

Table IA.1
Additional Deal Summary Statistics

This table reports additional deal level summary statistics for CDOs in our sample. $p10$ and $p90$ denote the 10th and 90th percentiles, respectively.

	N	Mean	Median	Std. Dev.	p10	p90
No. of Obligors	1109	130.76	122.00	62.69	62.00	210.00
Deal Size (\$M)	1096	398.16	375.00	334.30	0.48	707.00
WAM	1109	6.18	5.83	1.33	4.93	7.71
S&P SDR	867	0.361	0.359	0.120	0.200	0.503
Moody's SDR	867	0.334	0.332	0.110	0.228	0.439

Table IA.2**Correlation of Rating Changes**

This table reports the correlation matrix of directional rating changes. Reported are the time-series correlations for the percentage of directional rating changes at the monthly level from January 1986 to December 2012.

	Rating Downgrade	Rating Unchanged	Rating Upgrade
Rating Downgrade	1		
Rating Unchanged	-0.885	1	
Rating Upgrade	-0.160	-0.319	1

Table IA.3**Corporate Default Correlations Prior to 2007**

This table reports the matrix of default correlations from three model specifications considering time-varying credit ratings and/or time-varying default frailty. Reported are the pair-wise 5-year default correlation between two bonds of varying credit quality from January 1986 to December 2006. Panel A reports the results of a model including only model frailty, Panel B reports the results of a model only including time-varying rating transitions, and Panel C reports the results of a model including both frailty and rating transitions drawn from their joint distribution. We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Time-Varying Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0000							
AA	0.0002	0.0000						
A	0.0003	0.0001	0.0001					
BBB	0.0003	0.0004	0.0004	0.0004				
BB	0.0002	0.0002	0.0006	0.0010	0.0007			
B	0.0004	0.0002	0.0006	0.0008	0.0013	0.0012		
CCC	0.0001	0.0002	0.0005	0.0008	0.0012	0.0015	0.0017	
CC	0.0003	0.0002	0.0006	0.0008	0.0014	0.0013	0.0019	0.0024

Panel B. Default Frailty

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0004							
AA	0.0001	0.0004						
A	0.0004	0.0014	0.0026					
BBB	0.0013	0.0035	0.0055	0.0121				
BB	0.0029	0.0068	0.0107	0.0242	0.0477			
B	0.0042	0.0101	0.0164	0.0335	0.0688	0.0998		
CCC	0.0057	0.0123	0.0192	0.0404	0.0863	0.1295	0.1881	
CC	0.0052	0.0110	0.0176	0.0367	0.0787	0.1208	0.1884	0.1993

Panel C. Jointly Determined Default Frailty and Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0015							
AA	0.0023	0.0036						
A	0.0044	0.0058	0.0088					
BBB	0.0067	0.0095	0.0157	0.0248				
BB	0.0105	0.0153	0.0237	0.0423	0.0697			
B	0.0123	0.0197	0.0303	0.0543	0.0935	0.1165		
CCC	0.0140	0.0213	0.0324	0.0582	0.1018	0.1422	0.1772	
CC	0.0136	0.0197	0.0321	0.0564	0.0987	0.1349	0.1787	0.1765

Table IA.4**Corporate Default Correlations - Independently Drawn Frailty and Rating Change Paths**

This table reports the matrix of default correlations similar to Panel C of Table IV, with the exception that the frailty and rating transition paths are independently drawn. Reported are the pair-wise 5-year default correlations between two bonds of varying credit quality from January 1986 to December 2012 (Panel A) and January 1986 to December 2006 (Panel B). We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Full Sample

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0037							
AA	0.0049	0.0081						
A	0.0072	0.0108	0.0140					
BBB	0.0120	0.0169	0.0234	0.0361				
BB	0.0164	0.0232	0.0352	0.0582	0.0981			
B	0.0190	0.0287	0.0442	0.0707	0.1197	0.1494		
CCC	0.0197	0.0285	0.0435	0.0736	0.1257	0.1694	0.1960	
CC	0.0187	0.0265	0.0409	0.0712	0.1212	0.1641	0.1972	0.1979

Panel B. Pre-2007

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0013							
AA	0.0024	0.0031						
A	0.0036	0.0052	0.0078					
BBB	0.0063	0.0090	0.0140	0.0243				
BB	0.0103	0.0137	0.0227	0.0411	0.0668			
B	0.0116	0.0190	0.0280	0.0508	0.0874	0.1121		
CCC	0.0135	0.0197	0.0315	0.0555	0.0994	0.1403	0.1772	
CC	0.0131	0.0186	0.0300	0.0549	0.0992	0.1332	0.1756	0.1731

Table IA.5**Frailty Model Parameter Estimates – Asset Backed Security Defaults**

This table reports the parameter estimates of model frailty component when predicting defaults of ABS tranches with credit ratings lagged by one month and a time-varying rating transition matrix from January 1990 to December 2012 (Panel A) and from January 1990 to December 2006 (Panel B). Standard errors are reported in parenthesis.

