
Industry Study

2022 DBRS Morningstar Structured Finance Rating Transition and Default Study

DBRS Morningstar

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Introduction

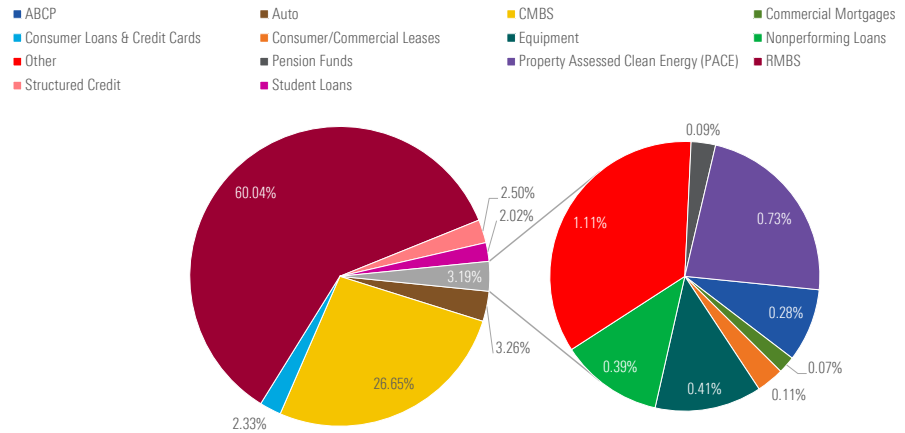
DBRS, Inc.'s (DBRS Morningstar) 17th structured finance rating transition and 15th default study covers its rating history from 1985 through December 31, 2022. The rating transitions in this study reflect the historical performance of DBRS Morningstar structured finance long-term ratings over one-, three-, and 10-year time horizons. The ratings herein represent securities issued in Canada, the United States, and Europe in the following sectors: asset-backed securities (ABS), commercial mortgage-backed securities (CMBS), residential mortgage-backed securities (RMBS), structured credit, and medium-term notes (MTNs) issued by asset-backed commercial paper (ABCP) conduits. Beginning with the *2010 DBRS Structured Finance Rating Transition and Default Study*, ratings for covered bonds are included in the DBRS Morningstar Fundamental Transition and Default Study. As of the 2011 study, separate rating transition tables have been provided for the United States and Europe. The European tables display rating transitions for issuance originating in Australia, Austria, Belgium, Cyprus, Finland, France, Germany, Greece, Guernsey, Ireland, Italy, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom.

As of December 31, 2022, DBRS Morningstar had 25,612 structured finance ratings outstanding, 92.8% of which originated in the United States, followed by 5.5% in Europe and 1.7% in Canada. Consistent with the 2009–21 period, a majority of the outstanding ratings in 2022 (60.3%) were in the RMBS sector, followed by the CMBS (26.8%), ABS (10.1%), structured credit (2.5%), and ABCP (0.3%) sectors. Additionally, U.S. RMBS ratings accounted for 58.0% of DBRS Morningstar's outstanding global structured finance ratings and 62.5% of its 23,763 outstanding U.S. ratings.

Exhibits 1 through 4 delineate the outstanding end-of-year ratings issued (1) globally, (2) in Canada, (3) in Europe, and (4) in the United States. DBRS Morningstar compiled rating counts for all sectors by examining ratings outstanding on the final day of the relevant year, specifically excluding any rating that was discontinued prior to that date.

DBRS Morningstar 2022 Ratings Composition

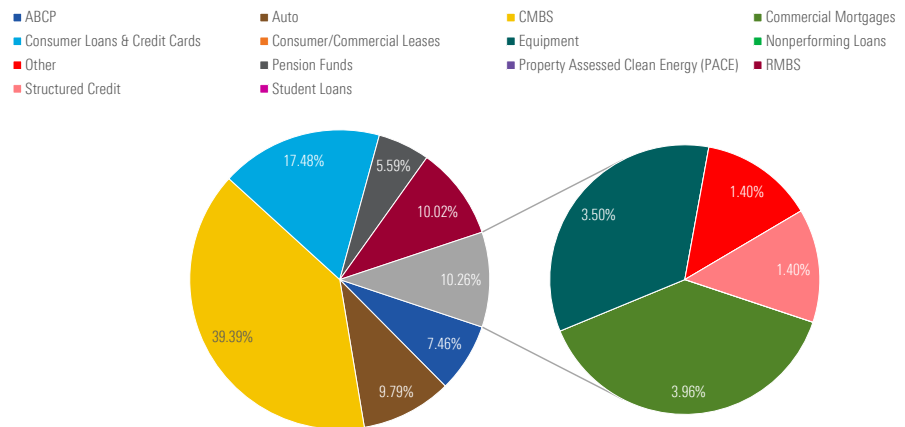
Exhibit 1 End-of-Year Ratings Outstanding (Global)



Notes:

1. Percentages may not add up to 100% because of rounding.
2. Auto includes Loans, Leases, Rental Cars, Fleet, and Floorplan.
3. ABCP comprises long-term ratings assigned to MTNs.
4. The sector entitled Other consists of Utility Tariffs, Real Estate Secured, Trade Receivables, Credit-Linked Notes, Structured Settlements, Intermodal Containers, Asset-Based Loans, Healthcare Receivables, Insurance Premium Finance, Timeshare Loans, Film Finance Receivables, Long-Term Care Insurance Commissions, Energy Savings Performance Contracts, and Small Business Loans.

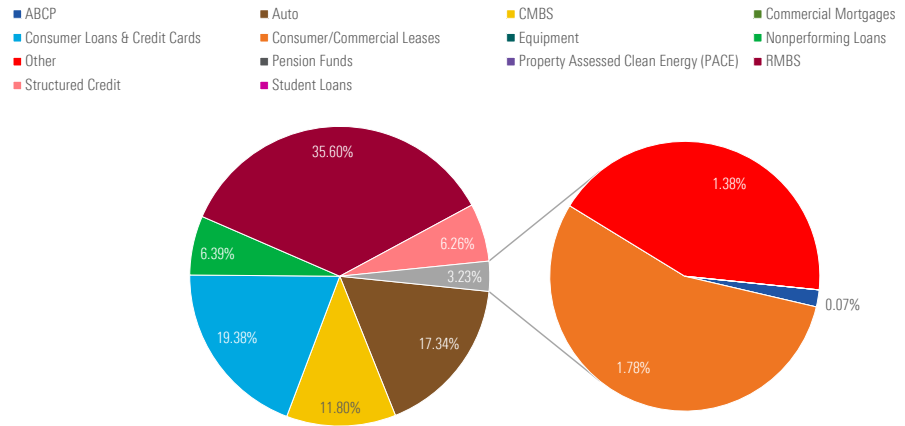
Exhibit 2 End-of-Year Ratings Outstanding (Canada)



Notes:

1. Percentages may not add up to 100% because of rounding.
2. Auto includes Loans, Leases, Rental Cars, Fleet, and Floorplan.
3. ABCP comprises long-term ratings assigned to MTNs.
4. Equipment includes Loans and Leases.
5. The sector entitled Other consists of Real Estate Secured and Residential Rental Equipment Contract Receivables.

