of the sovereign CDS data: Table 2 reveals that the level of the CDS spread behaves like simple random walk processes, which implies that the optimal h-step-ahead forecast of the level is equal to the last available observation, which implies a zero first difference. Note that our main results are based on rolling regressions using a window of 250 trading days. Consequently, the imputed data will only enter the rolling samples ending prior to mid-2007 and will not enter the later samples at all.

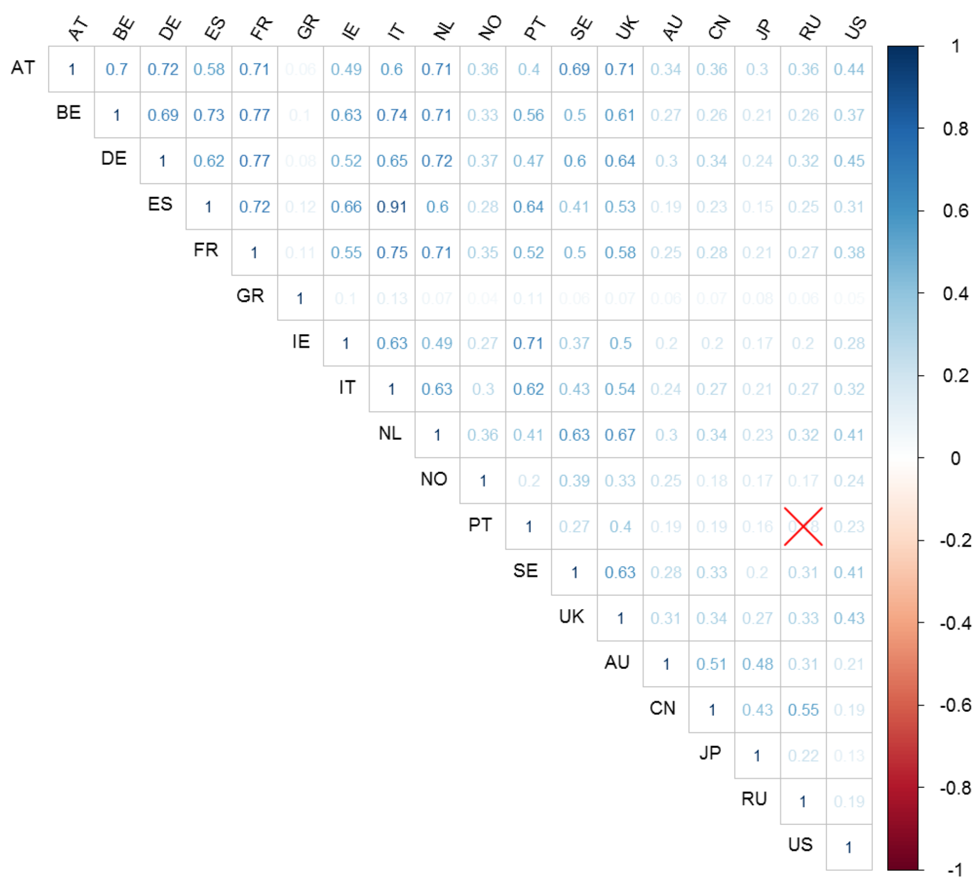
For Greece, the period of missing data covers more than a year and occurs at a volatile time. In addition, the final few listed observations of the Greek sovereign CDS spread in

February and March 2012 exhibit extreme volatility, rising above 10,000bp on 15-Feb-2012 and reaching 23,189bp by 08-Mar-2012. These extreme observations largely reflect illiquidity and they introduce large outliers into the dataset which are likely to compromise the stability of the estimated model. Consequently, we remove these extreme observations. To fill the CDS spread data over the period 15-Feb-2012 to 06-Jun-2013 inclusive, we require a more refined approach than was necessary for either Sweden or the UK — we therefore elect to switch to an alternative credit risk measure at this time. The theoretical literature shows that both sovereign CDS and sovereign bonds offer an investor exposure to government debt and the associated risk (e.g. Duffie, 1999). Furthermore, many empirical studies have used both CDS spreads and bond yield spreads and have generally found that both convey similar information on credit risk (e.g. Caporin, Pelizzon, Ravazzolo, and Rigobon, 2013; Acharya, Drechsler, and Schnabl, 2014) although there is some evidence that credit risk price discovery is more likely to occur in the CDS market than the bond market (Blanco, Brennan, and Marsh, 2005). Therefore, from 15-Feb-2012 to 06-Jun-2013 inclusive, we replace the sovereign CDS spread with the yield spread between the 5 year Greek government bond and the 5 year German Bund. To avoid any discontinuities when we switch between the CDS spread to the bond yield spread, we re-scale the latter such that it precisely meets the end points of the available CDS data. As noted in the manuscript, given that our results are derived from rolling regression analysis, our use of the Greek yield spread from 15-Feb-2012 to 06-Jun-2013 will have no effect on rolling samples that do not include this period.

Figure 1 reports the full-sample correlation matrix for the first differences of the sovereign credit spreads. The correlations are non-negative in all cases. The correlations among the GIIPS are generally strong as one may expect. Correlations among the European 'core' are also relatively strong in many cases, reflecting a high level of bond market convergence.

Figure 2 provides time series plots of the sovereign credit spreads both in levels and in first differences, measured in basis points. The credit spreads for all sovereigns show a marked spike in early 2009 as a result of the global financial crisis. European sovereigns experience a second spike in 2011/2 during the European sovereign debt crisis. This is particularly marked among the GIIPS, where these peaks correspond to acute crises and bailouts.

Table 2 provides descriptive statistics for the level and first difference of the sovereign credit spreads, as well as unit root test results and the first order autocorrelation coefficient for each series. The most striking feature of the descriptive statistics is the comparison of the level and volatility of the CDS spreads for the European core and periphery, especially the GIIPS. Note also that the sovereign credit spreads are first difference stationary for every country, which is one of the reasons that our model is specified in first differences.



NOTE: Values marked with a red X are insignificant at the 5% level.

Figure 1: Correlations among the First Differences of the Sovereign CDS Spreads

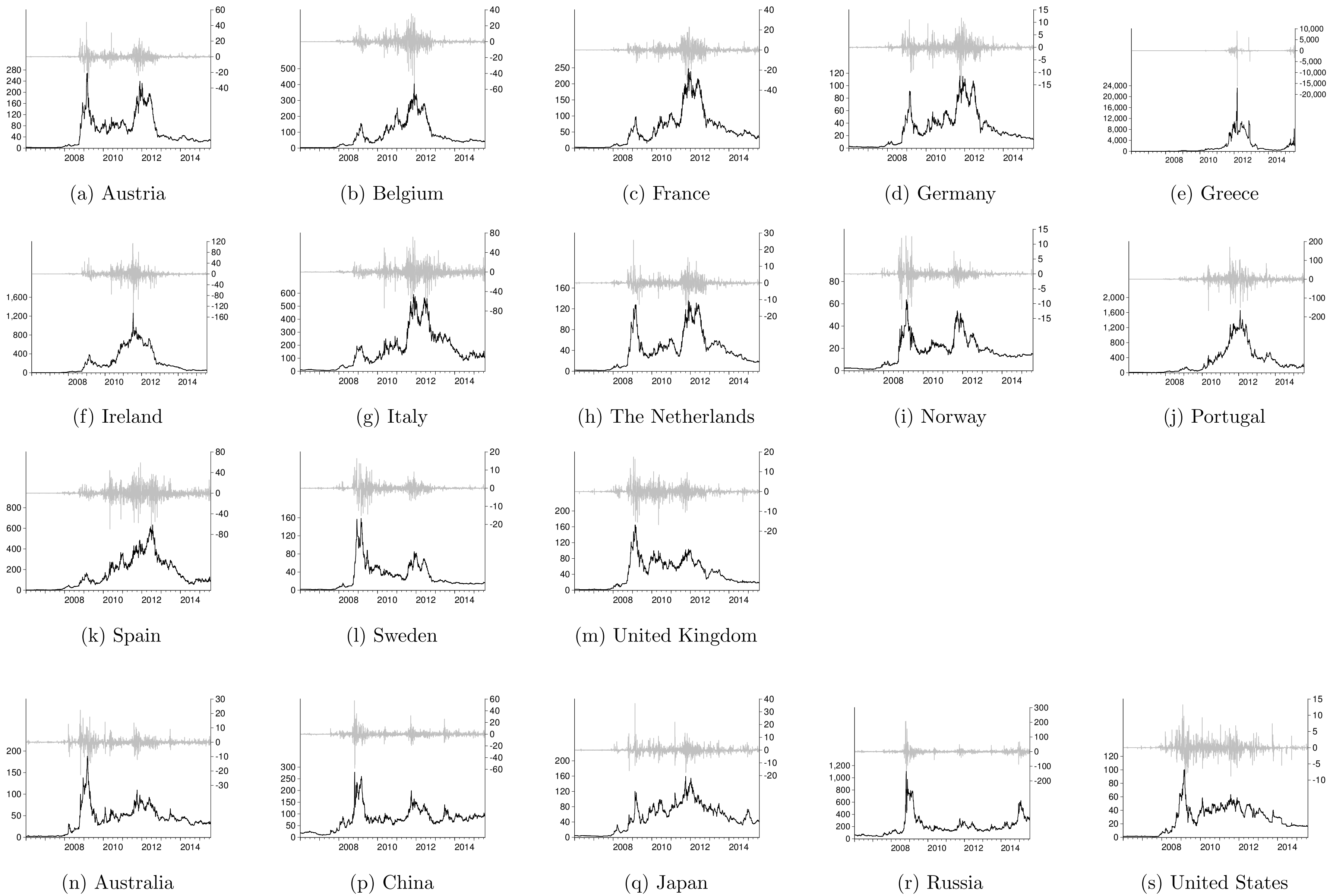


Figure 2: Sovereign CDS Spreads. Black line: CDS spread (lhs, bp). Gray line: first difference (rhs, bp).

	Level					First Difference				
	Mean	Med	SD	ADF	AR(1)	Mean	Med	SD	ADF	AR(1)
AT	56.597	39.102	55.227	0.597	0.998	0.010	0.000	3.458	< 0.01	0.275
BE	78.290	48.974	79.871	0.875	0.998	0.015	0.000	4.546	< 0.01	0.229
DE	30.518	24.033	26.565	0.660	0.998	0.005	0.000	1.562	< 0.01	0.202
ES	154.100	100.639	144.118	0.935	0.998	0.037	0.000	8.301	< 0.01	0.223
FR	57.618	46.770	54.419	0.914	0.998	0.012	0.000	2.989	< 0.01	0.178
GR	1,214.199	518.981	1,901.092	0.267	0.991	0.828	0.001	259.596	< 0.01	-0.030
IE	211.064	129.327	247.485	0.949	0.999	0.019	0.000	10.824	< 0.01	0.296
IT	154.581	124.424	137.557	0.870	0.998	0.043	0.000	8.350	< 0.01	0.207
NL	38.432	33.713	32.848	0.755	0.998	0.007	0.000	1.917	< 0.01	0.211
NO	16.851	15.306	12.196	0.572	0.995	0.005	0.000	1.149	< 0.01	-0.143
PT	298.115	167.838	351.367	0.926	0.999	0.066	0.000	15.999	< 0.01	0.298
SE	28.284	18.663	27.500	0.350	0.998	0.006	0.000	1.723	< 0.01	0.290
UK	41.492	35.696	33.443	0.752	0.998	0.007	0.000	1.941	< 0.01	0.215
AU	40.440	39.544	30.305	0.411	0.997	0.013	0.000	2.189	< 0.01	0.173
CN	77.210	75.330	44.808	0.363	0.995	0.033	-0.007	4.202	< 0.01	0.175
JP	51.521	50.267	35.675	0.600	0.998	0.015	0.000	2.270	< 0.01	0.097
RU	200.957	162.895	156.740	0.484	0.995	0.112	-0.018	14.484	< 0.01	0.300
US	26.729	28.727	18.812	0.522	0.997	0.006	0.000	1.303	< 0.01	0.052