Panel A. Full Sample

<i>Time-Varying Transition Matrix:</i>		<i>Model Frailty:</i>	
Unchanged Rating Scalar, γ	0.775 (0.0045)	Intercept, α	-1.368 (0.0166)
Volatility, η^{tm}	0.067 (0.0006)	Volatility, η^{frail}	0.634 (0.0073)
Reversion Speed, κ^{tm}	0.148 (0.0408)	Reversion Speed, κ^{frail}	0.185 (0.0126)

Panel B. Pre-2007

<i>Time-Varying Transition Matrix:</i>		<i>Model Frailty:</i>	
Unchanged Rating Scalar, γ	0.442 (0.0220)	Intercept, α	-0.612 (0.0576)
Volatility, η^{tm}	0.045 (0.0020)	Volatility, η^{frail}	0.707 (0.0168)
Reversion Speed, κ^{tm}	0.626 (0.0992)	Reversion Speed, κ^{frail}	0.201 (0.0147)

Table IA.6**ABS Default Correlations Prior to 2007**

This table reports the matrix of default correlations from three model specifications considering time-varying credit ratings and/or time-varying default frailty. Reported are the pair-wise 5-year default correlation between two bonds of varying credit quality from January 1990 to December 2006. Panel A reports the results of a model including only model frailty, Panel B reports the results of a model only including time-varying rating transitions, and Panel C reports the results of a model including both frailty and rating transitions drawn from their joint distribution. We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Time-Varying Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0005							
AA	-0.0003	0.0008						
A	-0.0002	0.0011	0.0004					
BBB	0.0012	0.0011	0.0005	0.0015				
BB	0.0000	0.0002	0.0009	0.0016	0.0013			
B	0.0003	0.0003	0.0009	0.0011	0.0010	0.0011		
CCC	0.0003	0.0003	0.0004	0.0001	0.0007	0.0003	0.0003	
CC	0.0000	-0.0002	-0.0001	0.0001	0.0002	-0.0001	0.0001	0.0002

Panel B. Default Frailty

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0007							
AA	0.0001	0.0010						
A	-0.0003	0.0010	0.0020					
BBB	0.0014	0.0023	0.0041	0.0089				
BB	0.0027	0.0060	0.0090	0.0186	0.0365			
B	0.0032	0.0075	0.0125	0.0250	0.0514	0.0723		
CCC	0.0037	0.0081	0.0125	0.0265	0.0562	0.0828	0.1097	
CC	0.0025	0.0058	0.0095	0.0201	0.0426	0.0650	0.0938	0.0895

Panel C. Jointly Determined Default Frailty and Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0032							
AA	0.0050	0.0085						
A	0.0060	0.0093	0.0133					
BBB	0.0095	0.0127	0.0161	0.0231				
BB	0.0111	0.0181	0.0243	0.0339	0.0493			
B	0.0129	0.0217	0.0282	0.0400	0.0583	0.0715		
CCC	0.0119	0.0203	0.0250	0.0385	0.0598	0.0761	0.0867	
CC	0.0107	0.0185	0.0235	0.0343	0.0544	0.0695	0.0832	0.0905

Table IA.7**ABS Default Correlations - Independently Drawn Frailty and Rating Change Paths**

This table reports the matrix of default correlations similar to Panel C of Table IV, with the exception that the frailty and rating transition paths are independently drawn. Reported are the pair-wise 5-year default correlations between two bonds of varying credit quality from January 1990 to December 2012 (Panel A) and January 1990 to December 2006 (Panel B). We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Full Sample

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0098							
AA	0.0150	0.0241						
A	0.0180	0.0305	0.0352					
BBB	0.0231	0.0378	0.0451	0.0550				
BB	0.0243	0.0410	0.0527	0.0658	0.0824			
B	0.0236	0.0420	0.0511	0.0675	0.0870	0.0961		
CCC	0.0160	0.0278	0.0347	0.0489	0.0715	0.0863	0.0910	
CC	0.0094	0.0164	0.0207	0.0303	0.0495	0.0645	0.0780	0.0822