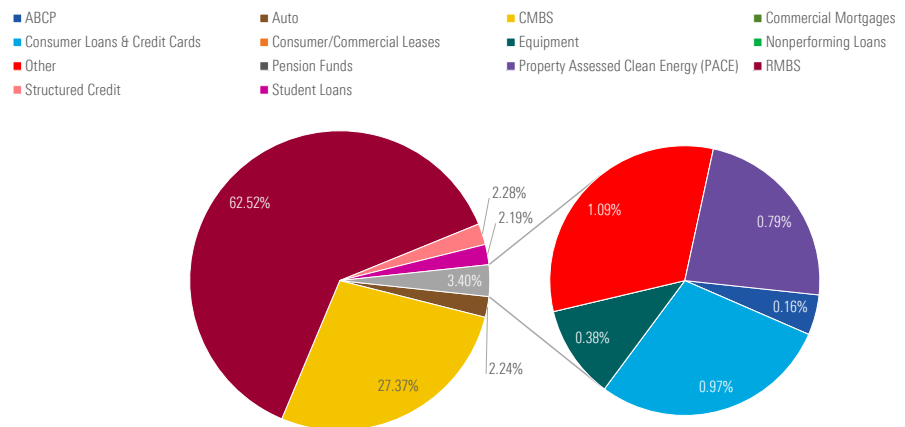
Exhibit 3 End-of-Year Ratings Outstanding (Europe)



Notes:

1. Percentages may not add up to 100% because of rounding.
2. Auto includes Loans, Leases, Rental Cars, and Floorplan.
3. ABCP comprises long-term ratings assigned to MTNs.
4. The sector entitled Other consists of Utility Tariffs.

Exhibit 4 End-of-Year Ratings Outstanding (U.S.)



Notes:

1. Percentages may not add up to 100% because of rounding.
2. Auto includes Loans, Leases, Rental Cars, Fleet, and Floorplan.
3. ABCP comprises long-term ratings assigned to MTNs.
4. Equipment includes Loans and Leases.
5. The sector entitled Other consists of Structured Settlements, Intermodal Containers, Healthcare Receivables, Insurance Premium Finance, Timeshare Loans, Film Finance Receivables, Small Business Loans, Long-Term Care Insurance Commissions, Energy Savings Performance Contracts, and Credit-Linked Note ratings.

Structured Finance Geographic Ratings Distribution

The following tables, detailing the absolute count and percentage of ratings extant on December 31 of each indicated year, display the change in composition of the ratings database. Over the past year, 20 tranches defaulted and 2,527 others transitioned to Discontinued – Repaid status.

Absolute Count

2021	2022				2021	2022			
	Global	Canada	Europe	United States		Global	Canada	Europe	United States
Global	24,271	359	1,541	22,371	Global	25,612	429	1,420	23,763
ABCP	44	9	2	33	ABCP	72	32	1	39
Auto	847	45	257	545	Auto	838	42	263	533
CMBS	6,615	166	176	6,273	CMBS	6,853	169	179	6,505
Commercial Mortgages	1	1	0	0	Commercial Mortgages	17	17	0	0
Consumer Loans & Credit Cards	604	62	286	256	Consumer Loans & Credit Cards	600	75	294	231
Consumer/Commercial Leases	34	0	34	0	Consumer/Commercial Leases	27	0	27	0
Equipment	100	19	0	81	Equipment	105	15	0	90
Nonperforming Loans	93	0	93	0	Nonperforming Loans	0	0	0	0
Other	242	4	24	214	Other	286	6	21	259
Pension Funds	12	12	0	0	Pension Funds	24	24	0	0
Property Assessed Clean Energy (PACE)	138	0	0	138	Property Assessed Clean Energy (PACE)	188	0	0	188
RMBS	14,571	38	569	13,964	RMBS	15,439	43	540	14,856
Structured Credit	456	3	100	353	Structured Credit	643	6	95	542
Student Loans	514	0	0	514	Student Loans	520	0	0	520

Percentage (%)¹

2021	2022				2021	2022			
	Global	Canada	Europe	United States		Global	Canada	Europe	United States
Global	100.00	1.48	6.35	92.17	Totals	100.00	1.67	5.54	92.78
ABCP	0.18	2.51	0.13	0.15	ABCP	0.28	7.46	0.07	0.16
Auto	3.49	12.53	16.68	2.44	Auto	3.27	9.79	18.52	2.24
CMBS	27.25	46.24	11.42	28.04	CMBS	26.76	39.39	12.61	27.37
Commercial Mortgages	0.00	0.28	0.00	0.00	Commercial Mortgages	0.07	3.96	0.00	0.00
Consumer Loans & Credit Cards	2.49	17.27	18.56	1.14	Consumer Loans & Credit Cards	2.34	17.48	20.70	0.97
Consumer/Commercial Leases	0.14	0.00	2.21	0.00	Consumer/Commercial Leases	0.11	0.00	1.90	0.00
Equipment	0.41	5.29	0.00	0.36	Equipment	0.41	3.50	0.00	0.38
Nonperforming Loans	0.38	0.00	6.04	0.00	Nonperforming Loans	0.00	0.00	0.00	0.00
Other	1.00	1.11	1.56	0.96	Other	1.12	1.40	1.48	1.09
Pension Funds	0.05	3.34	0.00	0.00	Pension Funds	0.09	5.59	0.00	0.00
Property Assessed Clean Energy (PACE)	0.57	0.00	0.00	0.62	Property Assessed Clean Energy (PACE)	0.73	0.00	0.00	0.79
RMBS	60.03	10.58	36.92	62.42	RMBS	60.28	10.02	38.03	62.52
Structured Credit	1.88	0.84	6.49	1.58	Structured Credit	2.51	1.40	6.69	2.28
Student Loans	2.12	0.00	0.00	2.30	Student Loans	2.03	0.00	0.00	2.19

¹ May not add up to 100%.

Default and Transition Study Overview

This year's study comprises the examination of one-, three-, and 10-year transitions for all DBRS Morningstar-rated issuance. Stratifications within the transition study are displayed globally and, for issues originally rated in Canada, Europe, and the United States, are based on the following algorithm:

Step	Category
1	Domicile of issuer unless tax haven
2	Domicile of sponsor unless global
3	Domicile of assets unless global
4	Placement of bonds unless global
5	DBRS Morningstar office that assigned the original rating

DBRS Morningstar determines the jurisdiction associated with a given asset via table primacy. Within each of the three jurisdictional groupings, rating transitions for the ABS, RMBS, CMBS, and structured credit sectors are presented.

For 2022, the Global Structured Finance transition matrices delineate the expected ordinal ranking of credit risk in the investment-grade rating categories. One-, three-, and 10-year transitions for the AAA (sf)¹ rating category in Global Structured Finance equal 96.60%, 86.06%, and 18.14%, respectively.