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 2: Descriptive Statistics for the Level and First Difference of the Sovereign CDS Spread

A.1.2 Financial Sector CDS Spreads

Bai and Wei (2012, p. 9) note the following conventions for non-sovereign CDS contracts, which are largely determined by regional differences in the legal framework for bankruptcy:

– US CDS trade under and a mixture of MR and XR clauses prior to 2009 and under an XR convention as of April 8, 2009

– European CDS generally trade under an MM convention

– Emerging and Asian markets' CDS generally trade under a CR convention

Based on these conventions — and using only XR data for US corporations to avoid mixing different restructuring clauses — we compile a dataset of CDS spreads for financial institutions domiciled in each country. Taking inspiration from Acharya et al. (2014), for the ith country we select financial institutions which satisfy the following attributes:

- They must have CDS data in the Markit database
- They must be classified by Markit as *financials*
- They must be identified by Markit as operating in the ith sovereign
- They must be classified as either banking or insurance firms in *Osiris*
- They must have total assets of USD10bn or more at least once over our sample period
- They must typically have publicly traded equity

This procedure is based broadly on that of Acharya et al. (2014), although there are several differences, three of which are particularly noteworthy. First, while Acharya et al. consider only banks, we use both banks and insurance firms, a decision which reflects the concentration of bailouts in these two sectors. In principle, one could also include firms from other sectors such as real estate investment trusts although their role during the GFC was secondary to that of banks and insurers. Second, Acharya et al. use *Bankscope* data which is unavailable to us — we found Bureau van Dijk's *Osiris* database to be a suitable substitute. Finally, while Acharya et al. limit their attention to firms with publicly traded equity, we allow a small number of exceptions to this rule: (i) in Austria, we include data for Raiffeisen Zentralbank as otherwise our index would be based on a single firm; (ii) in China, we use data for four large state-sponsored banks as there is not enough CDS data for privately held Chinese banks to construct a meaningful index; and (iii) rather than simply dropping failed banks from the sample, we include CDS data for several institutions which became state-owned as a result of the crisis, such as the Irish Bank Resolution Corporation.

A complete list of the financial institutions that we include may be found in Table 3. Having identified the relevant set of financial firms for the ith sovereign, we follow Acharya et al. and compute the ith financial sector CDS spread as an equally weighted average of the firm-specific CDS spreads.

Table 3: A Summary of the Financial Institutions Included in our Sample

	Headquarters	ICB	Assets	CDS Spread, bp			
			\$bn	Min.	Max.	Mean	S.D.
Australia							
ADELAIDE BANK LTD	Adelaide	8355	26.58	18.72	104.87	387.50	110.15
AMP LTD	Sydney	8775	125.73	8.84	105.69	335.23	60.41
AUSTRALIA AND NEW ZEALAND BANKING GP LTD*	Melbourne	8355	675.73	4.00	84.25	241.14	50.50
BENDIGO AND ADELAIDE BANK LTD	Bendigo	8355	61.29	113.39	176.69	250.73	13.72
BANK OF QUEENSLAND LTD	Newstead	8355	43.85	145.67	163.97	185.20	12.90
COMMONWEALTH BANK OF AUSTRALIA*	Sydney	8355	782.69	4.61	83.42	240.32	49.93
INSURANCE AUSTRALIA GROUP LTD	Sydney	8536	42.22	87.70	88.69	89.18	0.46
MACQUARIE GROUP LTD*[2]	Sydney	8777	162.83	11.11	161.57	1317.61	133.70
NATIONAL AUSTRALIA BANK LTD*	Melbourne	8355	798.50	4.64	84.61	240.31	50.74
QBE INSURANCE GROUP LTD	Sydney	8538	45.71	8.72	152.77	497.58	101.06
ST. GEORGE BANK LTD[3]	Sydney	8355	124.16	7.00	42.12	208.84	45.52
SUNCORP GROUP LTD	Brisbane	8355	102.54	8.98	126.80	423.30	77.70
WESTPAC BANKING CORPORATION*	Sydney	8355	724.74	4.67	83.43	238.83	49.93
Austria							
ERSTE GROUP BANK AG*	Vienna	8355	295.18	9.50	140.29	482.70	87.79
RAIFFEISEN ZENTRALBANK[4]	Vienna	8355	190.18	9.70	141.25	527.71	88.69
Belgium							
AGEAS SA	Brussels	8355	1282.46	66.39	125.91	220.39	42.85
FORTIS SA NV	Brussels	8355	889.11	10.00	114.62	523.64	93.30
KBC GROEP NV/SA*	Brussels	8355	523.47	6.72	141.09	494.52	107.02
China[5]							
AGRICULTURAL BANK OF CHINA LTD	Beijing	8355	2610.58	14.19	142.16	499.63	84.63
BANK OF CHINA LTD	Beijing	8355	2492.46	14.58	127.62	451.60	79.50
BANK OF COMMUNICATIONS CO LTD	Shanghai	8355	1024.40	105.50	164.95	355.18	45.02
INDUSTRIAL & COMMERCIAL BANK OF CHINA	Beijing	8355	3368.19	101.94	159.47	355.99	52.92
France							
CREDIT AGRICOLE SA*	Montrouge	8355	2300.79	5.91	109.78	401.42	81.03
AXA	Paris	8532	1047.56	8.91	116.61	397.26	84.91
BNP PARIBAS SA*	Paris	8355	2964.32	5.38	89.80	360.63	69.17
NATIXIS SA	Paris	8355	773.45	7.26	129.61	335.83	86.27
SCOR SE	Paris	8538	45.54	11.08	90.80	248.91	54.23
SOCIETE GENERALE SA*	Paris	8355	1674.49	5.83	115.15	433.32	89.35
Germany							
ALLIANZ SE	Munich	8532	1539.58	5.93	65.14	192.08	37.28
COMMERZBANK AG*	Frankfurt	8355	1216.02	7.97	109.04	364.12	74.01
DEUTSCHE BANK AG*	Frankfurt	8355	3126.29	8.92	90.29	317.80	51.10
DEUTSCHE POSTBANK AG	Bonn	8355	326.45	44.78	91.65	169.19	23.31
HANNOVER RE SE	Hanover	8538	71.74	7.92	71.43	154.63	37.75
IKB DEUTSCHE INDUSTRIEBANK AG	Dusseldorf	8355	78.72	11.00	321.15	1411.99	252.86
MUNICH RE GROUP	Munich	8538	343.37	5.63	49.84	125.64	23.36
TALANX AG	Hanover	8532	174.13	32.45	141.75	411.55	89.93
Greece							
ALPHA BANK AE	Athens	8355	101.64	15.19	747.99	5308.22	723.46
EUROBANK ERGASIAS SA	Athens	8355	121.40	13.81	727.33	5323.94	714.61
NATIONAL BANK OF GREECE SA*	Athens	8355	163.36	11.44	726.17	5152.87	698.59
Ireland							
ALLIED IRISH BANKS PLC*	Dublin	8355	261.83	5.96	263.38	2165.49	359.29
ANGLO IRISH BANK	Dublin	8355	147.56	7.99	609.67	5853.11	900.82

Continued overleaf

[2] We use CDS data for the principal subsidiary (Macquarie Bank) as it is more complete than the CDS data for the group.

[3] St. George Bank became a subsidiary of Westpac on 01-Dec-08. We exclude its CDS data from this point on.

[4] Raiffeisen Zentralbank is included in our sample to ensure that our index for Austria does not rely on data for a single firm. It is also included in the analysis of Alter and Beyer (2014).

[5] The Markit database does not contain CDS data for any privately-owned Chinese banks. Therefore, to proxy for the financial sector credit risk in China, we use CDS spreads for the following majority state-owned banks.

Table 3 – continued from previous page

	Headquarters	ICB	Assets	CDS Spread, bp			
			$bn	Min.	Max.	Mean	S.D.
BANK OF IRELAND*	Dublin	8355	312.18	5.60	362.35	1999.49	384.80
IRISH BANK RESOLUTION CORPORATION LTD[6]	Dublin	8355	147.56	385.53	960.16	1886.91	378.57
PERMANENT TSB PLC	Dublin	8575	117.86	9.90	414.44	2146.97	434.18
Italy							
GENERALI ASSICURAZIONI SPA	Trieste	8532	613.40	5.79	126.68	452.91	103.18
MEDIOBANCA SPA*	Milan	8355	105.41	7.33	139.16	570.80	118.21
BANCA ITALEASE SPA	Milan	8775	37.94	65.05	308.32	1370.88	232.91
BANCO POPOLARE DI VERONA E NOVARA	Verona	8355	90.47	12.79	15.52	20.81	1.93
BANCA POPOLARE ITALIANA	Lodi	8355	68.36	10.00	25.03	84.61	14.37
BANCO POPOLARE*	Verona	8355	195.50	14.42	283.17	975.88	203.19
BANCA LOMBARDA E PIEMONTESE SPA	Brescia	8355	52.35	15.38	16.78	19.22	0.77
CAPITALIA SPA	Rome	8355	180.60	7.27	15.66	52.23	8.66
SAN PAOLO IMI SPA	Turin	8355	380.02	5.75	9.97	15.36	2.52
BANCA POPOLARE DI MILANO SCARL	Milan	8355	72.26	11.15	204.80	841.81	196.26
BANCA MONTE DEI PASCHI DI SIENA SPA*	Siena	8355	326.58	6.00	231.42	880.05	212.90
INTESA SANPAOLO*	Turin	8355	900.15	5.72	159.07	625.41	132.35
UNIONE DI BANCHE ITALIANE SPA	Bergamo	8355	178.85	10.59	182.58	682.83	133.81
UNIPOL GRUPPO FINANZIARIO SPA*	Bologna	8532	114.82	10.00	94.53	471.45	112.61
UNICREDIT SPA*	Milan	8355	1504.13	7.29	164.55	691.64	141.11
Japan							
ACOM COMPANY LTD	Tokyo	8773	18.60	22.84	207.62	1164.35	191.64
AEON FINANCIAL SERVICE COMPANY LTD	Chiba	8773	29.04	16.39	110.38	442.02	67.60
AOZORA BANK LTD	Tokyo	8355	72.29	10.42	191.23	1542.50	237.41
BANK OF FUKUOKA LTD	Fukuoka	8355	116.11	7.76	78.40	199.56	47.39
BANK OF IWATE LTD	Morioka	8355	38.60	12.39	84.88	173.11	41.14
BANK OF YOKOHAMA LTD*	Yokohama	8355	152.27	7.10	66.17	210.99	43.00
CHIBA BANK LTD*	Chiba	8355	131.65	8.84	83.91	161.24	39.49
CREDIT SAISON COMPANY LTD	Tokyo	8773	26.84	13.96	166.44	891.12	180.09
DAI-ICHI LIFE INSURANCE COMPANY LTD[7]	Tokyo	8575	407.41	46.76	103.17	148.70	19.35
DAIWA SECURITIES GROUP INC	Tokyo	8777	230.36	9.36	134.01	432.45	105.28
HIGO BANK LTD	Kumamoto	8355	49.81	12.89	75.25	200.38	40.82
HIROSHIMA BANK LTD	Hiroshima	8355	80.49	10.94	66.46	168.44	43.72
HITACHI CAPITAL CORPORATION	Tokyo	8773	24.45	9.77	63.30	256.75	44.04
HYAKUGO BANK LTD	Tsu	8355	54.52	17.30	57.07	204.88	35.99
JOYO BANK LTD	Mito	8355	97.22	7.00	126.82	612.50	70.35
MS&AD INSURANCE GROUP HOLDINGS INC	Tokyo	8575	168.70	5.38	55.77	320.21	44.57
MIZUHO HOLDINGS INC*	Tokyo	8355	79.35	5.88	83.09	229.41	48.99
MIZUHO TRUST AND BANKING CO LTD	Tokyo	8355	79.35	9.63	89.32	180.00	42.66
MITSUBISHI UFJ FINANCIAL GROUP INC*[8]	Tokyo	8355	2572.39	5.77	70.32	204.24	40.88
NISHI-NIPPON CITY BANK LTD	Fukuoka	8355	92.73	33.11	76.70	182.88	30.05
NIKKO CORDIAL CORPORATION[9]	Tokyo	8777	75.79	11.15	29.57	140.00	20.24
NOMURA HOLDINGS INC*	Tokyo	8777	441.39	8.79	155.37	487.87	117.62
ORIX CORPORATION	Tokyo	8775	103.23	18.98	235.26	2235.26	334.06
RESONA BANK LTD*	Osaka	8355	336.71	7.85	105.54	699.17	86.51
THE 77 BANK	Miyagi	8355	92.41	10.25	29.93	114.74	24.92
SHIGA BANK LTD	Osaka	8355	54.76	22.65	27.46	30.10	1.60
SHINSEI BANK LTD	Tokyo	8355	116.15	8.60	250.25	1169.98	240.25
SHIZUOKA BANK*	Shizuoka	8355	117.06	6.00	51.03	163.50	40.03
SOMPO JAPAN INSURANCE INC	Tokyo	8536	72.07	5.24	72.86	593.49	80.81
SUMITOMO MITSUI FINANCIAL GROUP INC*[10]	Tokyo	8355	1727.02	5.61	72.87	224.17	44.07
SUMITOMO MITSUI TRUST BANK LTD*	Tokyo	8355	385.93	6.39	75.44	177.86	43.64
TOKIO MARINE & NICHIDO FIRE INS CO LTD	Tokyo	8536	198.89	4.71	52.28	310.75	42.20
Netherlands							
ABN AMRO BANK NV[11]	Amsterdam	8355	464.16	5.02	89.05	326.56	64.29
AEGON NV	The Hague	8575	473.41	8.66	144.67	588.30	100.72

