MOODY'S INVESTORS SERVICE

SECTOR IN-DEPTH

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Default Research

Default and recovery rates for project finance bank loans, 1983-2017

This study examines the default and recovery performance of unrated project finance bank loans. The study data set is 17.1% larger than in our previous March 2018 study and accounts for 69.4% of all project finance transactions originated globally during a 35-year period from 1 January 1983 to 31 December 2017. Our findings, which are based on a data set from a consortium of leading project finance lenders and investors, are consistent with last year's report.

» **The 10-year cumulative default rate (CDR) was 5.6% (Basel), the lowest level since inception of the study in 2010 and down from 6.4% reported in last year's study.** As a comparison, corresponding CDRs for Baa3-rated and Ba1-rated corporates are 5.1% and 9.9%, respectively. Lower 10-year CDRs were observed across regions and industry sectors.

» **Marginal annual default rates improve as loans season.** Marginal annual default rates remain consistent with marginal default rates of high speculative-grade credits in the first three years. However, they trend toward marginal default rates that are consistent with single-A category corporate ratings by year seven from cohort formation.

» **Ultimate recovery rates for project finance bank loans average 77.5% (Basel), slightly lower than the 79.3% recorded in the March 2018 study.** However, the most likely ultimate recovery rate is 100% — in other words, no economic loss — which is the outcome in 58% of cases. Average ultimate recovery rates realized through work-outs exceed ultimate recovery rates achieved through distressed sale exits.

» **Credit Performance in Emerging Markets and Developing Economies (EMDEs) has been resilient.** The 10-year CDRs for our EMDE subsets are in the 7.8%-8.6% (Basel) range and average ultimate recovery rates are close to the study average of 77.5% (Basel). Jurisdiction tends to be a less critical driver of default risk once a project has started to build an operating record. The average time to emerge from default is, however, shorter for projects in more advanced economies and OECD countries.

» **Infrastructure projects and public-private partnership (PPP) projects have a lower 10-year CDR (Basel) than in the March 2018 study.** The 10-year CDR for PPP projects declined to 3.8% from 4.3% cited in the previous study. It fell for all infrastructure projects to 4.1% from 4.7% because the incremental default count was well below the incremental count of projects added to this year's study data set. However, the average ultimate recovery rate (Basel) for PPP projects declined to 79.3% from 85.5% driven by lower recoveries for the additional defaults in the transportation sector.

1. Update to this year's study

The study updates and expands the scope of research that we have previously published on the historical default and recovery performance of unrated project finance bank loans, most recently in March 2018. The data presented in this study is sourced from the Moody's Analytics Data Alliance Project Finance Data Consortium (the Data Consortium). All analytics and statistics are compiled by Moody's Analytics on behalf of Moody's Investors Service; all market and industry commentary has been prepared by Moody's Investors Service. For further information see "About the Moody's Analytics Data Alliance" on page 78 of this report. We wish to acknowledge and thank each of the financial institutions in the Data Consortium for supporting and contributing to the study.

Our findings from the current study are broadly consistent with the March 2018 study. New or updated information about historical defaults will result in minor revisions of the historical data. As always, the data contained in the most recently published Moody's default study supersedes the data published in the previous report.

The study data set now comprises 8,257 projects, which represent 69.4% of all project finance transactions originated globally during a 35-year period from 1 January 1983 to 31 December 2017. The study data set continues to be substantially representative of industrywide project finance activity by year of origination, by industry sector and by regional concentration.

The study uses the Basel III[1] definition of default (Basel).[2] Based on this definition, the study data set includes 570 projects for which at least one senior secured project finance bank loan has defaulted. Of these 570 defaulted projects, 280 have subsequently emerged from default.[3] The study also applies Moody's definition of default (Moody's), according to which the study data set contains 426 defaults, of which 244 have subsequently emerged from default. We discuss the differences between these default definitions in Section 4.2.

This year's study includes again a summary of key findings for a curtailed time horizon, from 1 January 1995 to 31 December 2017, and a comparison of the credit performance of certain subsets of projects located in advanced economies with certain projects located in emerging market and developing economies (EMDEs[4]).

We analyze two EMDE regional subsets, (1) EMDE-A, which is based on the World Bank Group's (WBG) average income level country classifications 1995-2017, and (2) EMDE-B, which is comprised of EMDE-A countries, but excluding those countries in the European Economic Area (EEA) and member countries of the Organisation for Economic Co-operation and Development (OECD).

The countries that we consider in our EMDE-A and EMDE-B subsets differ from those in our March 2018 study, because in this study we classify countries by income level averaged over the period 1995-2017, rather than by income level for 2017. As a result, certain findings for EMDE subsets differ from those published in our March 2018 study. This revised classification of countries by income level was already applied in our September 2018 addendum.

1 See "Basel III: Finalising post-crisis reforms" published by the Basel Committee on Banking Supervision (the "Basel III Framework", or "Basel III"). The Basel III definition of default is unchanged from that included in the Basel II Framework.

2 We reproduce the Basel III definition of default in Appendix B (Glossary).

3 Emergence criteria are described more fully in Section 4.3 (Recovery Analysis).

4 Please see also our September 2018 report; "Default and recovery rates for project finance bank loans, 1983-2016: Advanced economies vs emerging markets". A definition of countries included in each subset can be found in the Appendix B (Glossary).

Terminology: In certain instances we use suffix notation to clarify whether information is presented based on the Basel III definition of default (Basel or Basel III) or Moody's definition of default (Moody's).

As part of the study, we derived historical default rates for project finance bank loans and compared these against historical default rates for corporate bond and loan issuers that we rate. We also compare the recovery behavior of project finance bank loans to the recovery behavior of a data set comprising corporate bank loans (predominantly senior secured debt facilities) derived from Moody's Ultimate Recovery Database.[5]

We have received extensive feedback in response to our previous research and continuously seek to expand and update the study data set. While the study reports on the historical performance of unrated project finance bank loans, we also highlight our data report "Infrastructure Default and Recovery Rates, 1983-2017", which reports on the historical performance of long-term infrastructure debt that we rate (see Appendix E).

Caveats

In this study, we report on a number of different aspects of historical project finance default and recovery rates — for example, segmented analysis of default and recovery rates by industry and region. Necessarily, such segmented analysis is likely to lead to small sample sizes that lack the statistical robustness of larger sample sizes.

- Results based on small sample sizes should be treated with caution.
- Many projects have yet to emerge from default, which will affect ultimate recovery rates when corresponding recovery data is available.
- The inclusion of additional data will lead to different results in future studies and it is possible that such differences may be material.

2. Summary of key findings

We highlight below our key findings based on the study data set. The study data set is 17.1% larger than that considered in the March 2018 study, containing 1,205 additional projects and 60 more defaults (Basel). Fifty of the additional 60 Basel defaults occurred in the period 2008-17, of which eight occurred in 2017. The findings of the study continue to suggest that the risk allocation, structural features, underwriting disciplines and incentive structures that characterize the project finance asset class have proven effective.

Key findings for the study data set as a whole:

- Cumulative annual default rates (CDRs):
  - The 10-year CDR for the study data set as a whole is 5.6% (Basel), slightly lower than the 6.4% (Basel) reported in the March 2018 study (see Exhibit 13). Lower 10-year CDRs were observed across regions and industry sectors.
  - As a comparison, corresponding CDRs for Baa3-rated and Ba1-rated corporates are 5.1% and 9.9%, respectively, for the period 1983-2017[6]. Ten-year CDRs for Baa3-rated and Ba1-rated corporates also declined modestly compared to the previous study period 1983-2016.

[5] Moody's proprietary database, which contains information on nearly 5,600 defaulted loans and bonds taken from more than 1,100 non-financial US corporations that initially defaulted between 1987 and 2017.

[6] Please see Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018, Exhibit 35.

» Marginal annual default rates:

- Marginal annual default rates for project finance bank loans show certain characteristics that distinguish them from corporate issuers. Marginal default rates fall over time and trend toward marginal default rates consistent with the single-A rating category by year seven from cohort formation. They are consistent with high speculative-grade credit quality during an initial three-year period. In comparison, marginal default rates for corporate issuers show greater stability over time (see Exhibit 15).
- The decline in marginal annual default rates with the passage of time suggests that on average, the default risk of a project declines as construction is completed and the project starts to build its operating track record.

» Ultimate recovery rates:

- Ultimate recovery rates for project finance bank loans are similar to ultimate recovery rates for senior secured corporate bank loans.
- Ultimate recovery rates for project finance bank loans averaged 77.5% (Basel) and 76.2% (Moody's), consistent with last year's study findings. The most likely ultimate recovery rate remains 100% (Basel and Moody's) — in other words, no economic loss — which is seen in 57.9% of cases (see Exhibit 35).
- Ultimate recovery rates realized through a work-out process of 77.5% (Basel) and 76.2% (Moody's), substantially exceed average recovery rates achieved through distressed sale exits of 49.4% (Basel) and 47.5% (Moody's) (see Exhibit 35).
- Average ultimate recovery rates (Basel) for project finance bank loans emerging from default during 1999-2017 (excluding 2013) were in the range of 66.1%-100%. In 2013, the average ultimate recovery rate was exceptionally low at 43.2%. Between 1999-2017, average ultimate recovery rates show substantial independence from the incidence of defaults and from the incidence of projects emerging from default (see Exhibit 37).
- Ultimate recovery rates for construction phase defaults averaged 69.8% (Basel and Moody's), lower than ultimate recovery rates for operation phase defaults, which averaged 78.9% (Basel) and 77.4% (Moody's) (see Exhibit 42).