The Global Structured Finance transition matrices for all sectors, excluding U.S. RMBS, delineate stable ratings performance with AAA (sf) transition rates of 98.21%, 93.12%, and 87.22% for the one-, three-, and 10-year periods, respectively. DBRS Morningstar observed a similar trend in 2021 for all investment-grade ratings within this stratification.

Please refer to Appendices 1 and 3 for DBRS Morningstar's historical transition rates by whole rating category for the one-, three-, and 10-year intervals and Appendices 2 and 4 for its historical transition rates by notched rating category for the one-, three-, and 10-year intervals.²

From 1985 through December 31, 2021, the DBRS Morningstar Global Structured Finance default rate totaled 1.893%.³ In addition to 24 defaults in the 2008 calendar year, four defaults in 2009, four defaults in 2010, 27 defaults in 2011, 44 defaults in 2012, 27 defaults in 2013, 21 defaults in 2014, 14 defaults in 2015, seven defaults in 2016, 11 defaults in 2017, four defaults in 2018, 11 defaults in 2019, 48 defaults in 2020, and 35 defaults in 2021, there were 20 defaults in 2022—14 in U.S. RMBS and six in U.S. CMBS.

1. DBRS Morningstar implemented a structured finance modifier, (sf), on a global basis. DBRS Morningstar uses the (sf) modifier next to the rating category for ratings that meet the requisite criteria in its press releases and rating reports on its public website. The (sf) modifier only indicates that the security is a structured finance instrument and will not change the meaning or definition of the rating in any other way or change the risk of any particular structured finance instrument. As exclusions from the (sf) modifier, covered bonds are included in the DBRS Morningstar Fundamental Transition and Default Study.

2. As detailed on page 11, this study differentiates between inclusion and exclusion of discontinued ratings.

3. Please refer to the 2022 Cumulative Default Statistics—Excluding Discontinued Ratings tables.

The CMBS defaults resulted from losses realized in 2022 that stemmed from the liquidation of defaulted loans. The loan loss severities are similar to or lower than losses experienced in other transactions of the same vintage.

The 14 defaults in U.S. RMBS reflected assets that either reached their final maturity date with outstanding principal writedowns or instances where the trustee chose to terminate reporting prematurely. These assets were rated C (sf) shortly before the final maturity, consistent with the DBRS Morningstar *U.S. RMBS Surveillance Methodology*. With the onset of final maturity, DBRS Morningstar first downgraded these assets to D and subsequently discontinued the ratings. See Appendix 5 for specific defaults.

Methodology

This study is based on information from the DBRS Morningstar proprietary ratings database and includes ratings from 1985 up to and including December 31, 2022. As of December 31, 2022, the DBRS Morningstar database comprised approximately 330,000 structured finance rating events. The rating transition rates represent historical rating changes and may not reflect future ratings migration patterns. DBRS Morningstar will continue to refine its methodology, which may produce different results in the future.

Data Set

The study is limited to long-term public, Rule 144A, and private ratings that are monitored. Long-term ratings that existed for less than one year are not included in the data set. Ratings on MTNs issued by ABCP conduits are included in the data set.

Transition Rate Calculations

DBRS Morningstar calculated transition rates for each given period by comparing the number of securities that held a given rating at the beginning of the relevant period with the distribution of the ratings of the same securities at the end of the period. The transition rates represent a quotient whereby the numerator is the subset of securities that held a given beginning-of-period rating and currently hold a specific end-of-period rating, while the denominator is the number of securities that held the given beginning-of-period rating.

Discontinuation of Ratings

Beginning with the *2013 DBRS Structured Finance Rating Transition and Default Study*, DBRS Morningstar essentially doubled the major tables to demonstrate two methodologies for counting discontinued ratings—Exclusion of Discontinued Ratings and Inclusion of Discontinued Ratings.

Exclusion of Discontinued Ratings, the process by which DBRS Morningstar analyzed all previous transition and default studies, views an asset as no longer extant once DBRS Morningstar has discontinued the rating. Therefore, for any counting method that requires an asset to be extant at the beginning and at the end of the calendar year, all ratings for this asset during this period will be ignored. For example, DBRS Morningstar will consider an asset that was discontinued in December to have had no ratings for that calendar year, even though the asset may have actually been rated AAA (sf) for all but the final day of the year.

Inclusion of Discontinued Ratings is the process whereby the published date of the discontinued rating is artificially extended to the end of the calendar year, thereby ensuring that the asset is extant at the end of the period. For example, DBRS Morningstar would treat an asset rated AAA (sf) in January but Discontinued – Repaid prior to January 31 as if the asset had held the AAA (sf) rating for all 12 months of the period, even though the asset simply did not exist for the previous 11 months.

Definition of Default

A security rated D implies that either the issuer has not met a scheduled interest or principal payment, or the issuer has made it clear that it will miss such a payment in the near future. In some cases, DBRS Morningstar may not assign a D rating under a bankruptcy announcement scenario as allowances for grace periods may exist in the underlying legal documentation. Once assigned, the default rating will continue as long as the missed payment continues to be in arrears and until DBRS Morningstar discontinues or reinstates the rating, noting that DBRS Morningstar reserves the right to discontinue and withdraw D ratings after 30 business days. There may be cases where DBRS Morningstar assigns a default rating status (D) to an issuer's security or class of securities, but its other securities or classes of securities are not considered to be in default as the issuer continues to meet its obligations in respect of those securities or classes of securities in a timely manner. Please refer to Rating Policies on www.dbrsmorningstar.com for further information.

Aggregate Default Rate Calculation

Compared with last year's publication, DBRS Morningstar has introduced a new logic for calculating an Aggregate Default Rate. Considering only ratings outstanding at the end of a month, DBRS Morningstar creates monthly cohorts of individual securities where a "cohort" is defined based on its rating grade and the calendar month in which its securities are outstanding (e.g., AAA (sf)-rated securities in January 2013).

DBRS Morningstar divides the cohort's subsequent life into month-long periods, and for each of these, the default rate is calculated as the ratio of the number of securities that defaulted in that month divided by the number of securities that were outstanding in the beginning of that month and either remained outstanding or defaulted in the meantime. The cohort-level default rates are then aggregated by computing their weighted average based on the number of securities they contain. Finally, the aggregate default rates for a given time horizon are obtained by chaining together the monthly default rates within the selected time horizon.

This change results in higher numerical values for default rates than those published in prior years' studies, which resulted from the previous counting logic. A further explanation of this new approach is presented in Appendix 6.

Aggregate Default Statistics—2022

DBRS Morningstar examined the universe of data using cohorts to determine aggregate default statistics. Please refer to the Methodology section, the default list in Appendix 5, and the formulae in Appendix 6.