Continued overleaf

[6] The Irish Bank Resolution Corporation was established in 2011 from the merger of Anglo Irish Bank and Irish Nationwide Building Society, both of which had become state-owned as a result of the GFC.

[7] Dai Ichi Life Insurance Co was historically a mutual insurance company but it took steps to demutualise in 2009 and listed on the Tokyo stock exchange on 01-Apr-2010.

[8] We use CDS data for the principal subsidiary (MUFJ Bank of Tokyo) as it is more complete than the CDS data for the group.

[9] Nikko Cordial Corporation became a subsidiary of Citigroup on 29-Jan-08. We exclude its CDS data from this point on.

[10] We use CDS data for the principal subsidiary (Sumitomo Mitsui Bank) as it is more complete than the CDS data for the group.

[11] ABN AMRO was nationalised and split from Fortis during the GFC.

Table 3 – continued from previous page

	Headquarters	ICB	Assets	CDS Spread, bp			
			$bn	Min.	Max.	Mean	S.D.
AGEAS NV	Utrecht	8355	1282.46	114.20	158.79	212.57	19.66
FORTIS NV	Amsterdam	8355	1267.59	8.78	83.11	525.00	90.45
ING GROEP NV*	Amsterdam	8575	1932.15	4.37	93.99	274.31	61.70
NN GROUP NV[12]	The Hague	8575	439.97	50.44	59.66	79.82	5.67
SNS REAAL NV[13]	Utrecht	8775	185.75	8.63	233.77	596.80	148.33
VAN LANSCHOT NV	's-Hertogenbosch	8355	31.97	23.44	162.00	357.00	65.85
Norway							
DNB ASA*	Oslo	8355	416.56	8.08	69.99	204.14	43.86
STOREBRAND GROUP	Lysaker	8575	76.21	41.93	131.01	261.41	50.87
Portugal							
BANCO BPI SA	Porto	8355	68.36	9.58	308.86	1192.17	302.57
BANCO COMERCIAL PORTUGUES*	Porto	8355	137.65	8.29	371.38	1900.05	414.86
BANCO ESPIRITO SANTO SA*	Lisbon	8355	118.56	8.54	336.46	1319.02	324.90
NOVO BANCO[14]	Lisbon	8355	118.56	249.37	354.07	560.25	83.08
Russian Federation							
BANK OF MOSCOW OJSC	Moscow	8355	51.44	96.08	446.45	2101.29	247.41
BANK URALSIB	Moscow	8355	16.01	213.96	744.89	1462.90	171.97
GAZPROMBANK OJSC	Moscow	8355	111.43	80.26	434.39	2203.31	286.29
MDM BANK OJSC	Novosibirsk	8355	13.41	256.83	547.27	2862.00	361.28
PROMSVYAZBANK OJSC	Moscow	8355	22.85	327.50	512.76	1815.00	163.84
SBERBANK OF RUSSIA OJSC*	Moscow	8355	556.39	41.60	253.43	1500.23	181.35
VTB BANK OJSC	Moscow	8355	164.44	49.50	379.22	2254.98	260.65
Spain							
BANKIA SA	Madrid	8355	391.85	90.10	490.85	1603.97	367.97
BANCO DE SABADELL SA*	Sabadell	8355	225.51	9.44	262.29	846.94	213.45
BANCO BILBAO VIZCAYA ARGENTARIA SA*	Bilbao	8355	841.49	7.64	150.42	510.33	120.51
BANKINTER SA	Madrid	8355	81.75	11.25	215.42	850.57	191.46
BANCO POPULAR ESPANOL SA*	Madrid	8355	207.96	7.81	252.58	893.78	209.11
BANCO PASTOR SA	A Coruna	8355	46.57	14.40	252.35	568.18	137.89
BANCO SANTANDER SA*	Boadilla del Monte	8355	1675.11	7.52	143.84	490.10	113.23
Sweden							
NORDEA BANK AB*	Stockholm	8355	926.70	5.43	69.03	201.82	42.85
SKANDINAVISKA ENSKILDA BANKEN AB*	Stockholm	8355	386.82	7.48	88.51	257.57	58.29
SVENSKA HANDELSBANKEN*	Stockholm	8355	386.80	4.58	59.92	169.71	36.31
SWEDBANK AB*	Stockholm	8355	283.96	5.00	101.05	367.00	71.78
United Kingdom							
AVIVA PLC	London	8575	627.61	5.85	108.76	512.80	71.69
BARCLAYS PLC*	London	8355	2992.83	5.46	101.77	285.42	63.97
BRADFORD & BINGLEY PLC [15]	Bingley	8355	126.08	9.70	210.60	1681.25	249.94
FRIENDS PROVIDENT LTD	London	8575	121.28	12.72	173.05	300.00	62.76
HBOS PLC[16]	Edinburgh	8355	1336.16	4.99	104.30	483.44	71.03
HSBC HOLDINGS PLC*	London	8355	2692.54	5.02	78.01	202.42	43.72
3I GROUP PLC	London	8775	13.90	12.79	205.73	1465.46	226.28
LEGAL & GENERAL GROUP PLC	London	8575	593.29	7.77	130.51	1094.60	154.46
LLOYDS BANKING GROUP PLC*	London	8355	1663.64	3.93	119.99	390.70	91.09
MAN STRATEGIC HOLDINGS PLC	London	8771	55.07	131.05	189.41	342.18	67.36
OLD MUTUAL PLC	London	8575	301.17	11.95	228.23	2668.87	385.18
PRUDENTIAL PLC	London	8575	766.66	7.96	118.09	923.35	120.35
ROYAL BANK OF SCOTLAND GROUP PLC*	Edinburgh	8355	3807.50	3.97	132.96	415.48	92.48
RSA INSURANCE GROUP PLC	London	8532	40.71	7.83	70.65	168.38	34.02
STANDARD LIFE PLC	Edinburgh	8575	308.36	10.22	82.86	762.72	56.07
STANDARD CHARTERED PLC*	London	8355	725.91	6.00	93.11	354.09	57.09
United States							

Continued overleaf

[12] NN Group was formed as an IPO from ING in March 2014.

[13] We use CDS data for SNS Bank as it is more complete than the data for SNS Reaal Group.

[14] Novo Banco was formed in August 2014 as a result of the bailout of Banco Espirito Santo.

[15] Bradford & Bingley was nationalised and broken up as a result of the the GFC. We include its CDS spread until 28-Sep-2008.

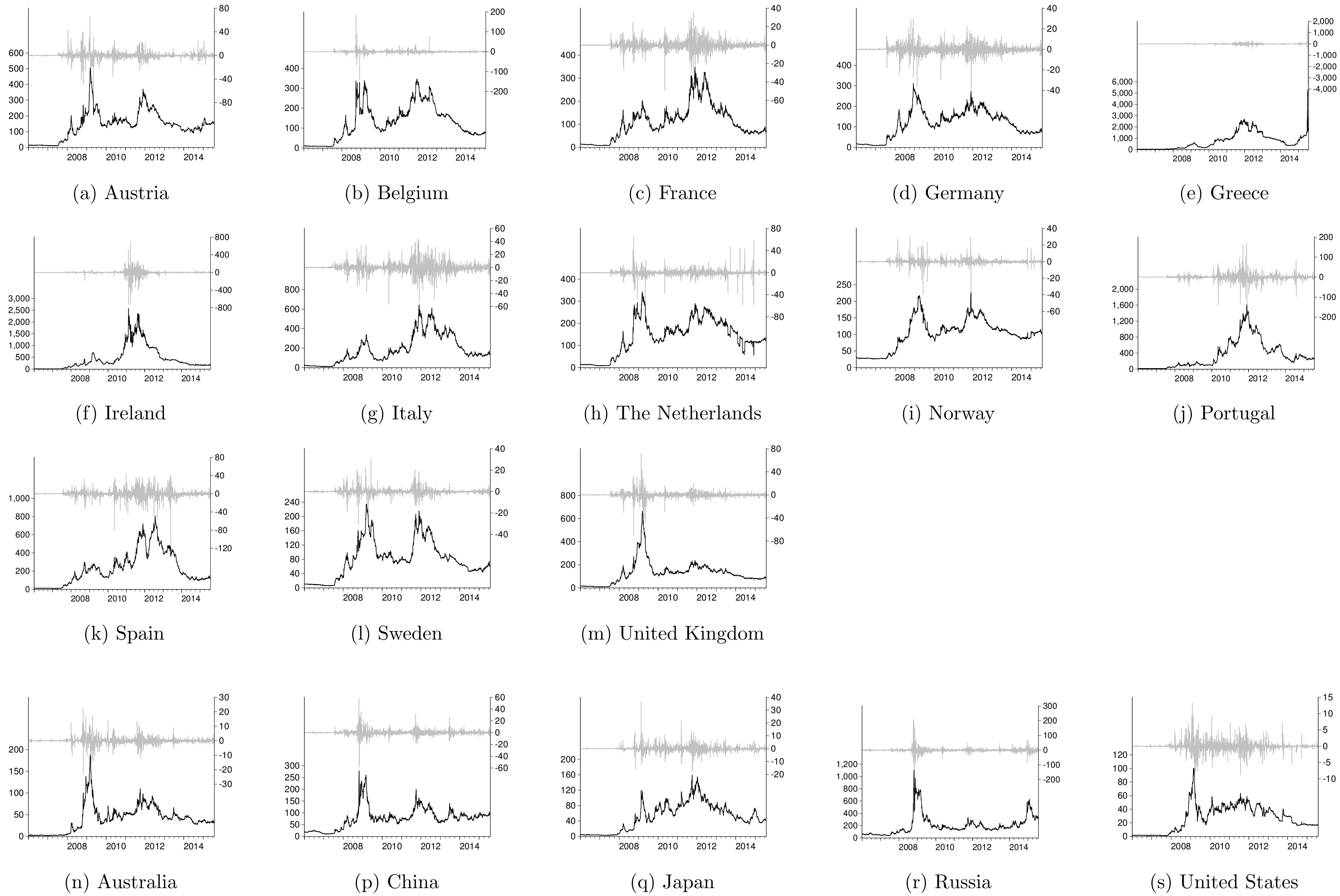
[16] HBOS became a wholly owned subsidiary of Lloyds Group in January 2009. We include its CDS spread until 18-Jan-2009.