Panel B. Pre-2007

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0036							
AA	0.0041	0.0082						
A	0.0058	0.0103	0.0113					
BBB	0.0098	0.0144	0.0163	0.0232				
BB	0.0109	0.0176	0.0234	0.0327	0.0485			
B	0.0135	0.0203	0.0269	0.0384	0.0588	0.0719		
CCC	0.0122	0.0191	0.0264	0.0373	0.0587	0.0761	0.0888	
CC	0.0109	0.0181	0.0233	0.0334	0.0536	0.0695	0.0871	0.0863

Table IA.8**Frailty Model Parameter Estimates – Mortgage Backed Security Defaults**

This table reports the parameter estimates of model frailty component when predicting defaults of MBS tranches with credit ratings lagged by one month and a time-varying rating transition matrix from January 1990 to December 2012 (Panel A) and from January 1990 to December 2006 (Panel B). Standard errors are reported in parenthesis.

Panel A. Full Sample

<i>Time-Varying Transition Matrix:</i>		<i>Model Frailty:</i>	
Unchanged Rating Scalar, γ	0.877 (0.0046)	Intercept, α	-1.383 (0.0261)
Volatility, η^{tm}	0.081 (0.0009)	Volatility, η^{frail}	0.552 (0.0099)
Reversion Speed, κ^{tm}	0.181 (0.0462)	Reversion Speed, κ^{frail}	0.130 (0.0254)

Panel B. Pre-2007

<i>Time-Varying Transition Matrix:</i>		<i>Model Frailty:</i>	
Unchanged Rating Scalar, γ	0.546 (0.0235)	Intercept, α	-0.876 (0.0813)
Volatility, η^{tm}	0.054 (0.0025)	Volatility, η^{frail}	0.535 (0.0267)
Reversion Speed, κ^{tm}	0.823 (0.0978)	Reversion Speed, κ^{frail}	0.202 (0.0428)

Table IA.9**MBS Default Correlations Prior to 2007**

This table reports the matrix of default correlations from three model specifications considering time-varying credit ratings and/or time-varying default frailty. Reported are the pair-wise 5-year default correlation between two bonds of varying credit quality from January 1990 to December 2006. Panel A reports the results of a model including only model frailty, Panel B reports the results of a model only including time-varying rating transitions, and Panel C reports the results of a model including both frailty and rating transitions drawn from their joint distribution. We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Time-Varying Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0008							
AA	0.0003	0.0004						
A	-0.0007	0.0010	0.0006					
BBB	0.0014	0.0010	-0.0001	0.0006				
BB	0.0007	0.0009	0.0006	0.0014	0.0010			
B	0.0010	0.0005	0.0008	0.0004	0.0009	0.0008		
CCC	0.0000	0.0003	0.0003	0.0001	0.0003	0.0004	0.0004	
CC	0.0001	0.0001	0.0001	0.0000	0.0001	0.0001	0.0001	0.0001

Panel B. Default Frailty

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0000							
AA	0.0002	0.0004						
A	-0.0001	-0.0002	0.0004					
BBB	0.0007	0.0008	0.0014	0.0028				
BB	0.0010	0.0026	0.0040	0.0081	0.0157			
B	0.0015	0.0029	0.0052	0.0105	0.0232	0.0340		
CCC	0.0014	0.0039	0.0066	0.0144	0.0303	0.0456	0.0658	
CC	0.0017	0.0035	0.0055	0.0121	0.0256	0.0397	0.0597	0.0582

Panel C. Jointly Determined Default Frailty and Rating Transitions

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0010							
AA	0.0024	0.0040						
A	0.0030	0.0054	0.0077					
BBB	0.0052	0.0069	0.0100	0.0132				
BB	0.0060	0.0096	0.0146	0.0190	0.0282			
B	0.0074	0.0116	0.0178	0.0227	0.0343	0.0438		
CCC	0.0068	0.0123	0.0170	0.0238	0.0377	0.0476	0.0594	
CC	0.0065	0.0107	0.0164	0.0212	0.0343	0.0447	0.0571	0.0557

Table IA.10**MBS Default Correlations - Independently Drawn Frailty and Rating Change Paths**