Aggregate Default Rate by Year and Whole Rating Category (%)

Rating/Years	1	2	3	4	5	6	7	8	9	10
AAA (sf)	0.03	0.07	0.10	0.13	0.17	0.19	0.21	0.22	0.23	0.29
AA (sf)	0.01	0.06	0.15	0.25	0.41	0.53	0.54	0.58	0.62	0.72
A (sf)	0.04	0.06	0.10	0.21	0.33	0.53	0.88	1.31	1.65	2.11
BBB (sf)	0.02	0.06	0.16	0.41	0.78	1.27	1.82	2.32	2.63	2.87
BB (sf)	0.02	0.07	0.38	1.15	2.23	3.46	4.62	5.67	6.39	7.06
B (sf)	0.03	0.22	1.06	2.38	3.97	5.47	6.72	7.81	8.86	9.68
CCC (sf)	2.50	14.13	31.64	43.39	51.42	55.69	59.54	63.76	70.69	75.45
CC (sf)	1.78	13.97	20.16	29.20	35.18	42.91	51.56	60.96	74.69	83.37
C (sf)	0.52	0.94	1.25	1.53	1.82	2.13	2.48	2.89	3.36	3.89

Aggregate Default Rate by Year and Notched Rating Category (%)

Rating/Years	1	2	3	4	5	6	7	8	9	10
AAA (sf)	0.03	0.07	0.10	0.13	0.17	0.19	0.21	0.22	0.23	0.29
AA (high) (sf)	0.00	0.00	0.00	0.00	0.14	0.14	0.14	0.14	0.14	0.14
AA (sf)	0.02	0.09	0.22	0.39	0.59	0.80	0.80	0.80	0.80	0.92
AA (low) (sf)	0.00	0.00	0.06	0.06	0.06	0.06	0.13	0.29	0.46	0.65
A (high) (sf)	0.00	0.00	0.00	0.00	0.03	0.14	0.29	0.43	0.45	0.45
A (sf)	0.02	0.05	0.11	0.26	0.33	0.41	0.65	1.02	1.42	1.97
A (low) (sf)	0.13	0.13	0.17	0.26	0.56	1.11	1.82	2.56	3.06	3.73
BBB (high) (sf)	0.00	0.01	0.03	0.19	0.59	1.03	1.60	2.12	2.44	2.57
BBB (sf)	0.03	0.10	0.23	0.42	0.66	1.00	1.50	2.00	2.34	2.74
BBB (low) (sf)	0.01	0.02	0.12	0.55	1.12	1.87	2.50	2.99	3.23	3.35
BB (high) (sf)	0.00	0.02	0.30	1.03	2.10	3.09	4.07	5.04	5.56	5.95
BB (sf)	0.01	0.04	0.19	0.76	1.62	2.52	3.45	4.37	5.04	5.83
BB (low) (sf)	0.06	0.22	0.97	2.29	3.95	6.33	8.32	9.92	11.16	11.98
B (high) (sf)	0.01	0.08	0.97	2.63	4.65	6.92	8.78	10.39	11.39	12.10
B (sf)	0.02	0.08	0.48	1.21	2.18	3.06	3.90	4.59	5.30	5.93
B (low) (sf)	0.07	0.79	2.92	5.71	8.83	11.70	13.83	15.88	18.26	19.94
CCC (high) (sf)	1.80	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47	2.47
CCC (sf)	2.36	14.81	33.23	45.28	53.29	57.50	61.26	65.38	72.18	76.93
CCC (low) (sf)	7.48	7.48	7.48	7.48	7.48	7.48	7.48	7.48	7.48	7.48
CC (sf)	1.78	13.97	20.16	29.20	35.18	42.91	51.56	60.96	74.69	83.37
C (sf)	0.52	0.94	1.25	1.53	1.82	2.13	2.48	2.89	3.36	3.89

Cumulative Default Rate (CDR) Calculation

Default rate calculations for this study are based on static analysis commencing with the assignment of the initial rating. DBRS Morningstar calculates CDRs with regard to a compilation of monthly cohorts. Each cohort consists of all securities with initial rating dates that fall before the first day of each cohort's associated month and year. The issues assigned to each respective cohort remain constant over time. For all months for which there exists historical data, DBRS Morningstar surveys each cohort to determine the then-current rating of each of its component issues without regard to defaults. Aggregating rating counts over all cohorts involves collecting the numbers of each rating extant over each month of the reference period. DBRS Morningstar then performs the same analysis using only the issues that do eventually default. DBRS Morningstar determines average CDR probabilities by computing the relevant quotients.

Cumulative Default Statistics—2022

DBRS Morningstar examined the universe of data using monthly cohorts to determine cumulative default statistics. Please refer to the Methodology section, the default list in Appendix 5, and the formulae in Appendix 6.

2022 Cumulative Default Statistics by Whole Rating Category—Excluding Discontinued Ratings

Rating	All-Inclusive Count	Default Count	Percentage (%)
AAA (sf)	68,249,574	234,772	0.344
AA (sf)	22,339,514	176,720	0.791
A (sf)	25,314,613	286,438	1.132
BBB (sf)	22,225,772	507,185	2.282
BB (sf)	11,782,026	532,041	4.516
B (sf)	10,087,004	624,773	6.194
CCC (sf)	978,004	285,761	29.219
CC (sf)	53,709	22,816	42.481
C (sf)	55,581,290	1,431,839	2.576
Aggregate	216,611,506	4,102,345	1.893

2022 Cumulative Default Statistics by Notched Rating Category—Excluding Discontinued Ratings

Rating	All-Inclusive Count	Default Count	Percentage (%)
AAA (sf)	68,249,574	234,772	0.344
AA (high) (sf)	4,748,340	20,981	0.442
AA (sf)	14,079,183	121,032	0.860
AA (low) (sf)	3,511,991	34,707	0.988
A (high) (sf)	4,661,184	28,012	0.601
A (sf)	15,777,136	156,158	0.990
A (low) (sf)	4,876,293	102,268	2.097
BBB (high) (sf)	4,230,323	109,402	2.586
BBB (sf)	11,986,321	217,695	1.816
BBB (low) (sf)	6,009,128	180,088	2.997
BB (high) (sf)	3,325,234	152,289	4.580
BB (sf)	5,970,797	225,198	3.772
BB (low) (sf)	2,485,995	154,554	6.217
B (high) (sf)	2,146,966	151,397	7.052
B (sf)	5,605,110	261,608	4.667
B (low) (sf)	2,334,928	211,768	9.070
CCC (high) (sf)	44,120	1,252	2.838
CCC (sf)	914,229	281,662	30.809
CCC (low) (sf)	19,655	2,847	14.485
CC (sf)	53,709	22,816	42.481
C (sf)	55,581,290	1,431,839	2.576
Aggregate	216,611,506	4,102,345	1.893

2022 Cumulative Default Statistics by Whole Rating Category—Including Discontinued Ratings

Rating	All-Inclusive Count	Default Count	Percentage (%)
AAA (sf)	72,904,731	234,772	0.322
AA (sf)	23,097,721	176,720	0.765
A (sf)	26,249,314	286,438	1.091
BBB (sf)	22,863,042	507,185	2.218
BB (sf)	12,002,897	532,041	4.433
B (sf)	10,180,945	624,773	6.137
CCC (sf)	1,001,807	285,834	28.532
CC (sf)	55,908	22,828	40.831
C (sf)	55,709,398	1,440,814	2.586
Aggregate	224,065,763	4,111,405	1.834