» Findings by region:

- The three most significant regions are North America, Western Europe and Latin America, accounting for 77.7% of total defaults (Basel) (see Exhibit 9). By a small margin, Latin America became the third largest region ahead of Asia as more default counts were added in Latin America to this year's study data set.
- CDRs and simple average annual default rates[7] show a variation by region:
  - Analysis of CDRs (Basel) by various regional subsets suggests that CDRs tend to vary by project jurisdiction, with CDRs close to the study average in OECD countries, EEA countries, and EEA/OECD countries. In line with the study average, 10-year CDRs declined slightly across all country classifications compared to the previous study, but in particular in the non-OECD subset.

[7] A simple average default rate is the count of defaults divided by the count of projects.

» Ten-year CDRs (Basel) are highest in EMDE-B countries (8.6%) followed by EMDE-A countries (7.8%) and EEA/OECD countries (5.4%). Projects located in EEA countries have the lowest 10-year CDR of 4.9%. Classification by OECD (5.4%) and non-OECD (6.6%) countries shows limited variation in default rates (see Exhibit 22). Please see Appendix B (Glossary) for a definition of the various regional subsets mentioned above.

» The study data set reveals no clear indication that project jurisdiction has a material impact on project finance bank loan recovery rates. Average ultimate recovery rates show a limited degree of variation across OECD/non-OECD and advanced economy/EMDE regional subsets.

» Findings by industry sector:

- The three most significant industry sectors are power, infrastructure, and oil & gas, accounting for 76.3% of total defaults (Basel) (see Exhibit 10).

- **Infrastructure:** The infrastructure industry sector is largely comprised of transportation and social infrastructure projects (see Appendix M). The infrastructure industry sector experienced significant stress in 2009-15. The study data set includes 99 defaults (Basel) in 2009-15, which represents 74.4% of the total 133 infrastructure defaults (Basel) during the study period. The data set only includes two infrastructure defaults in 2016 and three infrastructure defaults in 2017, which could be a sign that infrastructure defaults have started to level off from the annual average of 14 defaults in 2009-15 but may also reflect a lag in reporting of default counts.

  The 10-year CDR (Basel) for the infrastructure industry sector is 4.1%, better than the study average of 5.6% and the 4.7% infrastructure industry sector rate reported in the March 2018 study. The 10-year CDR (Basel) for the sector declined from the March 2018 study as 371 additional infrastructure projects were added to the data set but only 16 infrastructure defaults.

- **Power:** Around 40% of the 570 defaults (Basel) included in the study are observed in the power sector. The power sector experienced significant stress during 2001-04, representing 39.5% (90 defaults) of all 228 power sector defaults (Basel) in the study data set. In addition, the power sector experienced a spike in default counts in 2014 (31 Basel defaults) and in 2016 (19 Basel defaults). The spike in 2014 related mostly to defaults in the Spanish renewable sector following changes to regulations for the promotion of renewable electricity in Spain in 2013.

  The 10-year CDR (Basel) for the power sector decreased slightly to 5.9% compared with 6.5% reported last year, as the incremental project count exceeded the count of incremental defaults.

- **Oil & gas:** The 10-year CDR (Basel) for the oil & gas industry sector improved slightly to 5.7%, from 6.1%. The sector experienced stress during the period 2008-10 and during 2014-15. The study data set includes 74 defaults (Basel) in the oil & gas sector of which 32.4% occurred in 2008-10 and 20.3% in 2014-15.

- **Average ultimate recovery rates differ between industries.** The data shows a divergence of average ultimate recovery rates between industry sectors, within a range of 60%-100% (see Exhibit 41).

» Findings for PPP projects:

- The study data set contains 1,970 projects classified as PPP projects, a discrete subsector that remains at the low risk end of the project finance spectrum. This represents a 19.4% increase in the project count compared with the March 2018 study.

- The 10-year CDR (Basel) is 3.8% (see Exhibit H4), a decrease from the 4.3% rate reported in the March 2018 study. The 10-year CDR remains lower than for the infrastructure industry sector of 4.1% and lower than the 10-year CDR (Basel) for the total study data set of 5.6%.

- Marginal annual default rates (Basel) are borderline investment-grade, falling between the Baa and Ba rating category, for the initial years post cohort formation. They decline thereafter to marginal annual default rates consistent with those of corporate debt issuers in the Baa rating category by year six from cohort information and trend towards the single-A category after year seven from cohort information (see Exhibit H8).
  - The average ultimate recovery rates decreased to 79.3% (Basel) and 74.7% (Moody's) (see Exhibit H1) from 85.5% (Basel) and 81.8% (Moody's) as we added an additional 11 (Basel) and nine (Moody's) PPP recoveries to this year's data set. The observed decline in average ultimate recovery rates was driven largely by lower recoveries for additional defaults in the transportation sector.
- The average ultimate recovery rates for PPPs are now more consistent with the average ultimate recovery rates of 77.5% (Basel) and 76.2% (Moody's) observed for the study data set as a whole.
- There is some subjectivity in the classification of projects as PPP projects, and the number of defaults — 96 (Basel) and 53 (Moody's)) — remains relatively small. Nearly all defaulted PPP projects are included in the infrastructure sector.

» Findings for curtailed time horizon 1995-2017:

- Curtailing the time horizon to 1995-2017 from 1983-2017 results in modestly lower default rates for the total study data set (10-year CDR (Basel) of 5.2%) and across all regional subsets, which compares with 5.6% (Basel) for the total study period of 1983-2017 (see Exhibit 55).
- Recovery rates show limited variation, with an average ultimate recovery rate of 76.7% (Basel) for 1995-2017, which compares with 77.5% (Basel) for the total study period 1983-2017.

3. Overview of the project finance industry

Project and infrastructure financings encompass a broad range of asset types and are often used to fund the development of capital-intensive assets such as energy, natural resources, social infrastructure, economic infrastructure (for example, airports and bridges) and the provision of associated public services. Infrastructure assets and services tend to benefit from robust or inelastic demand, which supports the stability and predictability of long-term revenues.

Exhibit 1 shows the population of all project finance transactions originated from 1 January 1983 – 31 December 2017, based on industry data provided by Refinitiv Project Finance International (the Industry Data Set). Total debt raised for global project finance transactions reached $233 billion in 2017, a 13.1% decline from 2016 levels and following a 3.9% decline in 2016 from 2015 levels. The number of projects originated in 2017 declined slightly to 805 from 812 in 2016, but remains at a high level.

EXHIBIT 1

Profile of the industry data set by origination year

Year	Debt Raised ($ billions)	Number of projects
1983	3.7	28
1984	2.2	23
1985	1.3	10
1986	2.5	11
1987	11.0	16
1988	1.1	8
1989	0.6	5
1990	8.6	23
1991	8.5	31
1992	15.4	70
1993	26.2	118
1994	29.0	118
1995	23.3	156
1996	42.8	192
1997	67.4	281
1998	56.7	239
1999	72.4	239
2000	110.9	450
2001	108.5	314
2002	62.2	298
2003	69.6	323
2004	117.8	471
2005	136.3	512
2006	183.8	552
2007	228.3	644
2008	251.2	714
2009	140.2	475
2010	213.9	620
2011	221.1	641
2012	206.3	581
2013	204.9	596
2014	261.9	721
2015	278.8	800
2016	267.8	812
2017	232.7	805
Industry Total	**3,668.7**	**11,897**

Note: For consistency with the study data set, the industry data set from Refinitiv Project Finance International references projects reaching financial close in the period 1 January 1983 - 31 December 2017.

Sources: Refinitiv Project Finance International

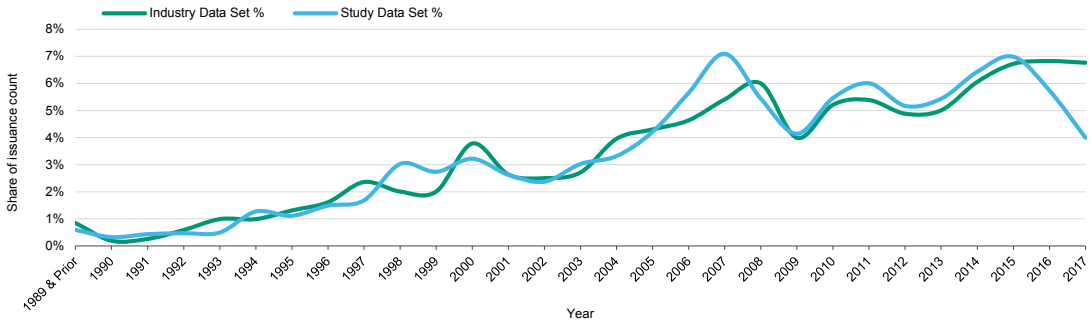
The study data set accounts for approximately 69.4% of the larger Refinitiv Project Finance International industry data set from 1983-2017. Correlations between the two data sets are very high: Correlation by year of origination is 93.3%, correlation by region is 88.4% and correlation by industry sector is 98.7%. We conclude that the study data set is substantially representative of industrywide project finance activity by year of origination, industry sector and regional concentration.