This table reports the matrix of default correlations similar to Panel C of Internet Appendix Table IA.9, with the exception that the frailty and rating transition paths are independently drawn. Reported are the pair-wise 5-year default correlations between two bonds of varying credit quality from January 1990 to December 2012 (Panel A) and January 1990 to December 2006 (Panel B). We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Full Sample

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0094							
AA	0.0144	0.0272						
A	0.0200	0.0342	0.0483					
BBB	0.0242	0.0399	0.0532	0.0631				
BB	0.0261	0.0446	0.0622	0.0760	0.0962			
B	0.0262	0.0431	0.0594	0.0751	0.1018	0.1117		
CCC	0.0174	0.0282	0.0400	0.0537	0.0808	0.1006	0.1150	
CC	0.0123	0.0193	0.0287	0.0402	0.0629	0.0884	0.1053	0.1048

Panel B. Pre-2007

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0021							
AA	0.0020	0.0043						
A	0.0026	0.0057	0.0079					
BBB	0.0057	0.0079	0.0097	0.0129				
BB	0.0063	0.0104	0.0140	0.0195	0.0274			
B	0.0082	0.0117	0.0171	0.0228	0.0350	0.0431		
CCC	0.0071	0.0122	0.0170	0.0239	0.0369	0.0479	0.0585	
CC	0.0066	0.0103	0.0160	0.0215	0.0337	0.0468	0.0562	0.0559

Table IA.11**Frailty Model Parameter Estimates – Regional Delinquencies**

This table reports the parameter estimates of regional frailty components when predicting 90 day loan delinquencies. Standard errors are reported in parenthesis.

90 Day Delinquency			
<i>Loan Characteristics</i>		<i>Frailty Volatility, η:</i>	
Intercept	-4.000 (0.0105)	Economy-Wide	0.177 (0.0005)
Loan Interest Rate	0.130 (0.0003)	Michigan	0.045 (0.0019)
Ln(Loan Size)	0.119 (0.0006)	Midwest	0.020 (0.0007)
Loan-to-Value	0.0001 (0.0000)	NE	0.083 (0.0010)
Second Lien	0.153 (0.0033)	NY/PA	0.050 (0.0012)
Credit Score	-0.005 (0.0001)	Florida	0.050 (0.0005)
Full Documentation	-0.175 (0.0034)	South	0.058 (0.0011)
Alternative Documentation	-0.571 (0.0078)	Texas	0.055 (0.0005)
Low Documentation	0.147 (0.0034)	Mountain	0.048 (0.0004)
No Documentation	0.143 (0.0065)	California	0.068 (0.0004)
		Mean Reversion, κ	0.039 (0.0061)

Table IA.12**Corporate Default Correlations with Parameter Uncertainty**

This table reports the matrix of default correlations when incorporating uncertainty in the parameter estimates. Reported are the pair-wise 5-year default correlation between two bonds of varying credit quality from January 1986 to December 2012 (Panel A) and January 1986 to December 2006 (Panel B). Reported are the results of a model including both frailty and rating transitions drawn from their joint distribution. For each draw we draw each model parameter from a normal distribution with a mean equal to the point estimate and a standard deviation equal to the parameter's standard error reported in Table II. We draw 100,000 sample rating transition and frailty paths 60 months in length for each pair of bonds and calculate the default probability of each bond over the 60 month period conditional on its monthly default intensities, and denote the bond as defaulting if a random variable drawn from a uniform distribution with a range of [0,1] is less than the default probability of the bond. We then calculate the default correlation from these 100,000 realizations of bond default.

Panel A. Full Sample

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0072							
AA	0.0080	0.0132						
A	0.0137	0.0219	0.0227					
BBB	0.0172	0.0226	0.0306	0.0522				
BB	0.0201	0.0316	0.0426	0.0731	0.1088			
B	0.0214	0.0320	0.0477	0.0798	0.1275	0.1578		
CCC	0.0200	0.0302	0.0447	0.0775	0.1345	0.1776	0.2110	
CC	0.0195	0.0287	0.0433	0.0751	0.1280	0.1707	0.2140	0.2135

Panel B. Pre-2007

	AAA	AA	A	BBB	BB	B	CCC	CC
AAA	0.0028							
AA	0.0051	0.0072						
A	0.0061	0.0094	0.0150					
BBB	0.0098	0.0140	0.0214	0.0398				
BB	0.0149	0.0215	0.0327	0.0542	0.0853			
B	0.0166	0.0241	0.0365	0.0621	0.1030	0.1302		
CCC	0.0163	0.0239	0.0373	0.0638	0.1136	0.1488	0.1889	
CC	0.0152	0.0222	0.0364	0.0617	0.1072	0.1455	0.1875	0.1880