2022 Cumulative Default Statistics by Notched Rating Category—Including Discontinued Ratings

Rating	All-Inclusive Count	Default Count	Percentage (%)
AAA (sf)	72,904,731	234,772	0.322
AA (high) (sf)	4,908,425	20,981	0.427
AA (sf)	14,576,946	121,032	0.830
AA (low) (sf)	3,612,350	34,707	0.961
A (high) (sf)	4,863,373	28,012	0.576
A (sf)	16,361,318	156,158	0.954
A (low) (sf)	5,024,623	102,268	2.035
BBB (high) (sf)	4,341,683	109,402	2.520
BBB (sf)	12,362,258	217,695	1.761
BBB (low) (sf)	6,159,101	180,088	2.924
BB (high) (sf)	3,383,805	152,289	4.501
BB (sf)	6,080,426	225,198	3.704
BB (low) (sf)	2,538,666	154,554	6.088
B (high) (sf)	2,166,734	151,397	6.987
B (sf)	5,657,854	261,608	4.624
B (low) (sf)	2,356,357	211,768	8.987
CCC (high) (sf)	46,290	1,252	2.705
CCC (sf)	935,644	281,662	30.104
CCC (low) (sf)	19,873	2,920	14.693
CC (sf)	55,908	22,828	40.831
C (sf)	55,709,398	1,440,814	2.586
Aggregate	224,065,763	4,111,405	1.834

Appendix 1: Historical Transition Rates (by Whole Rating Category—One-, Three-, and 10-Year Intervals), Excluding Discontinued Ratings

The following appendix summarizes the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on whole rating categories. Regardless of the interval, an issue must be extant at the beginning of each interval and at the conclusion of this same interval to be included in this study. A discontinued rating terminates the rating history of that particular asset on the published date of the discontinued rating; therefore, the discontinued issue will not be extant at the end of that calendar year.

Given that there are 38 whole one-year intervals from January 1, 1985, through December 31, 2022, the one-year transitions summarized below present the fraction in which the numerator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating and concluding the interval with the given rating, is divided by the denominator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating. For example, to compute the aggregate one-year transition to an A (sf) from a AAA (sf) rating, DBRS Morningstar would determine the denominator by calculating the number of AAA (sf)-rated issues extant at the beginning of each of the 38 one-year intervals while the numerator would represent the count of AAA (sf)-rated issues extant at the beginning of each of the 38 one-year intervals that actually migrated to A (sf) from AAA (sf) during said interval. DBRS Morningstar excludes any issues that moved to a discontinued status during any evaluation interval from the statistics for that particular interval. This method of aggregating rating counts inherently assigns equal weight to each rating; therefore, years that feature higher numbers of ratings explain proportionally larger shares of the final percentages.

Statistics for the three-year tables result from DBRS Morningstar's amalgamation of 36 three-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1987. DBRS Morningstar only included issues in this interval if they were extant on both dates.

Statistics for the 10-year tables result from DBRS Morningstar's amalgamation of 29 10-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1994. DBRS Morningstar only included issues in this interval if they were extant on both dates.

The following tables summarize the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on whole rating categories.

Appendix 2: Historical Transition Rates (by Whole Rating Category—One-, Three-, and 10-Year Intervals), Including Discontinued Ratings

The following appendix summarizes the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on whole rating categories. Regardless of the interval, an issue must be extant at the beginning of each interval and at the conclusion of this same interval to be included in this study. Inclusion of discontinued ratings refers to the process by which the published date of a discontinued rating artificially extends to the end of the calendar year, the net effect of which is that this study will explicitly include all ratings of a discontinued asset during the calendar year of the discontinued rating because the asset will be extant at year's end.

Given that there are 38 whole one-year intervals from January 1, 1985, through December 31, 2022, the one-year transitions summarized below present the fraction in which the numerator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating and concluding the interval with the given rating, is divided by the denominator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating. For example, to compute the aggregate one-year transition to an A (sf) from a AAA (sf) rating, DBRS Morningstar would determine the denominator by calculating the number of AAA (sf)-rated issues extant in the beginning of each of the 38 one-year intervals while the numerator would represent the count of AAA (sf)-rated issues extant at the beginning of each of the 38 one-year intervals that actually migrated to A (sf) from AAA (sf) during said interval. DBRS Morningstar explicitly includes any issues that moved to a discontinued status during any evaluation interval in the statistics for that particular yearly interval, but excludes them from all future yearly intervals. This method of aggregating rating counts inherently assigns equal weight to each rating; therefore, years that feature higher numbers of ratings explain proportionally larger shares of the final percentages.

Statistics for the three-year tables result from DBRS Morningstar's amalgamation of 36 three-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1987. DBRS Morningstar only includes issues in this interval if they were extant on both dates. An asset that is discontinued during the final year of a three-year interval would be extant on both dates of the interval, while an asset that is discontinued during either the first or second year would not be considered extant on the last date of the three-year interval because the published date of the discontinuation only extends to the end of the relevant calendar year.

Statistics for the 10-year tables result from DBRS Morningstar's amalgamation of 29 10-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1995. DBRS Morningstar only includes issues in this interval if they were extant

on both dates. Similarly, DBRS Morningstar will only count a discontinued asset in a 10-year interval if the published date of the discontinued rating occurred in the final year of the interval.

The following tables summarize the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on whole rating categories.

Appendix 3: Historical Transition Rates (by Notched Rating Category—One-, Three-, and 10-Year Intervals), Excluding Discontinued Ratings

The following appendix summarizes the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on notched rating categories. Regardless of the interval, an issue must be extant at the beginning of each interval and at the conclusion of this same interval to be included in this study. A discontinued rating terminates the rating history of that particular asset on the published date of the discontinued rating; therefore, the discontinued issue will not be extant at the end of that calendar year.

Given that there are 38 whole one-year intervals from January 1, 1985, through December 31, 2022, the one-year transitions summarized below present the fraction in which the numerator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating and concluding the interval with the given rating, is divided by the denominator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating. For example, to compute the aggregate one-year transition to an A (low) (sf) from a AAA (sf) rating, DBRS Morningstar would determine the denominator by calculating the number of AAA (sf)-rated issues extant in the beginning of each of the 38 one-year intervals while the numerator would represent the count of AAA (sf)-rated issues extant at the beginning of each of the 38 one-year intervals that actually migrated to A (low) (sf) from AAA (sf) during said interval. DBRS Morningstar would exclude any issues that moved to a discontinued status during any evaluation interval from the statistics for that particular interval. This method of aggregating rating counts inherently assigns equal weight to each rating; therefore, years that feature higher numbers of ratings explain proportionally larger shares of the final percentages.

Statistics for the three-year tables result from an amalgamation of 36 three-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1988. DBRS Morningstar only includes issues if they were extant on both the beginning date of the interval and on the terminal date of said interval and if they were not considered discontinued during the interval.

Statistics for the 10-year tables result from DBRS Morningstar's amalgamation of 29 10-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1994. DBRS Morningstar only includes issues in an interval if they were extant on both the beginning date of the interval and on the terminal date of said interval and if they were not considered discontinued during the interval.