Differences in concentrations by year, region and industry are the result of the different client relationships, loan origination strategy, and geographic and industry focus of each participant in the Data Consortium. They also reflect potential differences in the classification of individual projects by year of origination, industry and region. For example, lenders providing information for the same project may not always be consistent in their classification of industry and region. Moreover, consortium participants that bought loan participations after financial close may have reported different origination dates from the date on which financial close occurred. Where possible, we have verified and corrected inconsistencies between data submitted by multiple lenders for the same project. However, we have not been able to cross-check data where that data was only submitted by a single lender.

Exhibit 2 compares the study data set and the Refinitiv Project Finance International industry data set by year of project origination.

EXHIBIT 2

Comparison of study data set and industry data set by year of project origination



Source: Data Alliance Project Finance Data Consortium, Refinitiv Project Finance International

The correlation between the two data sets by year of origination is 93.3%. As discussed further in Sections 5.1 and 5.2, similar high correlations also exist between the regional concentrations and the industry concentrations of the two data sets.

Based on previous studies we have observed that for the study data set the share of projects originated in the most recent calendar year has been understated due to delays in data submission. We expect that the share of projects originated in 2017 will rise when we next update our annual study.

3.1 Characteristics of project finance

Project finance refers to the financing of long-term infrastructure, industrial or public assets and services using limited-recourse long-term debt raised by an enterprise operating in a focused line of business in accordance with contractual agreements. Project financings are based on the notion that risks in the transaction are identified upfront, allocated to transaction parties best able to manage those risks and mitigated such that residual risks are acceptable to funders.

A typical project finance structure has many elements, including the use of a special or single-purpose entity or project company to raise non-recourse debt which is serviced and repaid from the net cash flows generated by the project. The scope of the project, its financing arrangements and the security interests

granted to secured debt providers are set out in comprehensive contractual arrangements entered into by the project company. These contractual arrangements limit the project's activities so that lenders can assess the project's initial construction and long-term business and operating risks. This assessment is fundamental to each project financing, given that they typically have higher debt levels compared with other non-financial corporates.

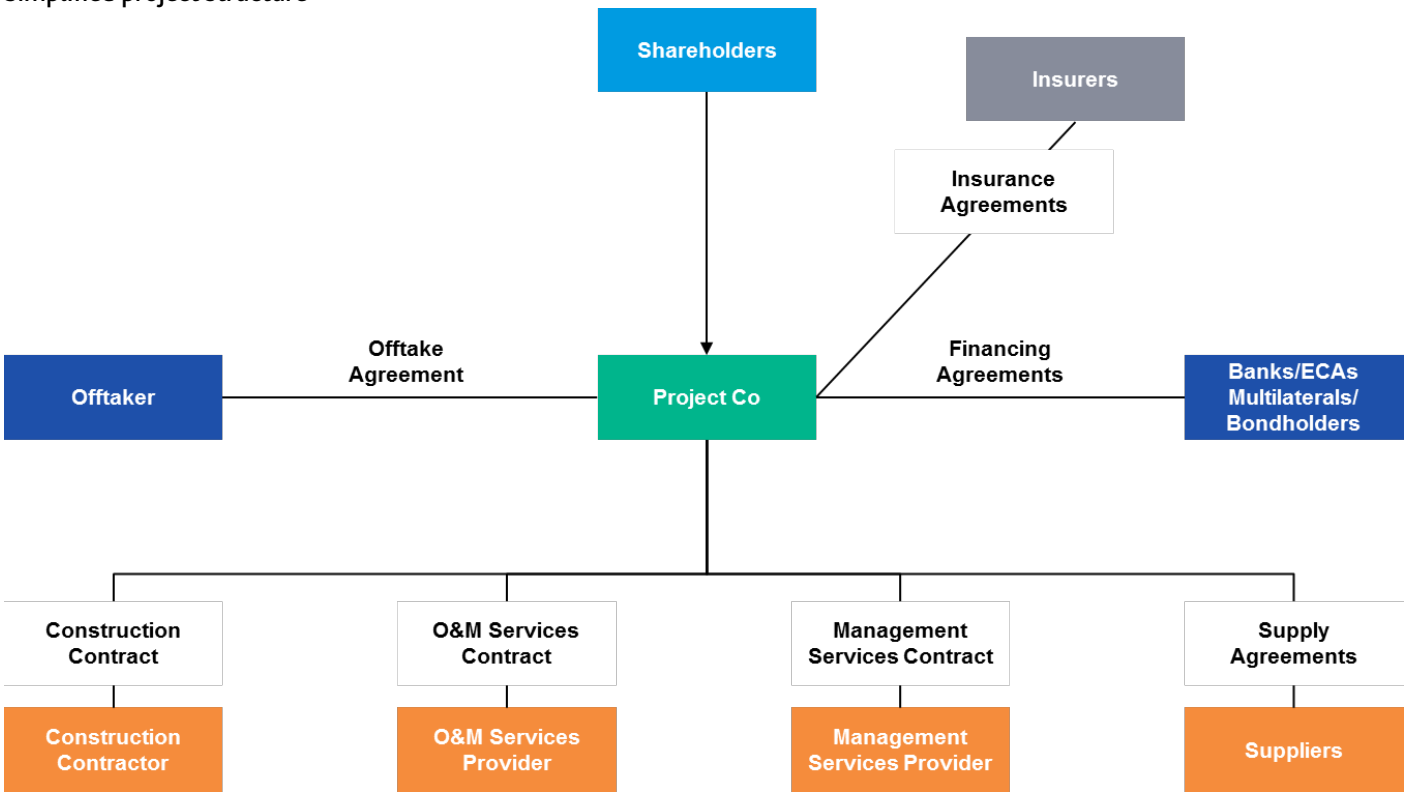
Project finance transactions with lower credit risk tend to benefit from long-term contracts providing predictable revenues from creditworthy counterparties and limited competition. At the other end of the spectrum are projects that have a weak economic or competitive position, face uncertain net cash flows given exposure to market risk, may use complex technologies and/or may have weak counterparties.

Project finance structural features typically include financial covenants that place controls on the project's operations such as: limitations on permitted business activities, limitations on additional debt issuance, limitations on shareholder distributions, obligations to maintain certain reserves, limitations on asset sales or purchases, and limitations over changes in control, etc. Project finance senior debt facilities are typically structured to be robust against potentially severe risks, including significant macroeconomic and performance stresses.

The study data set comprises project finance bank loans which fall within the Basel definition of Project Finance. For reference, we reproduce the Basel definition of Project Finance in Appendix B (Glossary). Exhibit 3 shows a simplified project structure. The contracts between the project company (Project Co) and parties such as the offtaker,[8] construction contractor, feedstock supplier, fuel supplier and other parties are structured to mitigate the risks retained by the project company itself.

[8] The recipient of the end product of the project.

EXHIBIT 3
Simplified project structure



Note: ECA is the abbreviation for Export Credit Agencies.
Source: Moody's Investors Service

We comment further in Appendix C (Overview of Project Finance Characteristics) on the typical features found in project finance transactions that mitigate default risk and loss given default.

4. Data and methodology

4.1 Study Data Set

The data presented in this study is sourced from the Data Consortium which is managed by Moody's Analytics. All analytics and statistics are compiled by Moody's Analytics on behalf of Moody's Investors Service; all market and industry commentary has been prepared by Moody's Investors Service. For further information see the "About the Moody's Analytics Data Alliance" on page 78 of this report.

The study data set comprises 8,257 distinct projects originated between 1 January 1983 and 31 December 2017.

4.2 Default analysis

The calculation of default rates is dependent on the definition of default adopted. At the request of the Data Consortium, the study analyzes the historical behavior of project finance bank loans using the Basel definition of default. While not directly comparable, we have included for reference in certain exhibits marginal annual default rates and cumulative default rates experienced by corporate bond, loan and deposit issuers that we rate based on our definition of default. We reproduce the Basel definition of default as well as our definition of default in Appendix E (Comments of certain aspects of Moody's research) and Appendix B (Glossary).

The Basel definition of default captures a wider range of defaults, including circumstances in which the reporting bank considers that the obligor is unlikely to pay its credit obligations in full. For example, under the Basel definition, defaulted credits would also include debt obligations where (1) the bank puts the credit obligation on non-accrued status; or (2) the bank makes a charge-off or account-specific provision resulting from a significant perceived decline in credit quality subsequent to the bank taking on the exposure.

While the default of a single project finance debt facility occurs at the instrument level, we present default rate analysis in this study on the basis of the number of projects for which at least one senior secured project finance bank loan has defaulted.[9] References in the study to a "project default" should be construed accordingly.

The Basel default date was used under the Basel definition of default, whereas the actual payment default date was used under our definition of default. In some cases the Basel default date was the same as the payment default date or bankruptcy date.