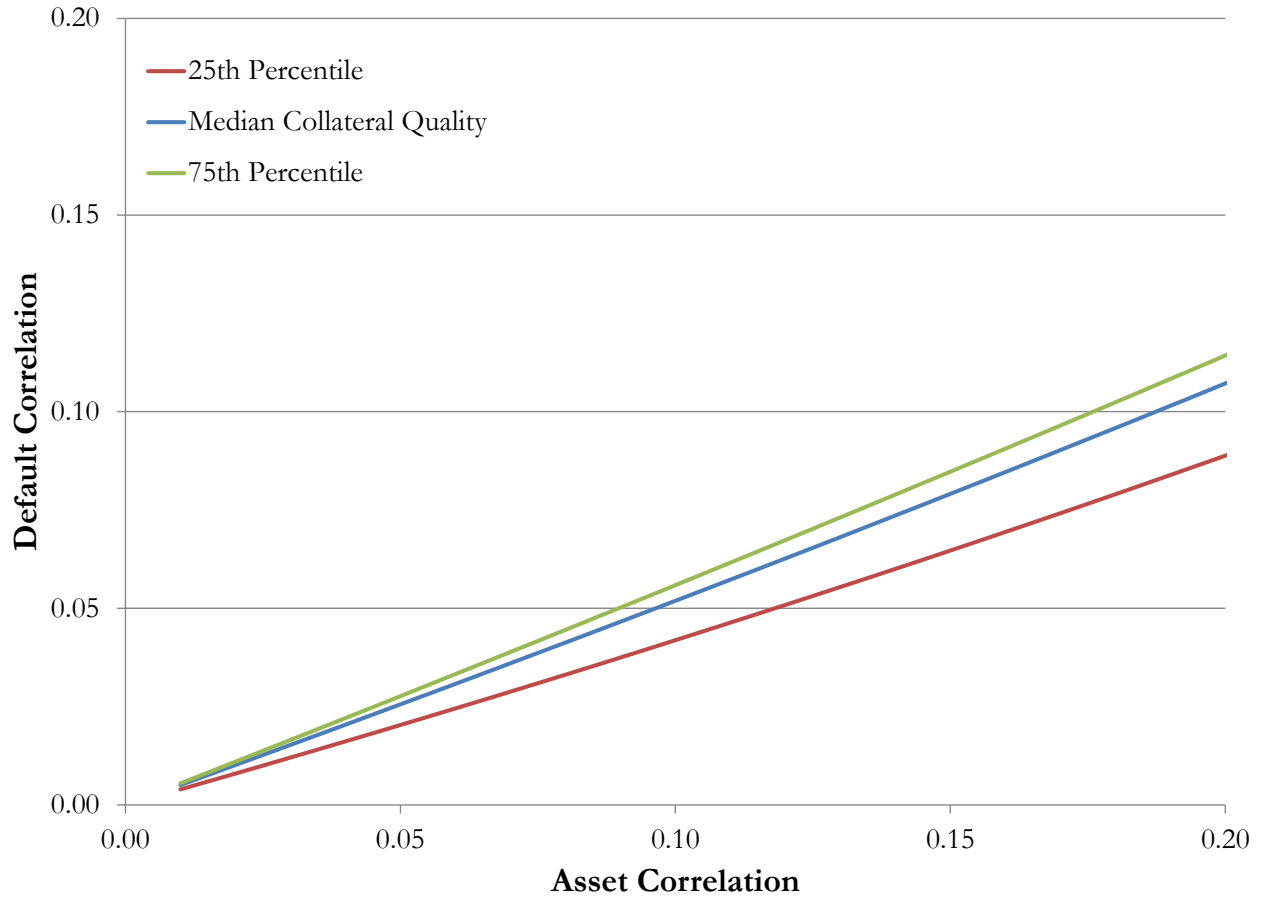


Figure IA.1

Asset Correlation versus Default Correlation

This figure illustrates the relationships between asset correlation and default correlation. The x-axis reports the asset correlation used as an input in the Gaussian Copula and the y-axis reports the average pair-wise default correlation from the simulated asset defaults. A pool of 122 assets, which corresponds to the median number of obligors in our sample of CDOs, was simulated 100,000 times for each asset correlation assumed. Reported are the mappings from asset correlation to default correlation when each assets probability of default is set to the 25th, 50th, and 75th percentiles of the average underlying collateral probability of default in our sample.