Table 3 – continued from previous page

	Headquarters	ICB	Assets	CDS Spread, bp			
			$bn	Min.	Max.	Mean	S.D.
AFLAC INCORPORATED	Columbus, GA	8575	131.09	9.58	127.56	518.43	71.42
ALLSTATE CORPORATION	Northfield T/ship, IL	8536	232.22	8.90	71.97	398.17	61.50
ALLY FINANCIAL INC	Detroit, MI	3353	184.06	91.86	546.12	6754.14	721.71
AMERICAN EXPRESS COMPANY*	New York, NY	8773	159.10	7.77	97.21	677.56	104.77
AMERICAN FINANCIAL GROUP INC	Cincinnati, OH	8536	42.09	22.16	127.85	180.32	54.57
AMERICAN INTERNATIONAL GROUP INC	New York, NY	8532	541.33	7.70	290.49	3498.35	453.19
ASSURANT INC	New York, NY	8575	24.64	119.92	219.17	359.45	58.00
BANK OF AMERICA CORPORATION*	Charlotte, NC	8355	2264.91	7.41	121.49	486.96	91.72
BANK OF NEW YORK COMPANY INC	New York, NY	8355	385.30	9.00	12.83	15.83	1.41
BANK OF NEW YORK MELLON CORPORATION*	New York, NY	8771	385.30	9.98	73.49	142.75	32.58
BB&T CORPORATION*	Winston-Salem, NC	8355	186.81	11.94	80.23	254.00	46.70
BEAR STEARNS COMPANIES INC[17]	New York, NY	8355	395.36	17.68	75.46	723.61	89.90
BERKSHIRE HATHAWAY INC	Omaha, NE	8538	481.88	6.41	104.32	507.40	83.14
BLACKROCK INC	New York, NY	8777	239.81	38.03	68.81	110.54	27.75
CAPITAL ONE FINANCIAL CORPORATION*	Tysons Corner, VA	8773	313.04	20.84	126.34	552.18	102.78
CHARLES SCHWAB CORPORATION	San Francisco, CA	8777	154.64	14.70	53.29	135.99	27.00
CHUBB CORPORATION	Warren, NJ	8536	21.72	8.84	47.41	184.14	28.04
CIT GROUP INC	New York, NY	8775	90.25	18.43	514.32	7150.31	922.63
CITIGROUP INC*	New York, NY	8355	2187.63	6.47	136.02	638.32	107.48
CNA FINANCIAL CORPORATION	Chicago, IL	8532	54.47	27.59	134.33	432.59	94.23
DISCOVER FINANCIAL SERVICES	Riverwoods, IL	8773	83.13	85.00	267.88	598.67	156.79
E*TRADE FINANCIAL CORPORATION	New York, NY	8777	56.85	99.94	808.46	6784.80	1124.06
FEDERAL NATIONAL MORTGAGE ASSOCIATION	Washington, DC	8779	3270.11	5.61	22.96	91.37	20.19
FIFTH THIRD BANCORP*	Cincinnati, OH	8355	138.71	15.30	190.04	325.01	108.86
FRANKLIN RESOURCES INC	San Mateo, CA	8771	61.29	16.49	37.50	110.09	16.19
GENWORTH HOLDINGS INC	Henrico County, VA	8575	111.59	11.24	443.96	4493.80	650.81
GOLDMAN SACHS GROUP INC*	New York, NY	8777	1119.80	17.23	131.01	579.29	87.20
HARTFORD FINANCIAL SERVICES GROUP INC	Hartford, CT	8532	360.36	9.04	175.32	1128.51	182.27
HUNTINGTON NATIONAL BANK	Columbus, OH	8355	66.30	22.00	94.10	380.00	93.96
JEFFERIES GROUP LLC	New York, NY	8777	44.52	57.21	86.00	87.17	4.19
JP MORGAN CHASE & CO*	New York, NY	8355	2573.13	10.87	77.13	227.33	39.67
KEYCORP	Cleveland, OH	8355	104.53	12.00	171.93	597.00	152.86
LEGG MASON INC	Baltimore, MD	8777	11.83	18.30	81.05	203.17	48.21
LEHMAN BROTHERS HOLDINGS INC	New York, NY	8777	691.06	17.20	96.13	677.78	104.71
LINCOLN NATIONAL CORPORATION	Radnor, PA	8575	253.38	11.02	206.87	2929.66	288.88
LOEWS CORPORATION	New York, NY	8536	76.88	10.12	52.90	174.67	28.58
MARKEL CORPORATION	Glen Allen, VA	8536	23.33	92.50	147.58	164.79	18.13
MARSHALL & ILSLEY CORPORATION	Milwaukee, WI	8355	62.34	14.54	19.41	105.00	17.53
MBIA INC	Purchase, NY	8536	47.42	18.36	786.40	2367.37	538.21
MELLON FINANCIAL CORPORATION	Pittsburgh, PA	8771	41.48	11.10	12.75	20.00	1.69
MERRILL LYNCH & CO INC	New York, NY	8777	1020.05	14.43	165.50	551.82	115.11
METLIFE INC	New York, NY	8575	799.63	9.62	168.41	959.49	161.05
MORGAN STANLEY*	New York, NY	8777	1120.65	16.55	164.75	1385.59	135.90
NATIONAL CITY CORPORATION	Cleveland, OH	8355	150.37	11.44	333.81	2675.00	504.47
NATIONWIDE FINANCIAL SERVICES	Columbus, OH	8575	119.53	18.43	96.10	160.00	35.13
PHH CORPORATION	Mt Laurel T/ship, NJ	2777	11.27	28.87	489.45	4120.65	503.96
PNC FINANCIAL SERVICES GROUP INC*	Pittsburgh, PA	8355	345.07	18.27	84.20	296.32	40.35
PRINCIPAL FINANCIAL GROUP INC	Des Moines, IA	8575	219.09	22.09	173.89	302.31	94.33
PROGRESSIVE CORPORATION	Mayfield, OH	8536	23.36	11.06	68.22	210.29	37.04
PROTECTIVE LIFE CORPORATION	Birmingham, AL	8575	70.48	42.60	71.02	77.89	9.10
PRUDENTIAL FINANCIAL INC	Newark, NJ	8575	766.66	10.00	170.65	1284.46	189.95
REGIONS FINANCIAL CORPORATION*	Birmingham, AL	8355	146.25	11.43	21.29	367.03	15.71
REINSURANCE GROUP OF AMERICA INC	Chesterfield, MO	8538	40.36	16.00	101.32	259.57	38.27
SLM CORPORATION (SALLIE MAE)	Newark, DE	8773	205.31	16.31	426.20	2695.42	339.26
STATE STREET CORPORATION*	Boston, MA	8771	274.12	15.96	158.70	233.00	66.90
SUNTRUST BANKS INC*	Atlanta, GA	8355	190.33	9.07	120.73	422.95	82.08
TORCHMARK CORPORATION	McKinney, TX	8575	20.21	21.32	207.51	378.50	85.56
TRAVELERS COMPANIES INC	New York, NY	8536	99.58	15.10	62.70	168.58	34.49
UNUM GROUP INC	Chattanooga, TN	8575	62.50	42.39	166.39	395.54	84.57
US BANCORP*	Minneapolis, MN	8355	402.53	7.10	70.80	249.00	45.89
W R BERKLEY CORP	Greenwich, CT	8536	20.32	28.92	161.34	232.17	54.87
WACHOVIA CORPORATION	Charlotte, NC	8355	782.90	8.89	81.96	1436.03	114.00
WELLS FARGO & COMPANY*	San Francisco, CA	8355	1687.16	5.89	75.21	305.84	47.94

NOTES: ICB is the industry classification benchmark (http://www.icbenchmark.com/). The assets column reports the maximum asset value at any point in our sample period, is billions of US dollars.

[17] Bear Stearns shareholders approved the takeover by JP Morgan in late May 2008. We include its CDS spread until May 29, 2008.



(a) Austria (b) Belgium (c) France (d) Germany (e) Greece

(f) Ireland (g) Italy (h) The Netherlands (i) Norway (j) Portugal

(k) Spain (l) Sweden (m) United Kingdom

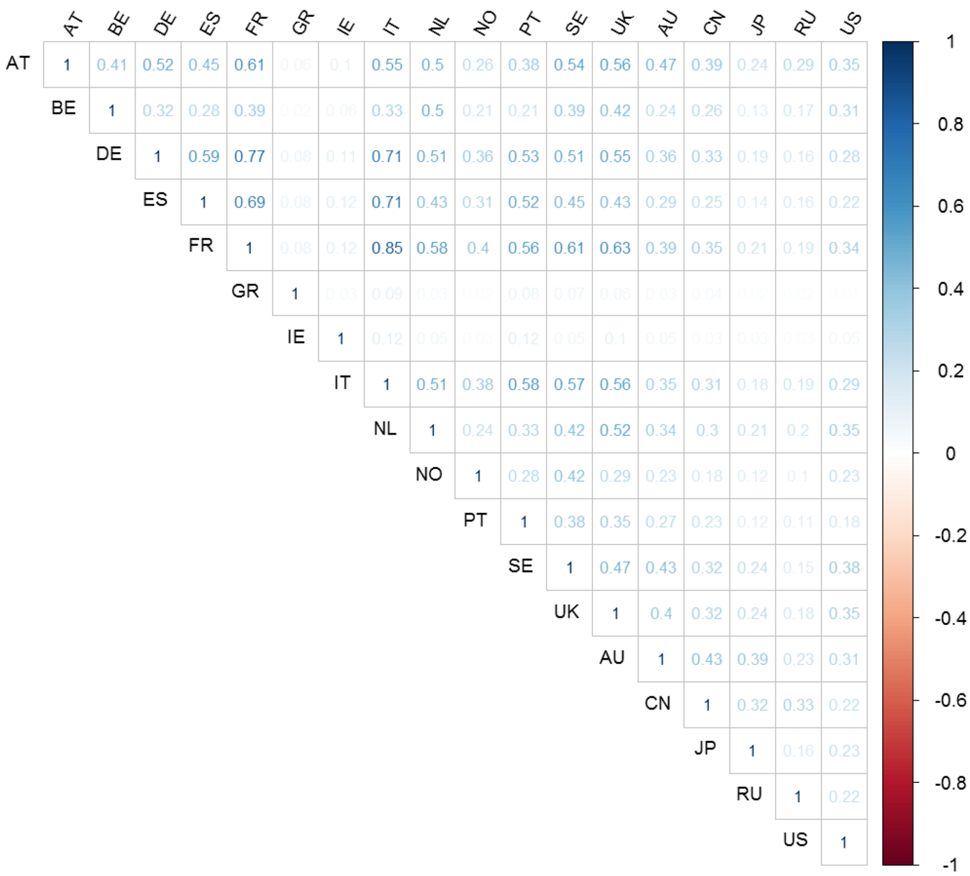
(n) Australia (p) China (q) Japan (r) Russia (s) United States

Figure 3: Financial Sector CDS Spreads. Black line: CDS spread (lhs, bp). Gray line: first difference (rhs, bp).