Based on the Basel definition of default, the study data set contains 570 distinct projects that defaulted (each a default (Basel)), comprising:

- 235 defaults (Basel) still in the work-out process (each a default in work-out (Basel))
- 55 defaults (Basel) for which recoveries have been realized following a distressed sale of the relevant defaulted loan participation (each a distressed sale (Basel))
- 280 defaults (Basel) for which recoveries have been realized following emergence from default [10] (each an ultimate recovery (Basel))

The default rates in the study are calculated based on the entire population of 570 defaults (Basel), whereas the calculation of ultimate recovery rates are based on the population of 280 ultimate recoveries (Basel).

The 235 defaults in work-out (Basel) are not included in the recovery analysis in the study. However, as defaulted credits are resolved either through distressed sale exits or through emergence from default, we anticipate that additional information will be made available to us for inclusion in an expanded and updated data set.

Based on our definition of default, the study data set contains 426 distinct projects that defaulted (each a default (Moody's)), comprising:

- 140 defaults (Moody's) still in the work-out process (each a default in work-out (Moody's))
- 42 defaults (Moody's) for which recoveries have been realized following a distressed sale of the relevant defaulted loan participation (each a distressed sale (Moody's))
- 244 defaults (Moody's) for which recoveries have been realized following emergence from default (each an ultimate recovery (Moody's))

The 140 defaults in work-out (Moody's) are not included in the recovery analysis in the study.

[9] This avoids the potential distortion arising from the calculation of facility-weighted default rates, where the number of facilities per project is arbitrary. Furthermore, while a default would necessarily occur at the instrument level, under typical project finance intercreditor arrangements it is likely that the instrument level default (if not remedied or waived) would lead to a cross-default of the other pari passu senior secured project finance debt facilities raised by that project borrower.

[10] Emergence criteria are described more fully in Section 4.3 (Recovery Analysis).

4.3 Recovery analysis

The calculation of recovery rates is dependent on the definition of emergence from default adopted. The study uses the definition of emergence from default set out below.

For the reasons set out in Section 4.3.1 below, recovery analysis is based on the assumption that all pari passu senior secured debt facilities for a single project would share the same average recovery rate. However, in validating this assumption we have evaluated recoveries on a facility level.

Emergence from default:

For a loan that has defaulted, emergence from default is deemed to occur following any of the events set out below:

- Repayment of overdue interest
- Restructuring with no subsequent default
- Restructuring with the lender being taken out of the deal — for example, by repayment of the defaulted loan with no participation in a restructured debt facility
- Material restructuring
- Liquidation

Ultimate recovery values are determined for each loan that has emerged from default based on the emergence criteria listed above, calculated as of the last date on which cash was paid prior to default.

Cash flows arising post default are discounted to the last date on which cash was paid prior to default at the pre-petition interest rate implicit in the loan at the time of its default. These post default cash flows could include interest payments, principal repayments, other cash payments or receipts[11] or asset-value recoveries, excluding recoveries under any political risk insurance arrangements or any guaranty arrangements.

Ultimate recovery values exclude any recoveries under political risk insurance arrangements and the number of defaults of facilities backed or insured by Export Credit Agencies (ECA) is very small and not statistically significant.

In some instances, for example for a loan that has emerged from default following the repayment of overdue interest, it is possible for a separate default to occur subsequent to emergence from the initial default. In such instances of serial default, only a single default is deemed to have occurred for which the ultimate recovery value is determined with reference to the initial default. The ultimate recovery rate for a loan that has emerged from default is determined by dividing the ultimate recovery value by the principal outstanding at the date of default.

The definition of emergence from default set out above specifically excludes exits that individual lenders may have executed via the distressed sale of relevant loan participations. Although distressed sales are a common exit route for lenders seeking early resolution of defaulted credits, the timing and value of such exits may differ significantly between lenders exiting from the same defaulted loan, and do not necessarily predict the loan's ultimate recovery value. The recovery value for a distressed sale (in other words, a distressed sale exit) is determined in a similar manner to that described above, including the disposal proceeds within post default cash flows. The recovery rate for a distressed sale is determined by dividing the recovery value by the principal outstanding at the date of default.

[11] For example, other cash payments would include legal fees; other cash receipts would include default interest.

4.3.1 Facility level recovery analysis

Recovery analysis for the study is based on the assumption that all senior secured project finance debt facilities for a single defaulted project would share the same ultimate recovery rate — and the study data set has been conformed accordingly (see Section 4.4 below). However, Basel requires that recovery analysis is undertaken for each defaulted facility.[12] We have therefore undertaken a facility level recovery analysis as part of the study.

Exhibit 4 shows that for the study data set, there is minimal difference between (1) the average ultimate recovery rate calculated on a project level basis; and (2) the average ultimate recovery rate calculated on a facility level basis. In the study, therefore, we do not distinguish between project level and facility level ultimate recoveries nor project level and facility level distressed sales, other than in this Section 4.3.1.

The number of defaults of facilities backed or insured by Export Credit Agencies (ECA) is de minimis and is not statistically significant.

EXHIBIT 4

Comparison of average recovery rates – project level vs. facility level ultimate recoveries and distressed sales

	Basel Definition of Default				Moody's Definition of Default			
	Ultimate Recoveries		Distressed Sales		Ultimate Recoveries		Distressed Sales	
	Project Level Recovery Analysis	Facility Level Recovery Analysis	Project Level Recovery Analysis	Facility Level Recovery Analysis	Project Level Recovery Analysis	Facility Level Recovery Analysis	Project Level Recovery Analysis	Facility Level Recovery Analysis
Number of Recoveries	280	538	55	82	244	472	42	74
Average Recovery Rate	77.5%	79.6%	49.4%	59.1%	76.2%	78.0%	47.5%	57.0%

Source: Data Alliance Project Finance Data Consortium

4.4 Data cleansing

Each lender provided standardized information for each defaulted project loan, including key dates such as origination date, maturity date, default date, date of emergence (if appropriate) or date of exit via distressed sale (if appropriate). Additional information included the project's host country, industry sector, tranche name, seniority, collateral, origination amount and post-default cash flows.

Lenders also provided a detailed narrative to accompany their data submission for each default — including a description of the project, details of the default and its cause, and an explanation of the recovery process and outcome. This narrative was used to validate the data and as a basis to reconfirm the recovery values.

Project-specific data from each lender were cross-checked based on the project's name, industry, region and key dates. Where inconsistencies were identified, lenders were asked to reconfirm their data to ensure its accuracy and consistency. Where available, external sources of information were also used to validate project data.

Where a single defaulted project was reported both as a distressed sale (Basel) and as an ultimate recovery (Basel) by different lenders, we categorized the default (Basel) as an ultimate recovery (Basel).

[12] See paragraph 199 of the Basel III Framework:

"199. Banks using the advanced IRB approach must also collect and store a complete history of data on the LGD and EAD estimates associated with each facility and the key data used to derive the estimate and the person/model responsible. Banks must also collect data on the estimated and realised LGDs and EADs associated with each defaulted facility. Banks that reflect the credit risk mitigating effects of guarantees/credit derivatives through LGD must retain data on the LGD of the facility before and after evaluation of the effects of the guarantee/credit derivative. Information about the components of loss or recovery for each defaulted exposure must be retained, such as amounts recovered, source of recovery (e.g. collateral, liquidation proceeds and guarantees), time period required for recovery, and administrative costs."

Where multiple lenders participated in the same defaulted loan, the relevant lenders reported similar ultimate recoveries. Any differences were mostly due to the timing of the emergence process or the recovery methodology[13] reported by each lender. In the small percentage of instances where different lenders reported different recovery values for the same project, we reviewed the project's narrative description to ensure that the timing and recovery methodology were correct, and reconfirmed the relevant data submitted by each lender. When working with historical data, specific details may not always be available and differences in data provided may be the result of different interpretations between lenders, such as when one lender reports an ultimate recovery and another lender reports the charge-off amount. We will continue to consult with the Data Consortium members and establish further refinements in data capture to support more granular analysis.

4.4.1 Excluded data

Loan details were reviewed to ensure that each debt facility met the Basel definition of Project Finance. Loans that did not meet this definition were excluded from the study data set. We reproduce the Basel definition of Project Finance at Appendix B (Glossary).

Project loan defaults were reviewed to ensure that each loan default met the Basel definition of default. Reported loan defaults that did not meet the Basel definition of default were excluded.

Lenders were not requested to provide recovery information for defaults in work-out (Basel) — although such projects are excluded from the recovery analysis they are counted as defaults in the default analysis.

In a small number of instances where a recovery rate for an ultimate recovery (Basel) or distressed sale (Basel) (as applicable) could not be determined due to insufficient information, that project was excluded from the recovery analysis. However, if such omissions can be addressed, we would anticipate including this data in a future study based on an expanded and updated data set.

Defaults of subordinated debt facilities were excluded from the recovery analysis.

We applied an analogous approach in relation to our review of each default (Moody's), default in work-out (Moody's), distressed sale (Moody's) and ultimate recovery (Moody's).

4.5 Caveat – limitations of small sample sizes

In the study, we have investigated a number of different aspects of historical project finance default and recovery rates — for example, by segmenting our analysis of default and recovery rates by industry and by region. Necessarily, such segmented analysis is likely to lead to small sample sizes that lack the statistical robustness of larger sample sizes.