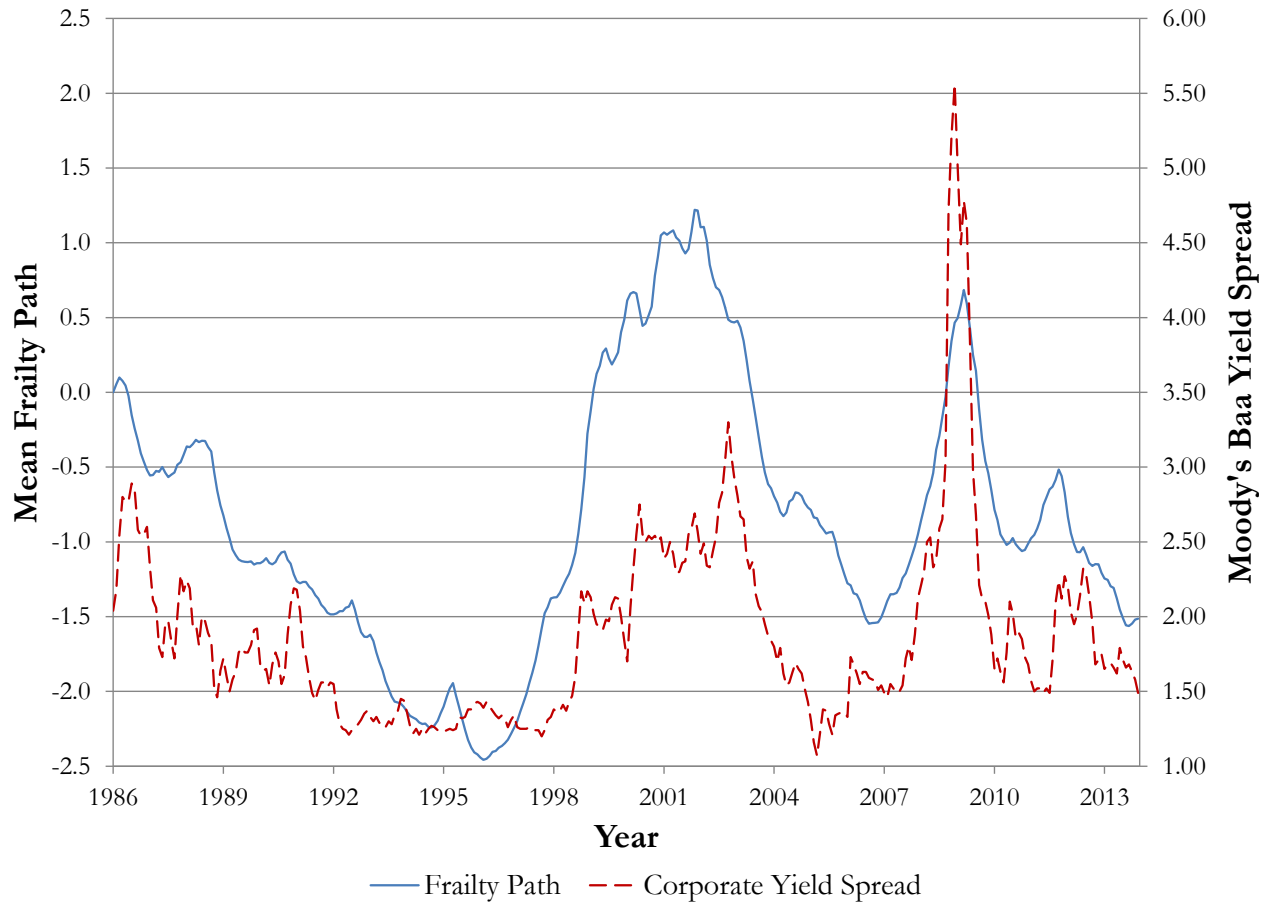


Figure IA.2

Corporate Bond Yield and Estimated Frailty Path

This figure illustrates the conditional mean of the frailty path from a hazard model fitted using the firm's credit rating lagged by 1 month (solid blue line) and the monthly corporate credit yield spread (dashed red line). 4,800 paths were drawn from a Gibbs sampler using the estimated coefficients from the fitted frailty and rating transition models reported in Table II. The path has been scaled by the appropriate scaling parameter, η . *Corporate Yield Spread* is the Moody's Seasoned Baa Corporate Bond Yield minus the 30-year Treasury Constant Maturity Rate, both provided by FRED.