	Level					First Difference				
	Mean	Med	SD	ADF	AR(1)	Mean	Med	SD	ADF	AR(1)
AT	140.770	143.966	87.434	0.381	0.998	0.057	0.000	5.397	< 0.01	0.234
BE	126.905	118.008	86.903	0.638	0.996	0.026	0.000	7.120	< 0.01	-0.072
DE	115.421	119.080	66.575	0.707	0.998	0.025	-0.021	4.061	< 0.01	0.133
ES	228.363	177.237	183.778	0.869	0.999	0.047	-0.004	8.136	< 0.01	0.175
FR	108.626	96.173	74.202	0.754	0.998	0.023	-0.008	4.669	< 0.01	0.215
GR	729.935	487.495	712.749	0.590	0.989	0.702	0.000	100.312	< 0.01	-0.301
IE	440.959	262.190	494.454	0.761	0.995	0.070	0.000	48.045	< 0.01	-0.216
IT	186.229	145.533	144.489	0.734	0.999	0.047	-0.014	7.144	< 0.01	0.229
NL	137.993	140.766	80.469	0.575	0.997	0.045	0.000	5.225	< 0.01	0.046
NO	100.501	105.233	45.534	0.832	0.998	0.030	0.000	2.740	< 0.01	0.008
PT	345.215	247.518	346.929	0.938	0.999	0.095	-0.006	14.595	< 0.01	0.184
SE	79.496	76.741	51.151	0.669	0.998	0.020	0.000	2.648	< 0.01	0.196
UK	127.397	124.226	97.308	0.427	0.998	0.028	-0.010	5.027	< 0.01	0.217
AU	113.475	113.687	66.204	0.524	0.997	0.032	-0.016	5.132	< 0.01	0.010
CN	136.996	132.540	82.509	0.569	0.997	0.041	-0.008	5.887	< 0.01	0.041
JP	110.753	102.398	78.119	0.601	0.999	0.020	-0.030	3.596	< 0.01	0.114
RU	437.859	404.848	251.017	0.423	0.993	0.176	-0.079	28.870	< 0.01	0.026
US	184.412	165.090	145.511	0.486	0.998	0.028	-0.056	9.359	< 0.01	0.088

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 4: Descriptive Statistics for the Level and First Difference of the Financial Sector CDS Spread



NOTE: Values marked with a red X are insignificant at the 5% level.

Figure 4: Correlations among the First Differences of the Financial Sector CDS Spreads

A.2 Sovereign Term Spreads

We define the sovereign term spread as the spread between the ten year and 90 day government bond yields. The term spread provides an approximate measure of the slope of the yield curve and is an important indicator of macroeconomic fundamentals.

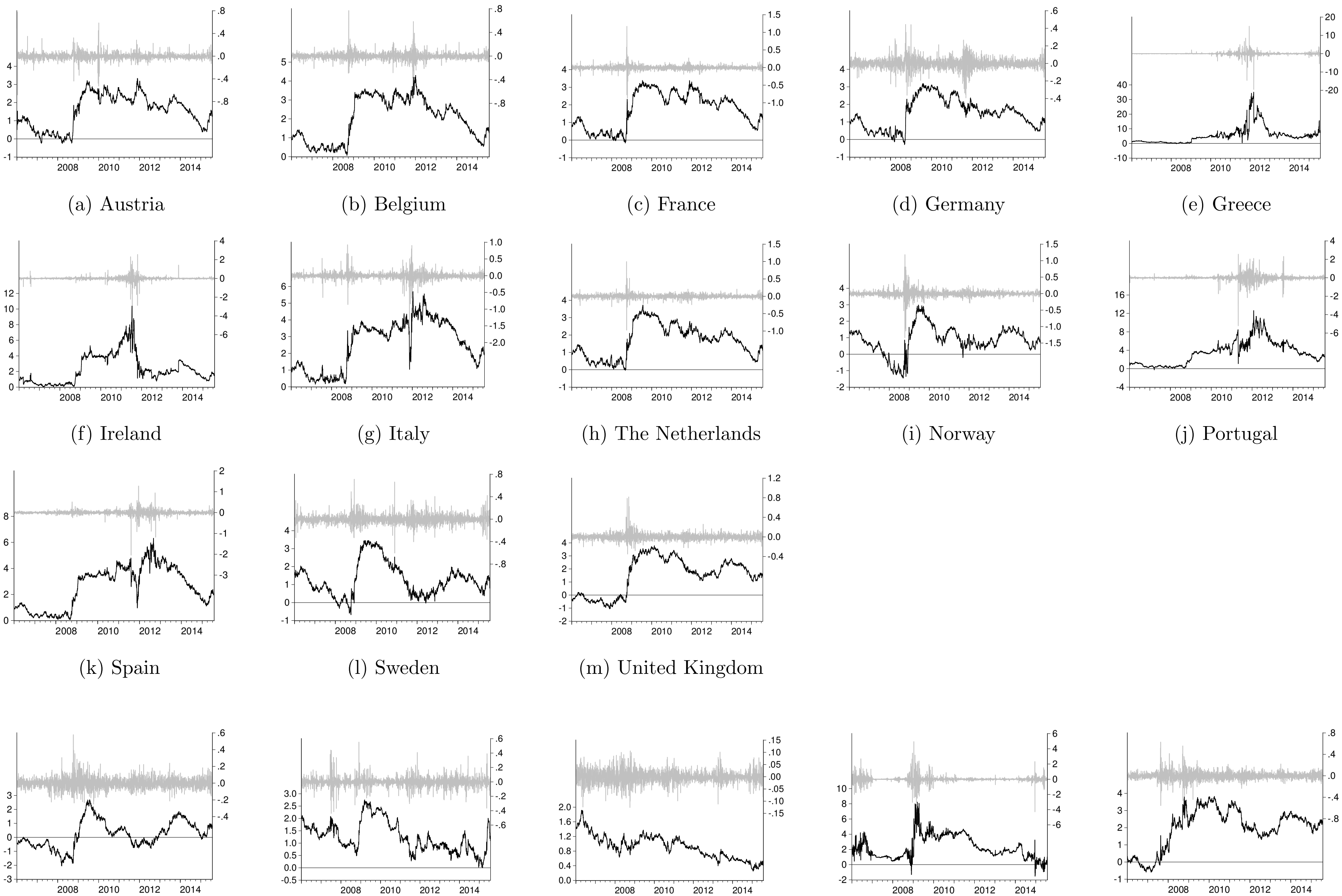
Where we are able to obtain reliable data, we compute the term spread using the yield to redemption on the 10 year benchmark bond and the 3 month treasury bill. In some cases, we were unable to obtain reliable or complete data for the 3 month yield, in which case we replace it with an appropriate zero coupon yields. These cases are documented below:

	10 year yield		3 month yield	
	Source	Series ID	Source	Series ID
AT	Datastream	S06676	Bloomberg	F90803M†
BE	Datastream	TRBG10T	Bloomberg	GBGT3MO
DE	Datastream	BDBRYLD	Bloomberg	GETB1
ES	Datastream	TRES10T	Bloomberg	GSPG3M
FR	Datastream	TRFR10T	Bloomberg	GTFRF3M
GR	Datastream	TRGR10T	Datastream	S539VW
IE	Datastream	TRIE10T	Bloomberg	F91803M†
IT	Datastream	TRIT10T	Bloomberg	GBOTG3M
NL	Datastream	TRNL10T	Bloomberg	GTBN3M
NO	Datastream	S06770	Datastream	Y74992
PT	Datastream	TRPT10T	Bloomberg	GSPT3M
SE	Datastream	TRSD10T	Datastream	S06156
UK	Datastream	UKMBRYD	Datastream	S02162
AU	Datastream	TRAU10Y	Datastream	S06120
CN	Datastream	TRCH10T	Bloomberg	F02003M†
JP	Datastream	TRJP10T	Bloomberg	GJGB3M
RU	Datastream	TRRS10T	Bloomberg	F49603M†
US	Datastream	USBD10Y	Bloomberg	USGB090Y

† denotes cases where we use zero coupon yields instead of 3 month yield to redemption.

Table 5: Data Sources used to Construct Sovereign Term Spreads

Time series plots of the term spreads are provided in Figure 5, while descriptive statistics and pairwise correlations are reported in Table 6 and Figure 6, respectively. The dynamic pattern of the term spreads displays marked commonalities across countries, except for Japan which had been in a low interest rate environment for many years prior to the start of our sample. In all other cases, the policy response to the GFC and the subsequent period of low short-term rates is readily apparent. Consequently, the cross-country correlations are mostly positive. All of the term spreads are first difference stationary.



(a) Austria (b) Belgium (c) France (d) Germany (e) Greece

(f) Ireland (g) Italy (h) The Netherlands (i) Norway (j) Portugal

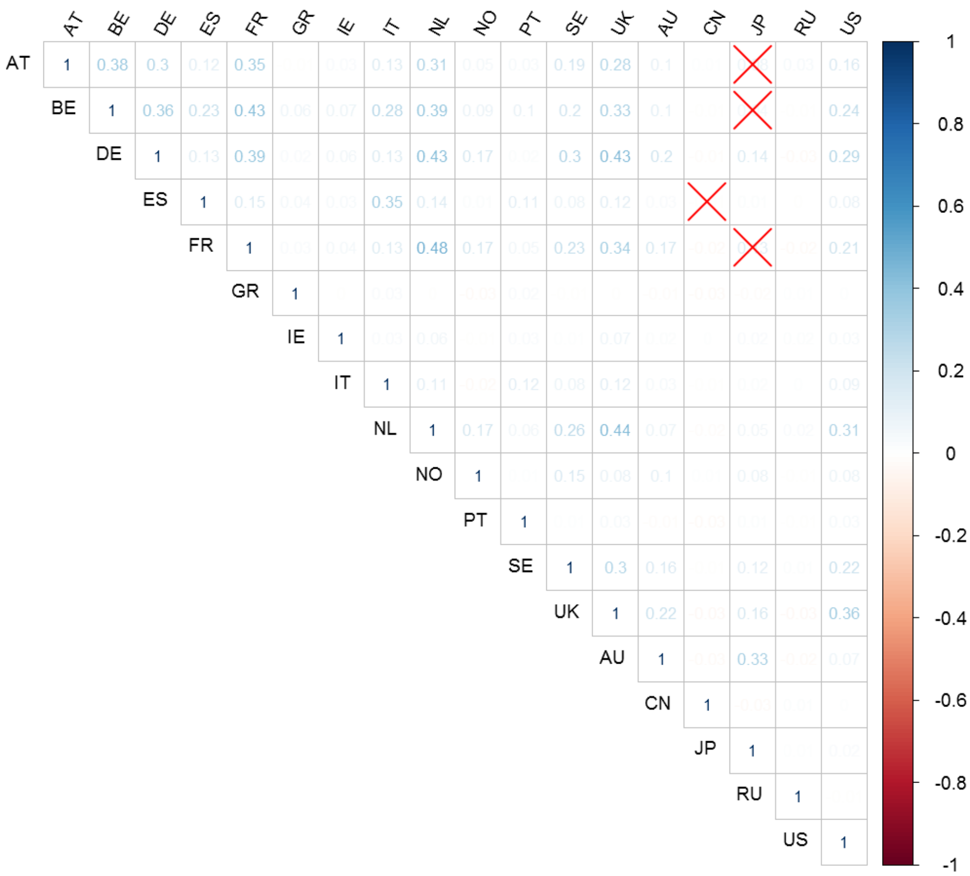
(k) Spain (l) Sweden (m) United Kingdom

Figure 5: Sovereign Term Spreads. Black line: term spread (lhs, bp). Gray line: first difference (rhs, bp).