Further expansion of the study data set would provide greater statistical confidence to the results and observations presented, and would support more detailed granular analysis. We look forward to publishing further research based on an expanded and updated data set. In the meantime, we would highlight that: Results based on small sample sizes should be treated with caution, the inclusion of additional data will lead to different results in future studies and it is possible that such differences may be material.

[13] For example, distressed restructuring, or restructuring without a loss (either extended maturity and or change in amortization). In certain instances, not all banks agreed that the maturity was extended or the amortization schedule changed.

5. Distribution of projects

5.1 Distribution of projects by region

Exhibit 5 shows the regional distribution of all the projects in the study data set, and compares this with the corresponding distribution of projects in the industry data set.

The study data set accounts for approximately 69.4% of the larger industry data set from 1983 through 2017. The regional concentrations of the study data set are similar to those of the industry data set — the correlation between the regional concentrations of the two data sets is 88.4%. However, there are notable differences between the two data sets in their respective concentrations in Asia[14], North America and Western Europe. It is likely that these differences are the result of the different client relationships, loan origination strategy and geographic focus of each participant in the Data Consortium, as well as the potential classification differences discussed in Section 3.

EXHIBIT 5

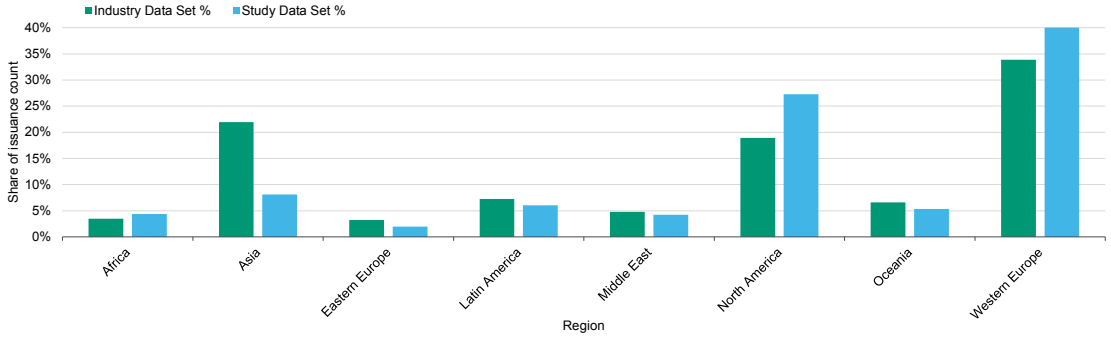
Comparison of study data set and industry data set by region

Region	Industry Data Set	Industry Data Set %	Study Data Set	Study Data Set %
Africa	413	3.5%	361	4.4%
Asia	2,610	21.9%	669	8.1%
Eastern Europe	380	3.2%	163	2.0%
Latin America	864	7.3%	498	6.0%
Middle East	566	4.8%	348	4.2%
North America	2,252	18.9%	2,253	27.3%
Oceania	784	6.6%	439	5.3%
Western Europe	4,028	33.9%	3,526	42.7%
Total	**11,897**	**100.0%**	**8,257**	**100.0%**

Source: Data Alliance Project Finance Data Consortium

EXHIBIT 6

Comparison of study data set and industry data set by region



Source: Data Alliance Project Finance Data Consortium

[14] We note that we have reclassified countries previously classified as Southeast Asia as Asia since the March 2017 study.

5.2 Distribution of projects by industry

Exhibit 7 shows the industry sector distribution of all the projects in the study data set, and compares this with the corresponding distribution of projects in the Refinitiv Project Finance International industry data set. In our analysis of industry sectors, we highlight that the infrastructure industry sector is largely comprised of transportation projects and social infrastructure projects (see Appendix M).

The industry concentrations of the study data set are very similar to those of the Refinitiv Project Finance International industry data set — the correlation between the industry concentrations of the two data sets is 98.7%. There are modest differences between the two data sets in their respective concentrations in the infrastructure and oil & gas industry sectors. It is likely that these differences are the result of the different client relationships, loan origination strategy and industrial focus of each participant in the Data Consortium, as well as the potential classification differences discussed in Section 3.

EXHIBIT 7

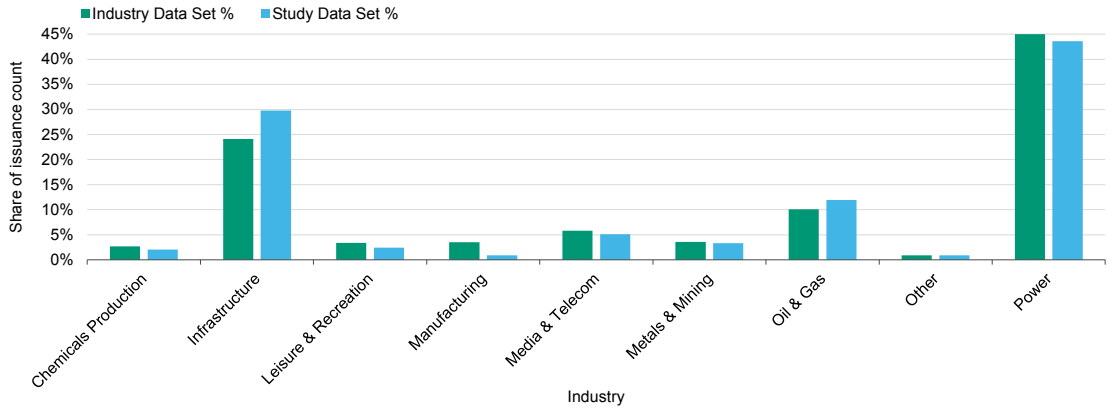
Comparison of study data set and industry data set by industry sector

Industry	Industry Data Set	Industry Data Set %	Study Data Set	Study Data Set %
Chemicals Production	324	2.7%	172	2.1%
Infrastructure	2,868	24.1%	2,458	29.8%
Leisure & Recreation	401	3.4%	199	2.4%
Manufacturing	421	3.5%	74	0.9%
Media & Telecom	693	5.8%	420	5.1%
Metals & Mining	428	3.6%	276	3.3%
Oil & Gas	1,201	10.1%	985	11.9%
Other	111	0.9%	73	0.9%
Power	5,450	45.8%	3,600	43.6%
Total	**11,897**	**100.0%**	**8,257**	**100.0%**

Source: Data Alliance Project Finance Data Consortium

EXHIBIT 8

Comparison of study data set and industry data set by industry sector



Source: Data Alliance Project Finance Data Consortium

6. Distribution of defaults

6.1 Distribution of defaults by region

Exhibit 9 shows the regional distribution of the 570 defaults (Basel) in the study data set. The three most significant regions are North America, Western Europe and Latin America, accounting for 77.7% of total defaults (Basel). By a small margin, Latin America is now the third largest region ahead of Asia.

EXHIBIT 9
Distribution of defaults by region

	Basel Definition of Default		Moody's Definition of Default	
Region	Defaults (Basel)	Regional Concentration %	Defaults (Moody's)	Regional Concentration %
Africa	20	3.5%	17	4.0%
Asia	59	10.4%	53	12.4%
Eastern Europe	14	2.5%	10	2.3%
Latin America	64	11.2%	57	13.4%
Middle East	6	1.1%	5	1.2%
North America	171	30.0%	140	32.9%
Oceania	28	4.9%	25	5.9%
Western Europe	208	36.5%	119	27.9%
Total	**570**	**100.0%**	**426**	**100.0%**

Source: Data Alliance Project Finance Data Consortium

6.2 Distribution of defaults by industry sector

Exhibit 10 shows the industry sector distribution of the 570 defaults (Basel) in the study data set. The three most significant industry sectors are power, infrastructure and oil & gas, accounting for 76.3% of total defaults (Basel).

EXHIBIT 10
Distribution of defaults by industry sector

	Basel Definition of Default		Moody's Definition of Default	
Industry	Defaults (Basel)	Industry Sector Concentration %	Defaults (Moody's)	Industry Sector Concentration %
Chemicals Production	16	2.8%	16	3.8%
Infrastructure	133	23.3%	78	18.3%
Leisure & Recreation	14	2.5%	12	2.8%
Manufacturing	15	2.6%	15	3.5%
Media & Telecom	50	8.8%	46	10.8%
Metals & Mining	35	6.1%	34	8.0%
Oil & Gas	74	13.0%	58	13.6%
Other	5	0.9%	2	0.5%
Power	228	40.0%	165	38.7%
Total	**570**	**100.0%**	**426**	**100.0%**

Source: Data Alliance Project Finance Data Consortium

7. Default rate analysis

7.1 Cohort analysis: 1990 – 2017

Cumulative default rates are derived from monthly marginal default rates based on static pool cohorts that follow the default behavior of the projects in each cohort in annual intervals since cohort formation.

Cohort analysis – methodology

The cumulative default rate calculation methodology that we use is a discrete-time approximation of the non-parametric continuous-time hazard rate approach. A static pool cohort is formed based on the number of active projects on 1 January of each year, and the default/survival status of the members of the cohort was tracked from 1990-2017. Projects that are active on 1 January of each cohort year include loans originated from the commencement of the study period in 1983.

The time horizon T for which we wish to measure a cumulative default rate is divided into years. Hence, the data is discrete in that the time to default is not measured continuously. In Exhibit 11, each cohort has N(0) active projects on 1 January of the initial cohort year with time intervals of t years thereafter labeled as years 1, 2, 3 etc.