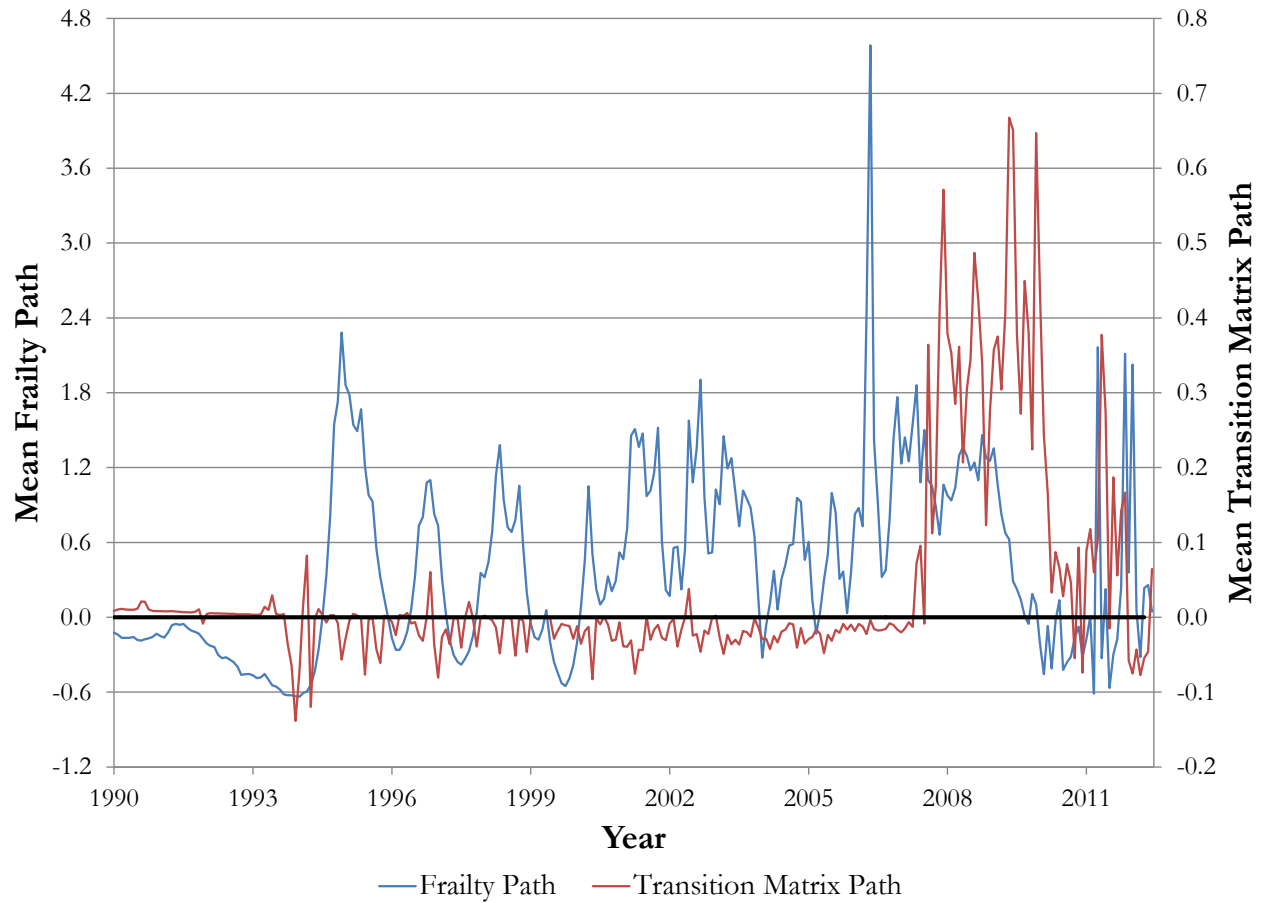


Figure IA.3

Estimated Frailty and Rating Transition Paths for ABS Securities

This figure illustrates the conditional mean of the frailty path from a hazard model fitted using the ABS tranche’s credit rating lagged by 1 month (blue line) and the mean path modifying the base transition matrix (red line). 4,800 paths were drawn from a Gibbs sampler using the estimated coefficients from the fitted frailty and rating transition models reported in Internet Appendix Table IA.5. Each path has been scaled by its respective scaling parameter, η .