	Level					First Difference				
	Mean	Med	SD	ADF	AR(1)	Mean	Med	SD	ADF	AR(1)
AT	153.514	171.770	91.567	0.806	0.998	0.006	-0.040	6.105	< 0.01	-0.056
BE	199.751	220.800	113.513	0.951	0.999	0.007	0.000	5.756	< 0.01	0.043
DE	148.968	151.510	84.422	0.673	0.997	-0.003	-0.020	5.816	< 0.01	-0.007
ES	259.572	312.750	158.397	0.912	0.997	0.041	0.000	11.240	< 0.01	-0.088
FR	173.830	204.450	100.479	0.907	0.998	0.012	0.000	6.188	< 0.01	0.017
GR	550.728	445.450	576.668	0.124	0.988	0.254	0.000	87.361	< 0.01	-0.073
IE	232.252	185.700	185.008	0.793	0.994	0.022	0.000	20.519	< 0.01	-0.248
IT	257.494	308.450	142.821	0.643	0.997	0.030	-0.200	10.467	< 0.01	0.027
NL	166.873	174.000	94.470	0.905	0.998	0.006	0.000	6.070	< 0.01	-0.151
NO	86.088	86.035	84.276	0.609	0.994	-0.028	-0.120	9.428	< 0.01	-0.183
PT	349.860	339.150	254.447	0.577	0.993	0.054	0.000	29.503	< 0.01	-0.226
SE	128.948	114.300	92.608	0.827	0.996	-0.019	-0.100	7.961	< 0.01	-0.204
UK	152.232	174.209	137.341	0.944	0.999	0.073	-0.050	6.219	< 0.01	0.011
AU	22.147	17.650	96.360	0.670	0.998	0.043	0.000	6.354	< 0.01	-0.016
CN	126.064	114.800	61.189	0.204	0.994	-0.039	0.000	6.574	< 0.01	-0.249
JP	92.236	92.500	32.068	0.026	0.996	-0.042	0.000	2.455	< 0.01	-0.058
RU	226.284	186.800	148.319	0.552	0.966	-0.032	0.000	38.845	< 0.01	-0.318
US	198.512	220.960	115.271	0.768	0.998	0.075	0.000	7.264	< 0.01	0.068

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 6: Descriptive Statistics for the Level and First Difference of the Sovereign Term Spread



NOTE: Values marked with a red X are insignificant at the 5% level.

Figure 6: Correlations among the First Differences of the Sovereign Term Spread

A.3 Stock Market Indices

To measure the conditions in the equity market in each country, we consider the following broad stock indices:

	Stock Index	Datastream ID
AT	ATX	ATXINDX
BE	BEL 20	BGBEL20
DE	DAX 30	DAXINDX
ES	IBEX 35	IBEX35I
FR	CAC 40	FRCAC40
GR	Athex Composite	GRAGENL
IE	ISEQ	ISEQUIT
IT	FTSE MIB	FTSEMIB
NL	AEX	AMSTEOE
NO	OBX	OSLOOBX(PI)
PT	PSI 20	POPSI20
SE	OMX	SWEDOMX
UK	FTSE 100	FTSE100
AU	S&P ASX 200	ASX200I
CN	SSE A Share	CHSASHR
JP	TOPIX	TOKYOSE
RU	MICEX	RSMICEX
US	S&P 500	S&PCOMP

Table 7: Stock Index Data by Country

Figure 7 plots each index in log form alongside its log-return. Every index experiences a peak prior to the global financial crisis which is followed by a severe downturn, the largest of which is observed in Russia. Most indices recover gradually although several European countries — notably the GIIPS and Austria — experience subdued performance in the last years of the sample.

Figure 8 reports the correlations among the daily log-returns for each market. The correlations are uniformly positive and generally relatively strong. The correlations with respect to Australia, China and Japan are somewhat weaker than the rest, reflecting the different behaviour of these markets relative to the other countries in our system which were more strongly affected by the GFC and the sovereign debt crisis.

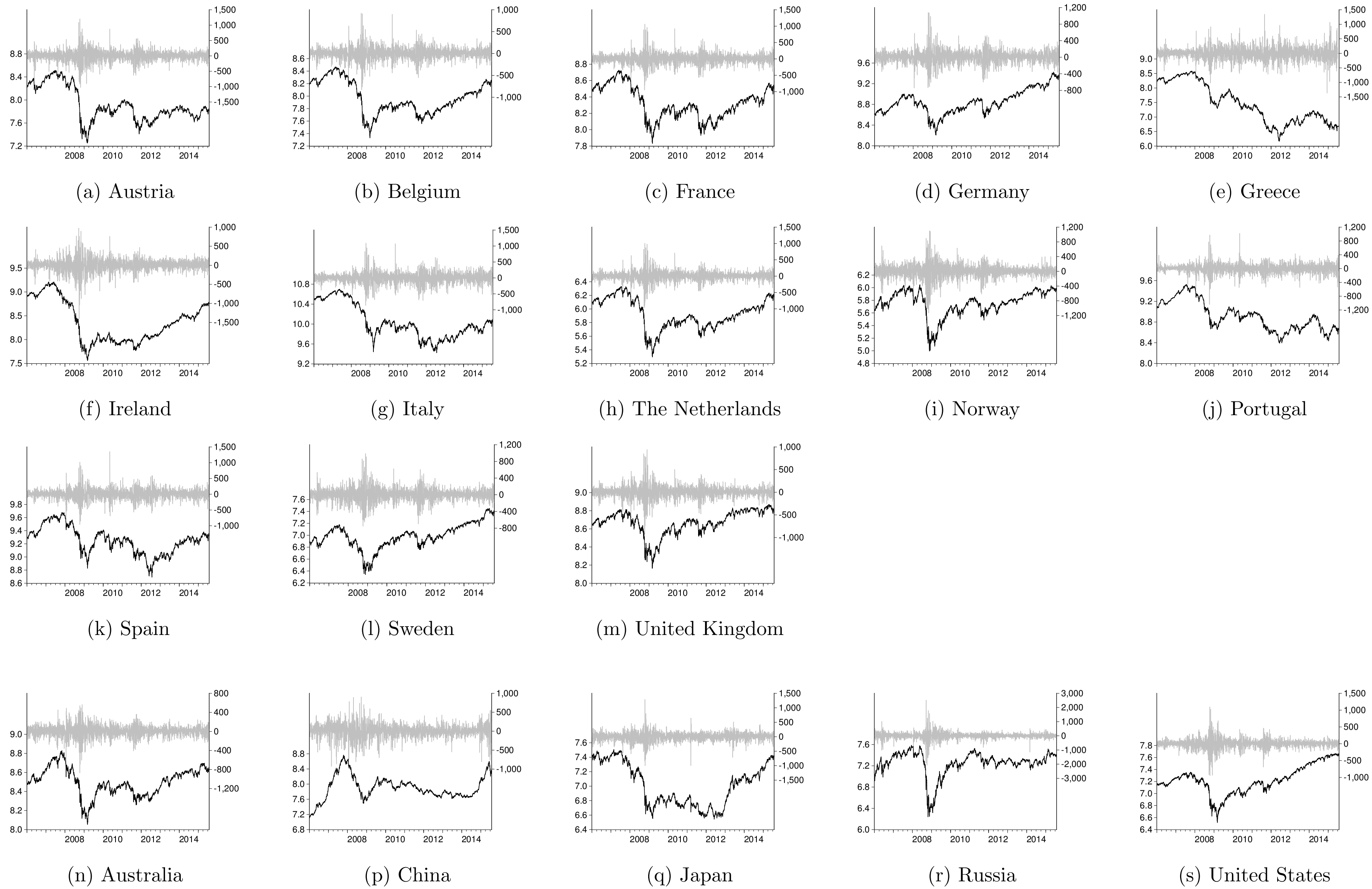
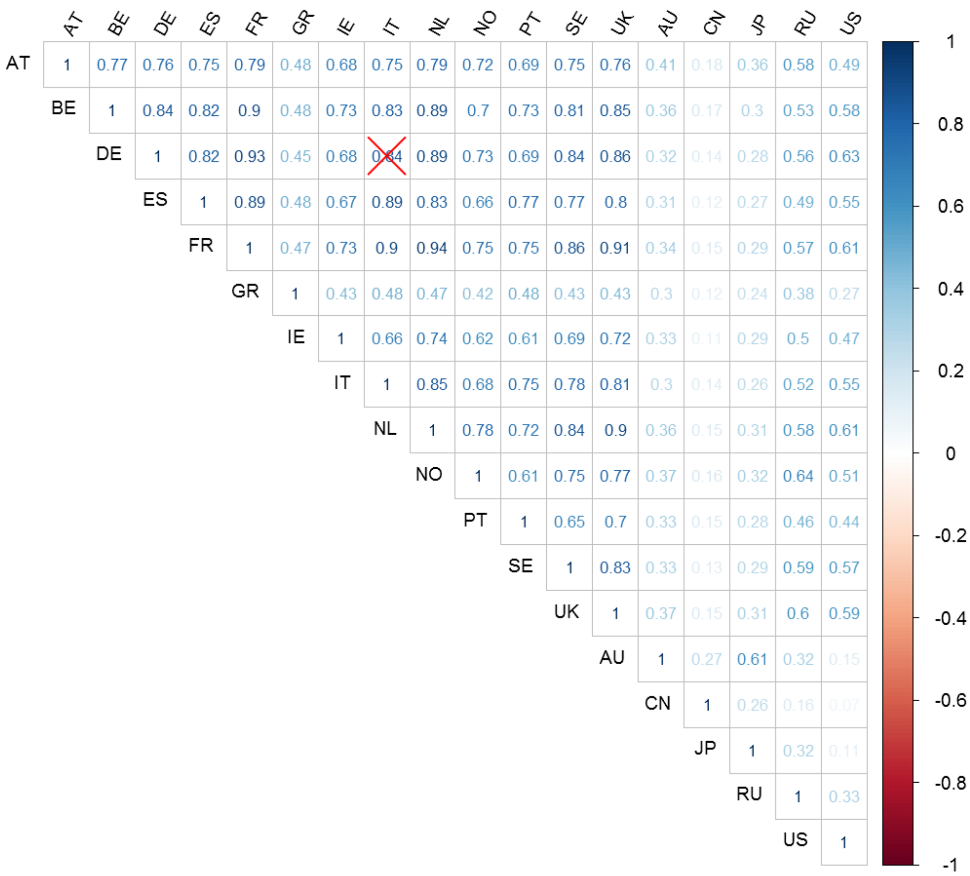


Figure 7: Equity Indices and Returns. Black line: equity index (lhs, log index value). Gray line: daily log-return (rhs, bp).