Based on a monthly time interval, the marginal default rate (hazard rate) is the probability that a project that has survived in the cohort up to the beginning of a particular month will default by the end of that month. The marginal default rate is calculated as the ratio of defaults in that month to the number of surviving projects at the beginning of that month. Projects that have been repaid during that month are excluded from the count of survivors in subsequent time intervals.

Cumulative default rates for each cohort (as shown in Exhibits 11 and 12) are derived from monthly marginal default rates for that cohort.

Average cumulative default rates for all cohorts 1990-2017 are derived from the weighted average marginal default rates from all the available cohort marginal default rates (1990-2017) — in other words, monthly marginal default rates are weighted by the relevant number of active projects at the start of year t for that cohort.

Average annual marginal default rates (1990-2017) are derived from average cumulative default rates (1990-2017).

7.1.1 Cumulative default rates

Exhibit 11 tabulates CDRs (Basel) for cohorts 1990-2017. While not directly comparable, for reference we have included certain CDR data taken from our published research on default and recovery rates for corporate bond, loan and deposit issuers rated in the A, Baa and Ba rating categories.[15]

It is apparent that the 10-year CDR (Basel) of 5.6% for the study data set is consistent with 10-year CDRs rates for corporate issuers of low investment grade credit quality. As a comparison, corresponding CDRs for Baa3-rated and Ba1-rated corporates are 5.1% and 9.9% respectively.[16]

[15] See Moody's Data Report: "Corporate Default and Recovery Rates, 1920-2017," February 2018. For comparison purposes we have included certain cumulative default rate data for corporate bond, loan and deposit issuers rated in the Baa and Ba rating categories by Moody's Investors Service.

[16] The comparative 10-year cumulative default rate for the Baa3 rating category is 5.1% (see Exhibit 35 of Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018).

Commentary on changes in sector-specific 10-year cumulative default rates from the March 2018 study

Findings for this year's study remain consistent with last year's findings.

The 10-year CDR (Basel) for the study data set is 5.6% and the 10-year CDR (Moody's) for the study data set is 4.0%. This year's study average is at the lowest level since inception of the study as the incremental project count exceeded the incremental default count.

The study data set continues to grow and is 17.1% larger than that of our previous study with an additional 1,205 projects and 60 defaults (Basel). Of the 60 Basel default counts, eight occurred in 2017. We also added 38 ultimate recoveries (Basel) to this year's study data set.

We note that:

- By number of projects, the three largest industry sectors remain power (43.6%), infrastructure (29.8%) and oil & gas (11.9%), representing 85.3% in aggregate of the 8,257 projects in the study data set.
- By number of defaults (Basel), the three largest sectors power (40.0%), infrastructure (23.3%) and oil & gas (13.0%) represent 76.3% in aggregate of the 570 defaults (Basel) in the study data set.
- Compared with our March 2018 study:
  - Consistent with the study average, 10-year CDRs across most industries declined slightly.
  - The 10-year CDR (Basel) for the power industry sector improved to 5.9% from 6.5%.
  - The 10-year CDR (Basel) for the infrastructure industry sector improved to 4.1% from 4.7%.
  - The 10-year CDR (Basel) for the oil & gas industry sector improved to 5.7% from 6.1%. However, this trend was not reflected in simple average default rates for the oil & gas sector, which deteriorated slightly to 7.5% from 7.0%.

The results are based on different data sets that will likely cause 10-year CDRs to differ. The sector composition and historical profile of data additions will also affect 10-year CDRs.

EXHIBIT 11

Cumulative default rates for cohorts 1990-2017 (Basel definition of default)

Years	N(0) (Note 1)	1	2	3	4	5	6	7	8	9	10
1990	49	2.04%	2.04%	14.29%	14.29%	16.43%	25.12%	27.32%	27.32%	27.32%	27.32%
1991	75	0.00%	8.00%	8.00%	10.77%	16.44%	19.32%	20.79%	20.79%	23.89%	23.89%
1992	111	5.41%	7.21%	9.97%	13.76%	15.70%	16.69%	16.69%	18.82%	18.82%	22.09%
1993	144	1.39%	3.52%	6.45%	8.70%	10.23%	11.01%	13.47%	13.47%	16.82%	16.82%
1994	180	2.23%	5.12%	8.65%	10.46%	12.31%	14.88%	14.88%	18.86%	18.86%	18.86%
1995	279	2.19%	5.15%	7.05%	9.74%	12.12%	12.12%	15.01%	16.70%	16.70%	17.16%
1996	344	2.64%	5.35%	8.74%	10.97%	11.63%	14.67%	16.40%	16.40%	17.15%	17.15%
1997	427	2.58%	6.79%	9.84%	10.77%	14.05%	16.63%	16.63%	17.10%	17.33%	17.33%
1998	523	3.88%	7.28%	8.52%	12.38%	16.84%	17.54%	18.04%	18.34%	18.34%	18.34%
1999	714	2.40%	3.56%	6.86%	11.37%	12.84%	13.38%	13.76%	13.76%	13.76%	13.76%
2000	863	1.31%	4.76%	9.86%	11.88%	12.62%	13.25%	13.42%	13.42%	13.42%	13.42%
2001	1,025	3.10%	9.65%	12.28%	13.00%	13.78%	14.06%	14.06%	14.06%	14.22%	14.53%
2002	1,091	6.84%	10.80%	12.00%	12.84%	13.23%	13.23%	13.23%	13.69%	13.99%	14.32%
2003	1,125	3.88%	5.29%	6.07%	6.56%	6.68%	6.82%	7.24%	7.67%	8.11%	8.11%
2004	1,214	1.46%	2.31%	2.83%	3.16%	3.39%	3.75%	4.23%	4.62%	4.62%	4.89%
2005	1,338	0.95%	1.38%	2.02%	2.22%	2.71%	3.12%	3.66%	3.89%	4.11%	4.46%
2006	1,484	0.42%	0.94%	1.26%	1.75%	2.25%	2.87%	3.33%	3.81%	4.29%	5.25%
2007	1,803	0.46%	0.94%	1.74%	2.70%	3.65%	4.21%	4.80%	5.84%	6.73%	7.03%
2008	2,230	0.60%	1.82%	3.05%	4.13%	5.00%	5.73%	6.81%	7.50%	7.85%	7.85%
2009	2,520	1.28%	2.62%	3.63%	4.50%	5.56%	6.90%	7.70%	8.06%	8.15%	
2010	2,700	1.21%	2.24%	3.20%	4.30%	5.55%	6.32%	6.68%	6.77%		
2011	2,928	0.94%	1.97%	3.05%	4.55%	5.27%	5.95%	6.03%			
2012	3,213	0.97%	2.11%	3.81%	4.72%	5.36%	5.46%				
2013	3,319	1.16%	2.78%	3.64%	4.29%	4.39%					
2014	3,484	1.57%	2.52%	3.25%	3.37%						
2015	3,727	0.90%	1.56%	1.67%							
2016	4,011	0.68%	0.85%								
2017	4,214	0.19%									
Cumulative Default Rate (Basel)		**1.29%**	**2.48%**	**3.42%**	**4.13%**	**4.66%**	**5.03%**	**5.27%**	**5.44%**	**5.55%**	**5.62%**
Moody's Baa (Note 2)		0.18%	0.46%	0.78%	1.15%	1.54%	1.93%	2.30%	2.67%	3.05%	3.46%
Moody's Ba (Note 2)		0.91%	2.57%	4.57%	6.66%	8.50%	10.15%	11.63%	13.01%	14.36%	15.70%

Notes:

1) N(0) represents the number of active projects as of 1 January.

2) Comparative cumulative default rate data reproduced from Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018– see Exhibit 34

Source: Data Alliance Project Finance Data Consortium

Exhibit 12 tabulates cumulative default rates (Moody's) for cohorts 1990-2017.