The following tables summarize the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on notched rating categories.

Appendix 4: Historical Transition Rates (by Notched Rating Category—One-, Three-, and 10-Year Intervals), Including Discontinued Ratings

The following appendix summarizes the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on notched rating categories. Regardless of the interval, an issue must be extant at the beginning of each interval and at the conclusion of this same interval to be included in this study. A discontinued rating terminates the rating history of that particular asset on the published date of the discontinued rating; therefore, the discontinued issue will not be extant at the end of that calendar year.

Given that there are 38 whole one-year intervals from January 1, 1985, through December 31, 2022, the one-year transitions summarized below present the fraction in which the numerator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating and concluding the interval with the given rating, is divided by the denominator, which represents the sum of the 38 yearly counts of issues beginning the interval with the given rating. For example, to compute the aggregate one-year transition to an A (low) (sf) from a AAA (sf) rating, DBRS Morningstar would determine the denominator by calculating the number of AAA (sf)-rated issues extant in the beginning of each of the 38 one-year intervals while the numerator would represent the count of AAA (sf) issues extant at the beginning of each of the 38 one-year intervals that actually migrated to A (low) (sf) from AAA (sf) during said interval. DBRS Morningstar explicitly includes any issues that moved to a discontinued status during any evaluation interval in the statistics for that particular yearly interval, but excludes them from all future yearly intervals. This method of aggregating rating counts inherently assigns equal weight to each rating; therefore, years that feature higher numbers of ratings explain proportionally larger shares of the final percentages.

Statistics for the three-year tables result from an amalgamation of 36 three-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1987. DBRS Morningstar only includes issues in this interval if they were extant on both dates. An asset that is discontinued during the final year of a three-year interval would be extant on both dates of the interval while a discontinued rating during either the first or second year would not be considered extant on the last date of the three-year interval because the published date only extends to the end of the relevant calendar year.

Statistics for the 10-year tables result from DBRS Morningstar's amalgamation of 29 10-year intervals from January 1, 1985, through December 31, 2022. The first such interval extends from January 1, 1985, through December 31, 1994. DBRS Morningstar only includes issues in this interval if they were extant

on both dates. Similarly, DBRS Morningstar will only count a discontinued asset in a 10-year interval if the published date of the discontinued rating occurred in the final year of the interval.

The following tables summarize the one-, three-, and 10-year historical migration experience for DBRS Morningstar structured finance credit ratings based on notched rating categories.

Appendix 5: Defaults

In addition to 24 defaults in the 2008 calendar year, four defaults in 2009, four defaults in 2010, 27 defaults in 2011, 44 defaults in 2012, 27 defaults in 2013, 21 defaults in 2014, 20 defaults in 2015, seven defaults in 2016, 11 defaults in 2017, four defaults in 2018, 11 defaults in 2019, 48 defaults in 2020, and 35 defaults in 2021, there were 20 defaults in 2022. Specific defaults are provided in the table below.

Issuer	Country	Debt Name	Sector	Highest Rating	Rating at Beginning of Default Year	Default Year
Taurus CMBS (Pan-Europe) 2007-1 Limited	France	Commercial Mortgage Backed Floating Rate Notes, Class C	CMBS	A (sf)	CCC (sf)	2020
Taurus CMBS (Pan-Europe) 2007-1 Limited	France	Commercial Mortgage Backed Floating Rate Notes, Class D	CMBS	BBB (sf)	C (sf)	2020
GS Mortgage Securities Trust, 2010-C1	United States	Commercial Mortgage Pass-Through Certificates Series 2010-C1, Class E	CMBS	BBB (sf)	BBB (sf)	2020
GS Mortgage Securities Trust, 2010-C1	United States	Commercial Mortgage Pass-Through Certificates Series 2010-C1, Class F	CMBS	BB (sf)	BB (sf)	2020
Wells Fargo Mortgage Backed Securities 2004-Y Trust	United States	Mortgage Pass-Through Certificates, Series 2004-Y, Class B-1	RMBS	AA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2004-Y Trust	United States	Mortgage Pass-Through Certificates, Series 2004-Y, Class B-2	RMBS	A (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2004-Y Trust	United States	Mortgage Pass-Through Certificates, Series 2004-Y, Class B-3	RMBS	BBB (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2004-Y Trust	United States	Mortgage Pass-Through Certificates, Series 2004-Y, Class B-4	RMBS	BB (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2004-Y Trust	United States	Mortgage Pass-Through Certificates, Series 2004-Y, Class B-5	RMBS	B (sf)	C (sf)	2020
Revelstoke CDO I Limited	Cayman Islands	Class A-1 Senior Variable Rate Secured Notes due 2020	Structured Credit	AAA (sf)	CC (sf)	2020
Revelstoke CDO I Limited	Cayman Islands	Class A-2 Senior Variable Rate Secured Notes due 2026	Structured Credit	AAA (sf)	C (sf)	2020
Revelstoke CDO I Limited	Cayman Islands	Class A-3 Senior Variable Rate Secured Notes due 2033	Structured Credit	AAA (sf)	C (sf)	2020
Morgan Stanley Home Equity Loan Trust 2005-1	United States	Mortgage Pass-Through Certificates, Series 2005-1, Class M-6	RMBS	A (low) (sf)	C (sf)	2020
Morgan Stanley Home Equity Loan Trust 2005-1	United States	Mortgage Pass-Through Certificates, Series 2005-1, Class B-1	RMBS	BBB (high) (sf)	C (sf)	2020
Morgan Stanley Home Equity Loan Trust 2005-1	United States	Mortgage Pass-Through Certificates, Series 2005-1, Class B-2	RMBS	BBB (sf)	C (sf)	2020
Morgan Stanley Home Equity Loan Trust 2005-1	United States	Mortgage Pass-Through Certificates, Series 2005-1, Class B-3	RMBS	BBB (low) (sf)	C (sf)	2020
GE Commercial Mortgage Corporation, Series 2005-C1	United States	Commercial Mortgage Pass-Through Certificates, Series 2005-C1, Class D	CMBS	A (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2005-AR3 Trust	United States	Mortgage Pass-Through Certificates, Series 2005-AR3, Class B-2	RMBS	A (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2005-AR3 Trust	United States	Mortgage Pass-Through Certificates, Series 2005-AR3, Class B-3	RMBS	BBB (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2005-AR3 Trust	United States	Mortgage Pass-Through Certificates, Series 2005-AR3, Class B-4	RMBS	BB (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2005-AR3 Trust	United States	Mortgage Pass-Through Certificates, Series 2005-AR3, Class B-5	RMBS	B (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class I-A-1	RMBS	AAA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class II-A-2	RMBS	AAA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class II-A-4	RMBS	AAA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class II-A-5	RMBS	AAA (sf)	C (sf)	2020