	Log-Level					Daily Log-Return				
	Mean	Med	SD	ADF	AR(1)	Mean	Med	SD	ADF	AR(1)
AT	7.916	7.835	0.294	0.700	0.998	-1.624	0.000	168.385	< 0.01	0.070
BE	7.974	7.911	0.256	0.955	0.998	0.141	1.457	131.417	< 0.01	0.035
DE	8.849	8.833	0.232	0.685	0.997	2.835	6.822	141.833	< 0.01	0.004
ES	9.252	9.260	0.205	0.662	0.997	0.131	4.484	156.507	< 0.01	0.015
FR	8.326	8.306	0.196	0.904	0.997	0.143	2.247	147.917	< 0.01	-0.044
GR	7.449	7.343	0.674	0.696	0.999	-6.111	0.000	208.765	< 0.01	0.067
IE	8.371	8.304	0.433	0.990	0.999	-0.614	0.257	157.101	< 0.01	0.041
IT	10.039	9.954	0.339	0.915	0.998	-1.825	0.000	163.984	< 0.01	-0.014
NL	5.928	5.910	0.219	0.903	0.998	0.357	2.664	138.766	< 0.01	-0.008
NO	5.753	5.781	0.198	0.617	0.996	1.278	3.263	172.970	< 0.01	-0.021
PT	8.915	8.888	0.282	0.542	0.999	-1.666	0.612	131.862	< 0.01	0.080
SE	6.983	6.986	0.207	0.758	0.997	1.986	1.654	145.941	< 0.01	-0.041
UK	8.670	8.685	0.134	0.541	0.996	0.587	0.202	122.826	< 0.01	-0.041
AU	8.501	8.504	0.145	0.754	0.997	0.641	0.205	114.379	< 0.01	-0.029
CN	7.905	7.854	0.309	0.443	0.997	4.658	2.485	170.626	< 0.01	0.009
JP	7.014	7.047	0.291	0.981	0.998	-0.029	0.000	143.616	< 0.01	0.006
RU	7.250	7.288	0.228	0.514	0.995	1.802	0.000	219.923	< 0.01	0.000
US	7.225	7.212	0.232	0.829	0.998	2.023	4.291	129.068	< 0.01	-0.114

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 8: Descriptive Statistics for the Stock Market Index Log-Level and Daily Log-Return



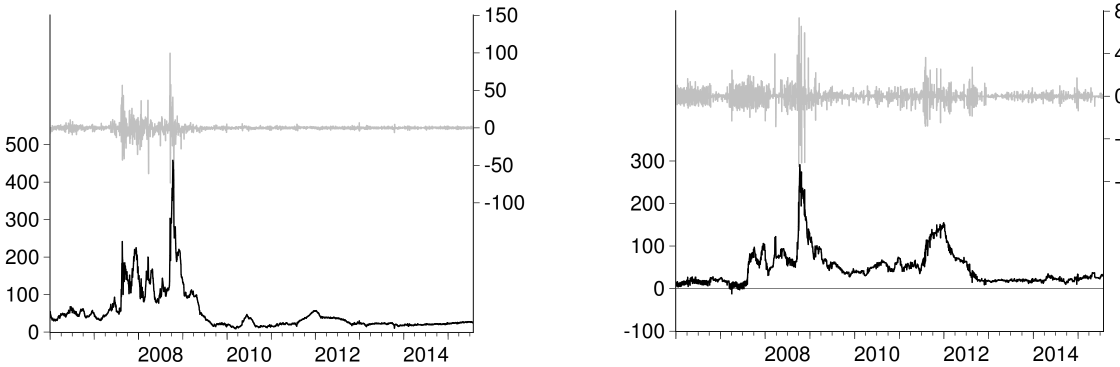
NOTE: Values marked with a red X are insignificant at the 5% level.

Figure 8: Correlations among Stock Market Log-Returns

A.4 Interbank–Treasury Yield Spreads

We include two measures of liquidity in the interbank money market. First, to measure US liquidity conditions, we include the TED spread, which is defined as the spread between the 3 month USD LIBOR and the yield on the three month Treasury Bill. Next, to measure liquidity conditions in Europe, we include the Euribor-DeTBill spread (to adopt the nomenclature of Pelizzon, Subrahmanyam, Tomio, and Uno, 2016), which is defined as the spread between the 3 month Euribor and the yield on the three month German Bund.

The level and first difference of each series is plotted in Figure 9 and descriptive statistics are reported in Table 9. Both series spike during the GFC although it is the TED spread that widens the most at this time and displays the greater volatility. This is natural given that the GFC originated in the US mortgage market. By contrast, and as expected, it is the Euribor-DeTBill spread which responds more strongly during the European debt crisis. The correlation between the two series over our sample period is 0.641 (in levels) and 0.049 (in differences). Even though the ADF test statistics suggest that the interbank–treasury spreads may be stationary in levels over the full sample, this is very unlikely to be the case in many of the rolling samples used in our analysis. Consequently, the first differences of both series are used in our model.



(a) TED Spread

(b) Euribor–DeTBill Spread

Figure 9: Interbank Spreads. Black line: level (lhs, bp). Gray: first difference (rhs, bp).

	Mean	Med	SD	ADF	AR(1)
Level					
TED spread	0.511	0.304	0.540	< 0.01	0.993
Euribor-DeTBill spread	0.483	0.369	0.397	0.050	0.987
First difference					
TED spread	0.000	0.000	0.062	< 0.01	0.210
Euribor-DeTBill spread	0.000	0.000	0.063	< 0.01	-0.296

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 9: Descriptive Statistics for the Interbank–Treasury Spreads

A.5 Variance Risk Premia

We include equity and treasury variance risk premia to measure the risk appetite of equity and bond investors, respectively — see Bollerslev, Tauchen, and Zhou (2009) and Carr and Wu (2009) on equity variance risk premia and Mueller, Vedolin, and Yen (2012) on bond variance risk premia. We adopt Bollerslev et al.'s (2009) definition of the variance risk premium (VRP_t) as follows:

$$VRP_t = IV_t - RV_t$$

where IV_t is the one-month implied variance at time t and RV_t is the realised variance at time t. Under this definition, the variance risk premium is typically positive. We use the following data to construct the risk premia:

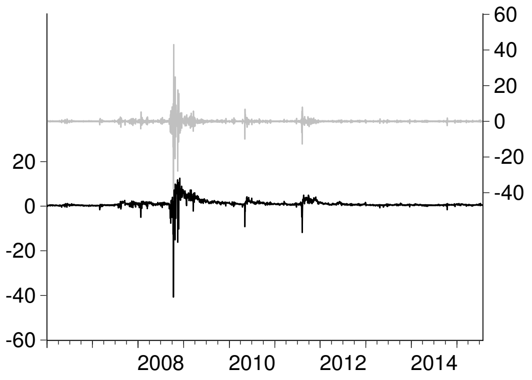
	Source	Notes/Transformations Applied
Equity VRP		
S&P 500 IV	CBOE†	De-annualised and squared VIX
S&P 500 RV	OMI*	Bipower variation
Treasury VRP		
US 10y Treasury IV	CBOE	De-annualised and squared TYVIX
US 10y Treasury RV	J.P.Morgan	Provided directly by J.P. Morgan

† CBOE is the Chicago Board Options Exchange.

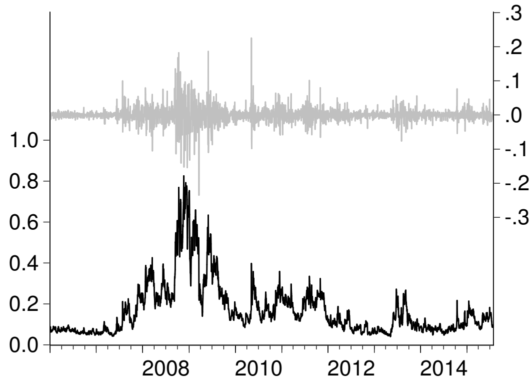
* OMI is the Oxford-Man Institute of Quantitative Finance.

Table 10: Data used in Construction of the Variance Risk Premia

In light of their construction, variance risk premia are quoted in squared percentage units. Time series plots of both the level and first difference of each series are shown in Figure 10 while the corresponding descriptive statistics are provided in Table 11. Beyond some superficial similarities (e.g. both VRPs spike during the GFC), the time series behaviour of the two measures is rather different. This is reflected in the pairwise correlation, which is 0.349 in levels and -0.134 in differences. As with the interbank–treasury spreads, the first differences of the VRP measures are used in our model — both are stationary.



(a) Equity VRP



(b) Treasury VRP

Figure 10: Variance Risk Premia. Black line: level (lhs, $\%^2$). Gray: first difference (rhs, $\%^2$).

	Mean	Med	SD	ADF	AR(1)
Level					
Equity VRP	1.070	0.777	1.731	< 0.01	0.372
Treasury VRP	0.169	0.127	0.131	0.122	0.984
First difference					
Equity VRP	0.000	0.000	1.940	< 0.01	-0.626
Treasury VRP	0.000	0.000	0.023	< 0.01	0.032

NOTES: 'Mean', 'Med' and 'SD' denote the sample mean, median and standard deviation, respectively. 'ADF' is the p-value of the Augmented Dickey-Fuller test statistic testing the null hypothesis of unit root non-stationarity against the alternative hypothesis of stationarity. A p-value of α or less indicates rejection of the null hypothesis at the α% level. 'AR(1)' is the first order autocorrelation of the series.

Table 11: Descriptive Statistics for the Variance Risk Premia

A.6 Macroeconomic Fundamentals

We use the following four macroeconomic fundamentals to study the factors which explain cross-sectional heterogeneity in the credit risk network:

Government debt relative to GDP. Our data is sourced from the Bank for International Settlements' *Total Credit Statistics* at quarterly frequency. We use the total credit to the general government at market value, expressed as a percentage of GDP.

Current account balance. For all countries except Russia, our data is sourced from the Organisation for Economic Cooperation and Development's *Balance of Payments* statistics. The data is sampled quarterly and is expressed as a percentage of GDP. In the case of Russia, we obtain quarterly data up to the first quarter of 2012 from the Federal Reserve Economic Data System (series identifier: BPBLTT01RUQ188S). Over the remainder of our sample, we obtain quarterly observations for Russia by linear interpolation of annual observations obtained from the International Monetary Fund's *World Economic Outlook*.

Real GDP growth. Our data is sourced from the International Monetary Fund's *International Financial Statistics* at quarterly frequency. We use the annual growth rate in percent relative to the same quarter of the previous year. We fill missing observations for China from the second quarter of 2013 onwards using data from the Organisation of Economic Cooperation and Development's *Quarterly National Accounts*.

Structural budget balance. Our data is sourced from the International Monetary Fund's *World Economic Outlook* at annual frequency. The data is reported as a percentage of potential GDP. We obtain quarterly series by linear interpolation of the annual data.

B Global VAR Weight Matrices

B.1 Trade Weights

We construct trade weights using bilateral trade data from the IMF's *Direction of Trade Statistics*. Let ex_{ijt} denote the total value of exports from country i to country j at time t. Likewise, im_{ijt} denotes the total value of imports of country i from country j at time t. We measure the total bilateral trade flow between countries i and j at time t as $trd_{ijt} = ex_{ijt} + im_{ijt}$ and its average value from 2006–2015 as $\overline{trd}_{ij} = \sum_{t=2006}^{2015} trd_{ijt}$. Note that $ex_{iit} = im_{iit} = trd_{iit} = 0$ by construction. The (i, j)th element of the trade weight matrix is defined as $w_{ij}^{trd} = \overline{trd}_{ij} / \sum_{j=1,j\neq i}^{N} \overline{trd}_{ij}$. The trade weight matrix is reported in Table 12. For clarity of presentation, the zeros on the prime diagonal have been excluded.

B.2 PPP-GDP Weights

We construct PPP-GDP weights based on the World Bank's *World Development Indicators*. Let gdp_{it} denote the PPP-GDP of country i at time t and $\overline{gdp}_i = \sum_{t=2006}^{2015} gdp_{it}$ its average value from 2006–2015. The (i, i)th element of the PPP-GDP weight matrix is simply set to zero, while the (i, j)th element is defined as $w_{ij}^{gdp} = \overline{gdp}_j / \sum_{j=1,j\neq i}^{N} \overline{gdp}_j$. The PPP-GDP weight matrix is reported in Table 13.