EXHIBIT 12

Cumulative default rates for cohorts 1990-2017 (Moody's definition of default)

Years	N(0) (Note 1)	1	2	3	4	5	6	7	8	9	10
1990	49	2.04%	2.04%	14.29%	14.29%	16.43%	25.12%	27.32%	27.32%	27.32%	27.32%
1991	75	0.00%	8.00%	8.00%	10.77%	16.44%	19.32%	20.79%	20.79%	22.34%	22.34%
1992	111	5.41%	7.21%	9.97%	13.76%	15.70%	16.69%	16.69%	17.76%	18.84%	21.04%
1993	144	1.39%	3.53%	6.49%	8.75%	10.30%	10.30%	11.95%	12.79%	15.32%	15.32%
1994	179	2.25%	5.15%	8.11%	9.93%	11.16%	12.44%	13.10%	16.42%	16.42%	16.42%
1995	278	2.20%	4.80%	7.09%	9.01%	10.59%	11.00%	13.48%	15.16%	15.16%	15.62%
1996	343	2.35%	4.77%	7.55%	9.14%	10.13%	12.82%	14.55%	14.55%	14.93%	14.93%
1997	426	2.35%	5.63%	8.22%	9.39%	12.21%	15.02%	15.02%	15.26%	15.49%	15.49%
1998	523	2.91%	5.91%	7.36%	10.57%	15.24%	15.71%	15.96%	16.25%	16.25%	16.25%
1999	719	2.10%	3.55%	6.23%	10.86%	11.98%	12.52%	12.71%	12.71%	12.71%	12.71%
2000	870	1.54%	4.47%	9.52%	10.99%	11.72%	12.04%	12.04%	12.04%	12.04%	12.04%
2001	1,030	2.69%	9.00%	11.17%	11.89%	12.28%	12.42%	12.42%	12.42%	12.58%	12.89%
2002	1,099	6.60%	10.13%	11.32%	11.81%	12.07%	12.07%	12.07%	12.52%	12.82%	12.82%
2003	1,135	3.47%	4.78%	5.23%	5.59%	5.59%	5.73%	6.27%	6.55%	6.69%	6.69%
2004	1,228	1.28%	1.85%	2.26%	2.47%	2.59%	3.05%	3.41%	3.54%	3.54%	3.67%
2005	1,351	0.64%	0.98%	1.43%	1.52%	1.92%	2.22%	2.54%	2.86%	2.97%	3.32%
2006	1,498	0.35%	0.72%	0.95%	1.27%	1.52%	1.87%	2.22%	2.51%	2.79%	2.98%
2007	1,816	0.28%	0.70%	1.31%	1.82%	2.22%	2.71%	3.00%	3.73%	3.95%	4.10%
2008	2,244	0.50%	1.25%	2.07%	2.64%	3.33%	3.83%	4.62%	4.79%	5.02%	5.02%
2009	2,534	0.80%	1.79%	2.36%	3.04%	3.61%	4.44%	4.69%	4.86%	4.86%	
2010	2,726	0.90%	1.45%	2.19%	2.75%	3.59%	3.85%	4.03%	4.03%		
2011	2,958	0.48%	1.24%	1.81%	2.74%	3.06%	3.46%	3.46%			
2012	3,258	0.73%	1.29%	2.34%	2.79%	3.17%	3.17%				
2013	3,375	0.54%	1.51%	1.95%	2.30%	2.30%					
2014	3,551	0.89%	1.41%	1.88%	1.91%						
2015	3,812	0.48%	0.91%	0.94%							
2016	4,106	0.39%	0.42%								
2017	4,316	0.02%									
Cumulative Default Rate (Moody's)		**0.95%**	**1.83%**	**2.52%**	**3.00%**	**3.36%**	**3.61%**	**3.76%**	**3.87%**	**3.93%**	**3.96%**
Moody's Baa (Note 2)		0.18%	0.46%	0.78%	1.15%	1.54%	1.93%	2.30%	2.67%	3.05%	3.46%
Moody's Ba (Note 2)		0.91%	2.57%	4.57%	6.66%	8.50%	10.15%	11.63%	13.01%	14.36%	15.70%

Notes:

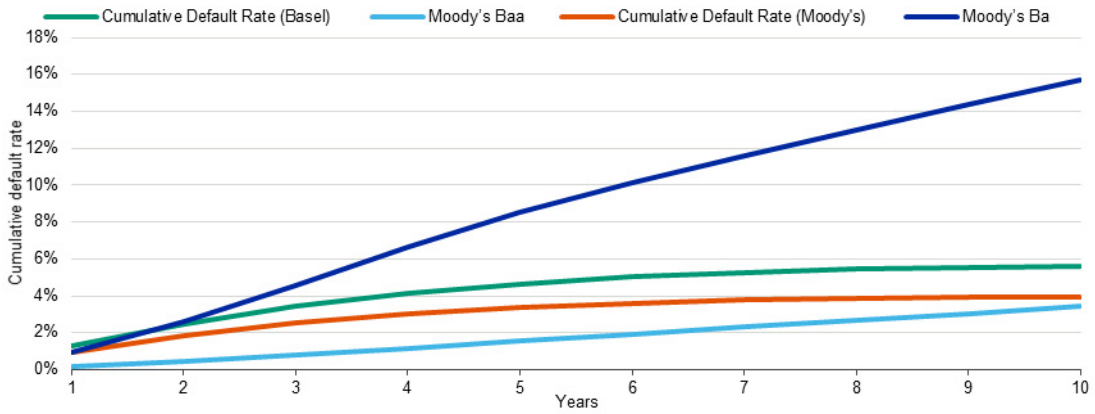
1) N(0) represents the number of active projects as of 1 January.

2) Comparative cumulative default rate data reproduced from Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018– see Exhibit 34

Source: Data Alliance Project Finance Data Consortium

Exhibit 13 charts the data presented in Exhibits 11 and 12:

EXHIBIT 13
Cumulative default rates



Source: Data Alliance Project Finance Data Consortium

7.1.2 Marginal annual default rates

Exhibit 14 tabulates marginal annual default rates for the study data set based on cohorts 1990-2017. For comparison, we have included marginal annual default rate data derived from our published research on default and recovery rates for corporate bond, loan and deposit issuers rated in the single-A, Baa and Ba rating categories.[17]

- It is apparent that marginal annual default rates (Basel) for project finance bank loans average 1.2% per annum during an initial two-year period, a slight decline from the average of 1.4% for the same period reported in the previous study. Marginal default rates fall significantly thereafter to levels consistent with single-A category corporate ratings by year seven from cohort formation.
- This characteristic of project finance bank loans is significantly different from the marginal annual default rates we have observed for investment grade non-financial corporate issuers, which are broadly stable.
- The initial period of elevated marginal default rates is likely linked to higher default risk during the construction phase or initial start-up challenges during the ramp up of operations. Once a project has built an operating track record, the data suggests that default risk declines.

[17] See Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018

EXHIBIT 14

Marginal annual default rates

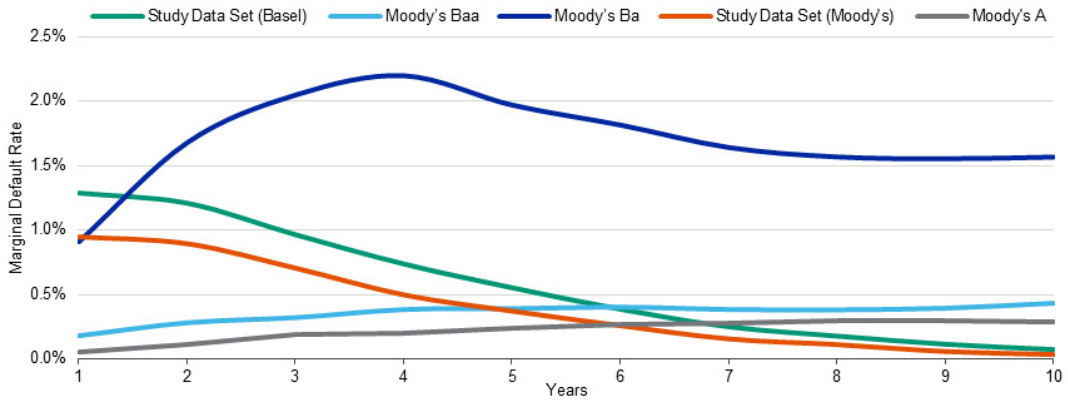
	Marginal Annual Default Rate %				
Year	Study Data (Basel)	Study Data (Moody's)	Moody's A	Moody's Baa	Moody's Ba
1	1.29%	0.95%	0.06%	0.18%	0.91%
2	1.21%	0.89%	0.12%	0.28%	1.68%
3	0.96%	0.70%	0.19%	0.32%	2.04%
4	0.74%	0.50%	0.20%	0.38%	2.19%
5	0.55%	0.37%	0.24%	0.39%	1.97%
6	0.39%	0.26%	0.27%	0.40%	1.81%
7	0.25%	0.16%	0.28%	0.38%	1.64%
8	0.18%	0.11%	0.29%	0.38%	1.57%
9	0.12%	0.06%	0.30%	0.39%	1.55%
10	0.08%	0.04%	0.29%	0.43%	1.57%

Source: Data Alliance Project Finance Data Consortium

Exhibit 15 charts the data presented in Exhibit 14:

EXHIBIT 15

Marginal annual default rates



Source: Data Alliance Project Finance Data Consortium

7.2 Average default rates by region

Exhibit 16 shows simple average default rates by region. A simple average default rate is the count of defaults divided by the count of projects.

Caveat: The simple average default rates included in Exhibit 16 should be interpreted with caution because (1) they do not reflect the risk profiles of individual projects, which are likely to change based on time from origination; and (2) they do not reflect the time-weighted population of active projects exposed to default. In essence, the simple average default rate takes into account the total project count and total count of defaults during the study period, but ignores when each default occurs. The simple average default rate of 6.9% (Basel) for the total study data exceeds the 10-year CDR of 5.6% (Basel) because the simple average default rate is based on a longer time horizon than the 10-year CDR.