Issuer	Country	Debt Name	Sector	Highest Rating	Rating at Beginning of Default Year	Default Year
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class II-A-6	RMBS	AAA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-1	RMBS	AA (high) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-2	RMBS	AA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-3	RMBS	AA (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-4	RMBS	AA (low) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-5	RMBS	A (high) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-6	RMBS	A (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-7	RMBS	A (low) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-8	RMBS	BBB (high) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-9	RMBS	BBB (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-10	RMBS	BB (high) (sf)	C (sf)	2020
Wells Fargo Mortgage Backed Securities 2006-AR2 Trust	United States	Mortgage Pass-Through Certificates, Series 2006-AR2, Class B-11	RMBS	B (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-1	RMBS	AA (high) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-2	RMBS	AA (high) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-3	RMBS	AA (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-4	RMBS	AA (low) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-5	RMBS	A (high) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-6	RMBS	A (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-7	RMBS	A (low) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-8	RMBS	BBB (high) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-9	RMBS	BBB (high) (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-10	RMBS	BBB (sf)	C (sf)	2020
ACE Securities Corp. Home Equity Loan Trust, Series 2006-HE2	United States	Asset-Backed Pass-Through Certificates, Series 2006-HE2, Class M-11	RMBS	BBB (low) (sf)	C (sf)	2020
GE Commercial Mortgage Corporation, Series 2007-C1	United States	Commercial Mortgage Pass-Through Certificates, Series 2007-C1, Class A-MFX	CMBS	BB (sf)	C (sf)	2021
GE Commercial Mortgage Corporation, Series 2007-C1	United States	Commercial Mortgage Pass-Through Certificates, Series 2007-C1, Class A-M	CMBS	BB (sf)	C (sf)	2021
Institutional Mortgage Securities Canada Inc., Series 2013-3	Canada	Commercial Mortgage Pass-Through Certificates Series 2013-3, Class G	CMBS	B (sf)	B (low) (sf)	2021
Ameriquest Mortgage Securities Inc., Series 2005-R2	United States	Asset-Backed Pass-Through Certificate, Series 2005-R2, Class M-7	RMBS	BBB (high) (sf)	C (sf)	2021
Ameriquest Mortgage Securities Inc., Series 2005-R2	United States	Asset-Backed Pass-Through Certificate, Series 2005-R2, Class M-9	RMBS	BBB (low) (sf)	C (sf)	2021
Ameriquest Mortgage Securities Inc., Series 2005-R2	United States	Asset-Backed Pass-Through Certificate, Series 2005-R2, Class M-10	RMBS	BB (high) (sf)	C (sf)	2021
Ameriquest Mortgage Securities Inc., Series 2005-R2	United States	Asset-Backed Pass-Through Certificate, Series 2005-R2, Class M-11	RMBS	BB (sf)	C (sf)	2021
Ameriquest Mortgage Securities Inc., Series 2005-R2	United States	Asset-Backed Pass-Through Certificate, Series 2005-R2, Class M-8	RMBS	BBB (sf)	C (sf)	2021
C-BASS 2005-CB2 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB2, Class B-4	RMBS	BB (high) (sf)	C (sf)	2021

Issuer	Country	Debt Name	Sector	Highest Rating	Rating at Beginning of Default Year	Default Year
C-BASS 2005-CB2 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB2, Class B-5	RMBS	BB (sf)	C (sf)	2021
C-BASS 2005-CB2 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB2, Class B-3	RMBS	BBB (low) (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-2	RMBS	BBB (high) (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-7	RMBS	BB (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-6	RMBS	BB (high) (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-5	RMBS	BB (high) (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-1	RMBS	A (low) (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-3	RMBS	BBB (sf)	C (sf)	2021
C-BASS 2005-CB4 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB4, Class B-4	RMBS	BBB (low) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class B-3	RMBS	BBB (high) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class B-2	RMBS	A (low) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class B-1	RMBS	A (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class M-5	RMBS	A (high) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class B-4	RMBS	BBB (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class B-5	RMBS	BBB (low) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class M-4	RMBS	AA (low) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class M-3	RMBS	AA (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class M-2	RMBS	AA (high) (sf)	C (sf)	2021
C-BASS 2005-CB6 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB6, Class M-6	RMBS	A (high) (sf)	C (sf)	2021
RESI Finance Limited Partnership 2005-C and RESI Finance DE Corporation 2005-C	United States	Real Estate Synthetic Investment Notes, Series 2005-C, Class B2 Risk Band	RMBS	AA (sf)	C (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-6 Notes	RMBS	A (low) (sf)	A (low) (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-5 Notes	RMBS	AA (sf)	A (low) (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-4 Notes	RMBS	AA (high) (sf)	A (low) (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-3 Notes	RMBS	AA (high) (sf)	A (low) (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-2 Notes	RMBS	AA (high) (sf)	A (low) (sf)	2021
LStreet II, LLC	United States	Series 2012-10 Class A-1 Notes	RMBS	AA (high) (sf)	A (low) (sf)	2021
Bear Stearns Commercial Mortgage Securities Trust, Series 2007-TOP26	United States	Commercial Mortgage Pass-Through Certificates, Series 2007-TOP26, Class C	CMBS	A (low) (sf)	C (sf)	2022
Bear Stearns Commercial Mortgage Securities Trust, Series 2007-TOP26	United States	Commercial Mortgage Pass-Through Certificates, Series 2007-TOP26, Class A-J	CMBS	AAA (sf)	C (sf)	2022
Bear Stearns Commercial Mortgage Securities Trust, Series 2007-TOP26	United States	Commercial Mortgage Pass-Through Certificates, Series 2007-TOP26, Class B	CMBS	AA (sf)	C (sf)	2022
GS Mortgage Securities Trust, Series 2012-GCJ7	United States	Commercial Mortgage Pass-Through Certificates, Series 2012-GCJ7, Class E	CMBS	BB (sf)	CCC (sf)	2022
GS Mortgage Securities Trust, Series 2012-GCJ7	United States	Commercial Mortgage Pass-Through Certificates, Series 2012-GCJ7, Class F	CMBS	B (sf)	C (sf)	2022
Single Borrower Morgan Stanley Capital I Trust 2015-XLF2	United States	Commercial Mortgage Pass-Through Certificates, Series 2015-XLF2, Class SNMD	CMBS	B (low) (sf)	C (sf)	2022
C-BASS 2005-CB1 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB1, Class B-5	RMBS	BB (sf)	C (sf)	2022
C-BASS 2005-CB1 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB1, Class B-3	RMBS	BBB (low) (sf)	C (sf)	2022
C-BASS 2005-CB1 Trust	United States	C-BASS Mortgage Loan Asset-Backed Certificates, Series 2005-CB1, Class B-4	RMBS	BB (high) (sf)	C (sf)	2022