B.3 Financial Weights

We construct financial weights using bilateral portfolio investment data from the IMF's *Coordinated Portfolio Investment Survey*. Let l_{ijt} denote the derived value of the total liabilities of country j held by country i at time t over all sectors of the economy. We use data on derived liabilities as it is more complete than the data on asset holdings (in particular, data on Chinese asset holdings is only available as of 2015 but historical data is available for derived liabilities). As before, let $\bar{l}_{ij} = \sum_{t=2006}^{2015} l_{ijt}$. The (i, j)th element of the financial weight matrix is defined as $w_{ij}^{fin} = \bar{l}_{ij} / \sum_{j=1,j\neq i}^{N} \bar{l}_{ij}$. The financial weight matrix is reported in Table 14.

	AT	AU	BE	CN	DE	ES	FR	GR	IE	IT	JP	NL	NO	PT	RU	SE	UK	US
AT		0.005	0.026	0.036	0.544	0.023	0.052	0.004	0.006	0.105	0.012	0.043	0.005	0.004	0.034	0.016	0.035	0.052
AU	0.004		0.012	0.394	0.052	0.011	0.022	0.001	0.008	0.026	0.236	0.017	0.002	0.001	0.005	0.011	0.053	0.145
BE	0.010	0.005		0.037	0.215	0.031	0.174	0.004	0.032	0.051	0.021	0.198	0.012	0.006	0.022	0.022	0.084	0.076
CN	0.005	0.069	0.018		0.108	0.019	0.035	0.003	0.005	0.032	0.222	0.046	0.005	0.003	0.052	0.009	0.044	0.327
DE	0.074	0.007	0.083	0.090		0.049	0.132	0.006	0.010	0.085	0.026	0.145	0.021	0.010	0.051	0.028	0.089	0.095
ES	0.012	0.006	0.046	0.058	0.183		0.213	0.008	0.015	0.112	0.015	0.062	0.009	0.083	0.028	0.014	0.084	0.052
FR	0.013	0.006	0.131	0.053	0.246	0.100		0.005	0.013	0.110	0.018	0.080	0.009	0.014	0.027	0.017	0.084	0.075
GR	0.018	0.003	0.049	0.069	0.189	0.056	0.080		0.011	0.182	0.015	0.074	0.005	0.006	0.120	0.014	0.062	0.047
IE	0.005	0.007	0.121	0.029	0.092	0.033	0.061	0.003		0.032	0.024	0.053	0.013	0.004	0.005	0.011	0.293	0.215
IT	0.038	0.009	0.056	0.072	0.232	0.083	0.162	0.017	0.010		0.020	0.064	0.008	0.011	0.055	0.016	0.067	0.082
JP	0.004	0.082	0.012	0.395	0.058	0.009	0.025	0.001	0.008	0.018		0.027	0.004	0.001	0.036	0.005	0.029	0.284
NL	0.012	0.005	0.145	0.084	0.275	0.033	0.088	0.005	0.012	0.046	0.022		0.027	0.007	0.045	0.023	0.098	0.072
NO	0.008	0.002	0.037	0.054	0.172	0.023	0.078	0.002	0.014	0.032	0.019	0.113		0.006	0.016	0.113	0.242	0.068
PT	0.007	0.001	0.036	0.023	0.166	0.382	0.123	0.003	0.009	0.061	0.007	0.058	0.007		0.010	0.014	0.057	0.035
RU	0.012	0.002	0.026	0.187	0.165	0.024	0.053	0.012	0.004	0.120	0.070	0.174	0.006	0.003		0.021	0.051	0.069
SE	0.016	0.011	0.064	0.059	0.210	0.026	0.070	0.004	0.013	0.045	0.021	0.088	0.139	0.007	0.048		0.102	0.078
UK	0.009	0.016	0.068	0.088	0.173	0.047	0.095	0.004	0.066	0.052	0.027	0.106	0.047	0.008	0.021	0.027		0.145
US	0.009	0.025	0.034	0.362	0.112	0.016	0.054	0.002	0.031	0.038	0.148	0.043	0.008	0.003	0.024	0.012	0.079	

NOTES: The weight used to construct the foreign variables from the perspective of the ith country, $\boldsymbol{x}_{it}^{*}$ are contained in the ith row of the matrix. Consequently, every row of the matrix sums to 1 by construction but the columns need not sum to 1.

Table 12: Weights Matrix Based on Bilateral Trade Averages Between 2006 and 2015

	AT	AU	BE	CN	DE	ES	FR	GR	IE	IT	JP	NL	NO	PT	RU	SE	UK	US
AT		0.018	0.009	0.254	0.065	0.029	0.046	0.006	0.004	0.040	0.085	0.015	0.006	0.005	0.065	0.008	0.045	0.300
AU	0.007		0.009	0.257	0.066	0.029	0.047	0.006	0.004	0.041	0.086	0.015	0.006	0.005	0.066	0.008	0.045	0.303
BE	0.007	0.018		0.254	0.065	0.029	0.046	0.006	0.004	0.040	0.085	0.015	0.006	0.005	0.065	0.008	0.045	0.301
CN	0.009	0.024	0.011		0.086	0.039	0.062	0.008	0.005	0.054	0.113	0.019	0.008	0.007	0.086	0.010	0.060	0.398
DE	0.007	0.019	0.009	0.269		0.031	0.049	0.006	0.004	0.043	0.090	0.016	0.006	0.006	0.069	0.008	0.048	0.319
ES	0.007	0.018	0.009	0.260	0.067		0.047	0.006	0.004	0.041	0.087	0.015	0.006	0.006	0.066	0.008	0.046	0.307
FR	0.007	0.019	0.009	0.264	0.068	0.030		0.006	0.004	0.042	0.089	0.015	0.006	0.006	0.068	0.008	0.047	0.312
GR	0.007	0.018	0.009	0.254	0.065	0.029	0.046		0.004	0.040	0.085	0.015	0.006	0.005	0.065	0.008	0.045	0.300
IE	0.007	0.018	0.009	0.253	0.065	0.029	0.046	0.006		0.040	0.085	0.015	0.006	0.005	0.065	0.008	0.045	0.299
IT	0.007	0.018	0.009	0.263	0.067	0.030	0.048	0.006	0.004		0.088	0.015	0.006	0.006	0.067	0.008	0.047	0.311
JP	0.008	0.019	0.009	0.275	0.071	0.032	0.050	0.006	0.004	0.044		0.016	0.007	0.006	0.070	0.008	0.049	0.326
NL	0.007	0.018	0.009	0.256	0.066	0.029	0.047	0.006	0.004	0.041	0.086		0.006	0.005	0.065	0.008	0.045	0.302
NO	0.007	0.018	0.009	0.254	0.065	0.029	0.046	0.006	0.004	0.040	0.085	0.015		0.005	0.065	0.008	0.045	0.300
PT	0.007	0.018	0.009	0.253	0.065	0.029	0.046	0.006	0.004	0.040	0.085	0.015	0.006		0.065	0.008	0.045	0.300
RU	0.007	0.019	0.009	0.269	0.069	0.031	0.049	0.006	0.004	0.043	0.090	0.016	0.006	0.006		0.008	0.048	0.319
SE	0.007	0.018	0.009	0.254	0.065	0.029	0.046	0.006	0.004	0.040	0.085	0.015	0.006	0.005	0.065		0.045	0.300
UK	0.007	0.018	0.009	0.264	0.068	0.030	0.048	0.006	0.004	0.042	0.088	0.015	0.006	0.006	0.067	0.008		0.312
US	0.010	0.025	0.012	0.359	0.092	0.041	0.066	0.008	0.006	0.057	0.120	0.021	0.009	0.008	0.092	0.011	0.064	

NOTES: The weight used to construct the foreign variables from the perspective of the ith country, $\boldsymbol{x}_{it}^{*}$ are contained in the ith row of the matrix. Consequently, every row of the matrix sums to 1 by construction but the columns need not sum to 1.

Table 13: Weights Matrix Based on Average PPP-GDP Between 2006 and 2015

	AT	AU	BE	CN	DE	ES	FR	GR	IE	IT	JP	NL	NO	PT	RU	SE	UK	US
AT		0.003	0.046	0.001	0.326	0.021	0.213	0.003	0.033	0.061	0.051	0.103	0.018	0.006	0.000	0.003	0.049	0.062
AU	0.004		0.007	0.010	0.039	0.005	0.042	0.000	0.048	0.007	0.184	0.034	0.024	0.001	0.001	0.009	0.139	0.445
BE	0.017	0.005		0.004	0.132	0.029	0.312	0.002	0.056	0.031	0.064	0.096	0.019	0.006	0.000	0.005	0.085	0.136
CN	0.002	0.021	0.002		0.018	0.004	0.050	0.000	0.065	0.004	0.066	0.038	0.035	0.000	0.000	0.009	0.174	0.511
DE	0.040	0.013	0.029	0.003		0.025	0.167	0.002	0.073	0.055	0.099	0.119	0.037	0.008	0.001	0.018	0.129	0.183
ES	0.013	0.004	0.040	0.001	0.211		0.246	0.003	0.067	0.049	0.033	0.068	0.029	0.021	0.000	0.008	0.085	0.121
FR	0.015	0.009	0.062	0.003	0.167	0.037		0.002	0.067	0.073	0.097	0.092	0.026	0.008	0.000	0.009	0.121	0.212
GR	0.036	0.002	0.070	0.000	0.170	0.039	0.252		0.050	0.078	0.027	0.079	0.016	0.026	0.000	0.006	0.074	0.075
IE	0.014	0.003	0.037	0.002	0.137	0.030	0.125	0.002		0.080	0.049	0.063	0.012	0.024	0.009	0.014	0.194	0.204
IT	0.019	0.003	0.041	0.001	0.171	0.061	0.254	0.004	0.113		0.053	0.063	0.016	0.013	0.000	0.005	0.102	0.081
JP	0.001	0.020	0.003	0.010	0.024	0.001	0.102	0.000	0.051	0.005		0.032	0.039	0.000	0.000	0.012	0.174	0.524
NL	0.016	0.011	0.058	0.002	0.158	0.032	0.198	0.001	0.051	0.047	0.070		0.016	0.008	0.002	0.007	0.127	0.195
NO	0.016	0.012	0.011	0.002	0.142	0.008	0.064	0.000	0.042	0.011	0.155	0.038		0.002	0.000	0.094	0.121	0.284
PT	0.011	0.001	0.042	0.000	0.150	0.084	0.235	0.003	0.240	0.044	0.015	0.062	0.014		0.000	0.002	0.052	0.044
RU	0.018	0.010	0.003	0.005	0.041	0.002	0.048	0.002	0.032	0.009	0.023	0.057	0.038	0.000		0.040	0.193	0.479
SE	0.012	0.010	0.013	0.004	0.115	0.008	0.100	0.000	0.068	0.014	0.100	0.048	0.083	0.003	0.000		0.106	0.317
UK	0.007	0.017	0.013	0.005	0.077	0.016	0.093	0.014	0.139	0.024	0.071	0.051	0.032	0.004	0.001	0.018		0.416
US	0.007	0.048	0.011	0.027	0.058	0.009	0.055	0.001	0.129	0.023	0.256	0.087	0.047	0.002	0.001	0.027	0.211	

NOTES: The weight used to construct the foreign variables from the perspective of the ith country, $\boldsymbol{x}^*_{it}$ are contained in the ith row of the matrix. Consequently, every row of the matrix sums to 1 by construction but the columns need not sum to 1.

Table 14: Weights Matrix Based on Bilateral Average Portfolio Investment Between 2006 and 2015

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