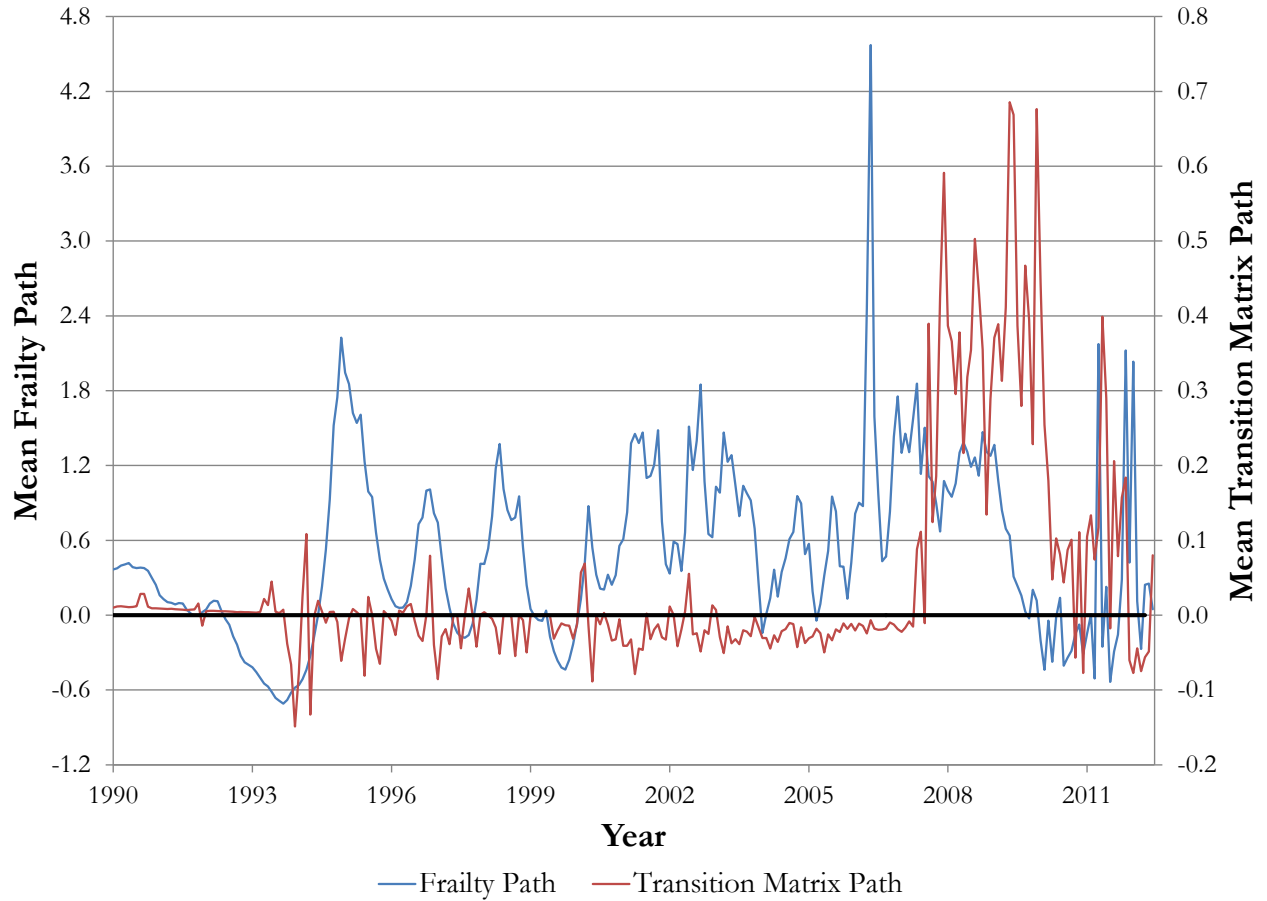


Figure IA.4

Estimated Frailty and Rating Transition Paths for MBS Securities

This figure illustrates the conditional mean of the frailty path from a hazard model fitted using the MBS tranche’s credit rating lagged by 1 month (blue line) and the mean path modifying the base transition matrix (red line). 4,800 paths were drawn from a Gibbs sampler using the estimated coefficients from the fitted frailty and rating transition models reported in Internet Appendix Table IA.8. Each path has been scaled by its respective scaling parameter, η .