Issuer	Country	Debt Name	Sector	Highest Rating	Rating at Beginning of Default Year	Default Year
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 4-A4	RMBS	B (sf)	C (sf)	2022
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 5-A4	RMBS	B (sf)	C (sf)	2022
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 1-A4	RMBS	B (sf)	C (sf)	2022
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 1-A4	RMBS	B (sf)	C (sf)	2022
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 6-A4	RMBS	B (sf)	C (sf)	2022
Jefferies Resecuritization Trust 2009-R4	United States	Resecuritization Trust Certificates 2009-R4, Class 2-A4	RMBS	B (sf)	C (sf)	2022
Merrill Lynch Mortgage Investors Trust, Series 2005-SL2	United States	Mortgage Loan Asset-Backed Certificates, Series 2005-SL2, Class B-5	RMBS	BBB (low) (sf)	C (sf)	2022
Merrill Lynch Mortgage Investors Trust, Series 2005-SL2	United States	Mortgage Loan Asset-Backed Certificates, Series 2005-SL2, Class B-2	RMBS	BBB (high) (sf)	C (sf)	2022
Merrill Lynch Mortgage Investors Trust, Series 2005-SL2	United States	Mortgage Loan Asset-Backed Certificates, Series 2005-SL2, Class B-1	RMBS	A (low) (sf)	C (sf)	2022
Merrill Lynch Mortgage Investors Trust, Series 2005-SL2	United States	Mortgage Loan Asset-Backed Certificates, Series 2005-SL2, Class B-3	RMBS	BBB (high) (sf)	C (sf)	2022
Merrill Lynch Mortgage Investors Trust, Series 2005-SL2	United States	Mortgage Loan Asset-Backed Certificates, Series 2005-SL2, Class B-4	RMBS	BBB (sf)	C (sf)	2022

Appendix 6: Formulaic Approach

Calculation of Aggregate Default Rate

To compute the cumulative default rates for a given rating and time horizon, DBRS Morningstar creates monthly cohorts of individual securities. A cohort is defined based on its rating grade and each calendar month for which the security is outstanding (e.g., AAA-rated securities in the beginning of January 2013). Default rates are measured over the cohort's life in the following manner. DBRS Morningstar divides the cohort's subsequent life into month-long periods, and for each of these, the default rate is calculated based on the number of securities that defaulted in that month divided by the number of securities that were outstanding at the beginning of that month and either remained outstanding or defaulted in the meantime. The cohort-level default rates are then aggregated by taking the weighted average of the cohorts based on the number of securities. Finally, the cumulative default rates for a given time horizon are obtained by chaining together the monthly survival rates (i.e., one minus the monthly default rates) within the time horizon, so that the survival rate for the time horizon equals the product of the monthly survival rates within the time horizon.

Importantly, this approach to calculate monthly default rates does not include ratings that were withdrawn from a nondefault state during the month. Also, securities are only included if a rating is observed during the whole period—no censored observations are taken into account. In turn, the fine-grained monthly nature of the calculation ensures that the maximum amount of information is used for each horizon while excluding censored cohorts. In this manner, DBRS Morningstar includes in the calculation of first-year default rates of the 10-year cumulative default rate information on those securities which only appeared in the last observed year and thus would have been censored for the full 10-year calculation.

In formulae, let $R(d, t, s)$ be the rating of debt d from cohort t in the period when s periods elapsed since the cohort's start. With this notation, and also using D and $Disc$ as the default and the discontinued states, respectively, a monthly default frequency can be defined as the frequency with which a debt defaults in period s when it started in rating grade r_0 in period t , that is:⁴

$$\frac{\sum_d \chi_{\{R(d,t,s)=D \cap R(d,t,s) \neq Disc \cap R(d,t,s-1) \neq D \cap R(d,t,s-1) \neq Disc \mid R(d,t,0)=r_0\}}}{\sum_d \chi_{\{R(d,t,s-1) \neq D \cap R(d,t,s) \neq Disc \cap R(d,t,s-1) \neq Disc \mid R(d,t,0)=r_0\}}}$$

⁴ In this formula, χ denotes the indicator function, which equals one if its event happens and zero otherwise. Thus, the formula only describes the counting of events in both the numerator and the denominator.

Note that from the nondefaulted securities $R(d, t, s - 1) \neq D$ at the end of period $s - 1$ those are also discarded that are discontinued in period s . For the weighted-average monthly default rate (MDR) by cohort, both the numerator and the denominator can be summed over t (i.e., over the different cohorts):

$$MDR_{r_0, s} = \frac{\sum_t \sum_d \chi_{\{R(d, t, s) = D \cap R(d, t, s-1) \neq D \cap R(d, t, s) \neq Disc \cap R(d, t, s-1) \neq Disc \mid R(d, t, 0) = r_0\}}}{\sum_t \sum_d \chi_{\{R(d, t, s-1) \neq D \cap R(d, t, s) \neq Disc \cap R(d, t, s-1) \neq Disc \mid R(d, t, 0) = r_0\}}}$$

The resulting expression depends on r_0 and s (i.e., the initial rating grade of the cohort and the elapsed months since the start of the cohort).

The resulting monthly default rates can then be cumulated to the aggregate default rate (ADR) with the following formula:

$$ADR_{r_0, t} = 1 - \prod_{s=1}^t 1 - MDR_{r_0, s}$$

Let us also provide a numerical example that may shed more light on the workings of the approach. Let us have a cohort of B-rated debts outstanding in the beginning of January 2013 and let us assume—for simplicity—that the 100 debts in it are only observed at most for three months. Assume that the behavior of their ratings is described by the following table.

	January 2013	February 2013	March 2013
Outstanding at the start of the month	100	90	65
Defaulted during the month	5	5	5
Discontinued during the month	5	20	20

As those debts' ratings that are discontinued during the month are not taken into account, the monthly default rates in this example are the following: $\frac{5}{100-5} = 5.26\%$ for January, $\frac{5}{90-20} = 7.14\%$ for February, and $\frac{5}{65-20} = 11.11\%$ for March. This results in a three-month ADR of:

$$1 - (1 - 0.0526) \times (1 - 0.0714) \times (1 - 0.1111) = 21.80\%$$

Calculation of CDR

For the purposes of computing the CDR, a cohort is defined as the class of all rated issues with initial rating dates before a date certain. Thus, the January 2023 cohort would contain all issues within structured finance that DBRS Morningstar rated prior to January 1, 2023. Cohorts can be referred to by name, the earliest of which is November 1985, or by number (e.g., Cohort 1). The final cohort included in this study is Cohort 447, the January 2023 cohort, which contains the entire history of structured finance rated issues through and including December 2022.

Let T denote the time from the earliest rating until January 1, 2023.

Let k denote Cohort 447, the maximum cohort.

Every cohort contains all months prior to the cohort month. Let m refer to a reference month within a given cohort.

$$\{m | m \in \mathbb{N}, m < K\}$$

Let $C(R, m, k)$ denote the number of issues with a rating (R) at the beginning of month (m) within cohort k .

Let $D(R, m, k, T)$ denote the number of issues with a rating (R) at the beginning of month (m) within cohort k that were defaulters within time (T).

The $CDR(R, T)$ for rating (R) and (T) years is

$$CDR(R, T) = \sum_{k=1}^K \sum_m^{k-1} \frac{D(R, m, k, T)}{C(R, m, k)}$$

The overall $CDR(T)$ is

$$CDR(T) = \sum_R \sum_k^K \sum_m^{k-1} \frac{D(R, m, k, T)}{C(R, m, k)}$$

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