EXHIBIT 16

Simple average default rates by region

		Basel Definition of Default		Moody's Definition of Default	
Region	Projects (Note 1)	Defaults (Note 2)	Average Default Rate %	Defaults (Note 3)	Average Default Rate %
Africa	361	20	5.5%	17	4.7%
Asia	669	59	8.8%	53	7.9%
Eastern Europe	163	14	8.6%	10	6.1%
Latin America	498	64	12.9%	57	11.4%
Middle East	348	6	1.7%	5	1.4%
North America	2,253	171	7.6%	140	6.2%
Oceania	439	28	6.4%	25	5.7%
Western Europe	3,526	208	5.9%	119	3.4%
Total	**8,257**	**570**	**6.9%**	**426**	**5.2%**

Notes:
1) Based on 8,257 total projects
2) Based on 570 total defaults (Basel)
3) Based on 426 total defaults (Moody's)
Source: Data Alliance Project Finance Data Consortium

Simple average default rates calculated for the study data set vary significantly by region — for example default rates for the Middle East, Africa, Western Europe and Oceania are lower than default rates for Latin America, North America and Asia.

Exhibits 17 and 18 tabulate average CDRs for cohorts 1990-2017, broken down by region. Due to the small size of the regional subsets, differences between regional and average cumulative default rates for the study data set may be due to statistical variations.

Caveat: The CDRs included in Exhibit 17 should be interpreted with caution because, for certain regions, sample sizes are small and do not support statistically robust conclusions.

EXHIBIT 17

Cumulative default rates by region for cohorts 1990-2017 (Basel definition of default)

Years	1	2	3	4	5	6	7	8	9	10
Africa	1.16%	2.31%	3.06%	3.58%	4.04%	4.51%	4.91%	5.26%	5.60%	5.88%
Asia	1.63%	3.12%	4.26%	5.02%	5.59%	5.91%	6.14%	6.34%	6.41%	6.47%
Eastern Europe	1.57%	3.26%	4.83%	6.22%	7.26%	7.88%	8.05%	8.21%	8.21%	8.21%
Latin America	2.81%	5.31%	7.11%	8.32%	8.89%	9.11%	9.22%	9.33%	9.39%	9.45%
Middle East	0.28%	0.52%	0.67%	0.77%	0.87%	0.92%	0.98%	0.98%	0.98%	0.98%
North America	1.70%	3.29%	4.46%	5.28%	5.90%	6.33%	6.62%	6.76%	6.88%	6.94%
Oceania	1.50%	2.84%	3.95%	4.80%	5.63%	6.20%	6.49%	6.71%	6.87%	6.94%
Western Europe	0.96%	1.85%	2.63%	3.28%	3.77%	4.13%	4.36%	4.55%	4.66%	4.74%
Cumulative Default Rate (Basel)	**1.29%**	**2.48%**	**3.42%**	**4.13%**	**4.66%**	**5.03%**	**5.27%**	**5.44%**	**5.55%**	**5.62%**
Moody's Baa (Note 1)	0.18%	0.46%	0.78%	1.15%	1.54%	1.93%	2.30%	2.67%	3.05%	3.46%
Moody's Ba (Note 1)	0.91%	2.57%	4.57%	6.66%	8.50%	10.15%	11.63%	13.01%	14.36%	15.70%

Note:

1) Comparative cumulative default rate data reproduced from Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018– see Exhibit 34

Source: Data Alliance Project Finance Data Consortium

EXHIBIT 18

Cumulative default rates by region for cohorts 1990-2017 (Moody's definition of default)

Years	1	2	3	4	5	6	7	8	9	10
Africa	0.98%	2.00%	2.75%	3.07%	3.33%	3.59%	3.86%	4.13%	4.41%	4.61%
Asia	1.42%	2.76%	3.82%	4.52%	5.05%	5.34%	5.53%	5.70%	5.73%	5.73%
Eastern Europe	1.10%	2.29%	3.32%	4.28%	4.86%	5.32%	5.47%	5.63%	5.63%	5.63%
Latin America	2.47%	4.70%	6.47%	7.65%	8.22%	8.43%	8.54%	8.65%	8.71%	8.76%
Middle East	0.23%	0.42%	0.57%	0.67%	0.77%	0.77%	0.77%	0.77%	0.77%	0.77%
North America	1.37%	2.67%	3.62%	4.26%	4.76%	5.11%	5.33%	5.46%	5.54%	5.58%
Oceania	1.33%	2.54%	3.52%	4.30%	5.05%	5.55%	5.76%	5.99%	6.14%	6.21%
Western Europe	0.54%	1.04%	1.46%	1.79%	2.04%	2.24%	2.36%	2.44%	2.47%	2.49%
Cumulative Default Rate (Moody's)	**0.95%**	**1.83%**	**2.52%**	**3.00%**	**3.36%**	**3.61%**	**3.76%**	**3.87%**	**3.93%**	**3.96%**
Moody's Baa (Note 1)	0.18%	0.46%	0.78%	1.15%	1.54%	1.93%	2.30%	2.67%	3.05%	3.46%
Moody's Ba (Note 1)	0.91%	2.57%	4.57%	6.66%	8.50%	10.15%	11.63%	13.01%	14.36%	15.70%

Note:

1) Comparative cumulative default rate data reproduced from Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018– see Exhibit 34

Source: Data Alliance Project Finance Data Consortium

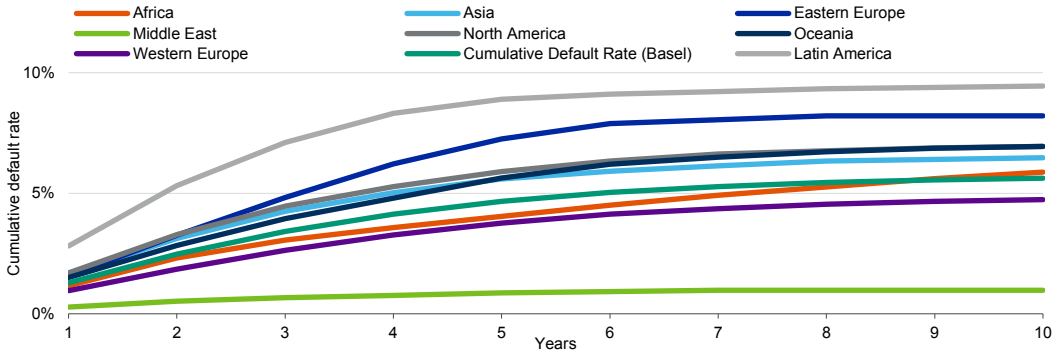
Exhibit 19 charts the data presented in Exhibit 17 i.e., CDRs (Basel) for each region.

Latin America has very little history in the years 1991-1997, with a substantial number of defaults relative to the number of originated and active projects. The CDRs for the region reflect this distortion.

Default history in Africa and the Middle East has been limited, with only 20 and 6 defaults, respectively, in the study data set. For the Middle East region, this outcome is highly notable, against a background of regional geopolitical tensions exemplified by the 1990-91 Gulf War, the invasion of Iraq in 2003, the wave of Arab Spring uprisings commencing in 2011 and the Israeli/Palestinian conflict.

EXHIBIT 19

Cumulative default rates (Basel) by region

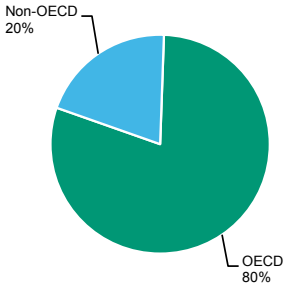


Source: Data Alliance Project Finance Data Consortium

7.2.1 Average default rate by regional subsets: OECD/non-OECD countries and advanced economies/EMDEs

EXHIBIT 20A

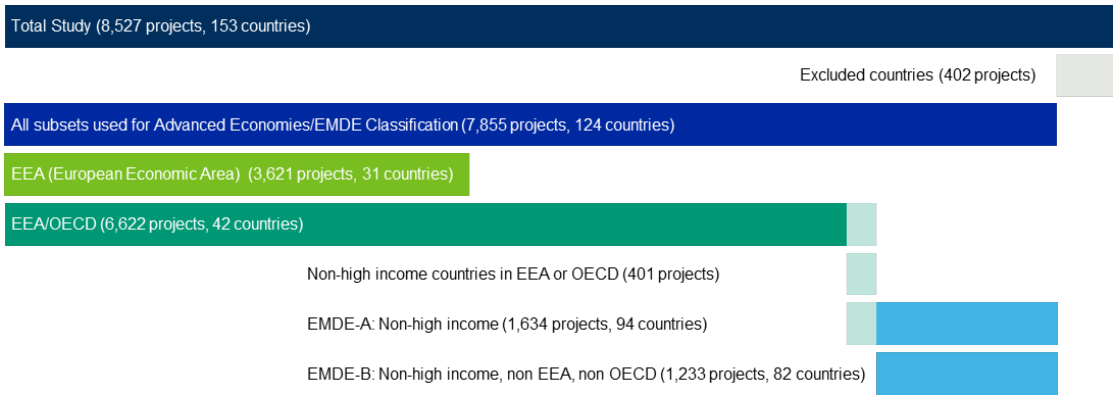
Study project counts by OECD/non-OECD classification



Source: Data Alliance Project Finance Data Consortium

EXHIBIT 20B

Project counts by advanced economies/emerging market and developing economies



Source: Data Alliance Project Finance Data Consortium

For additional details on specific countries included in each of these regional cohorts, please see the Appendix B (Glossary).

Caveat: The simple average default rates included in Exhibit 21 should be interpreted with caution because (1) they do not reflect the risk profiles of individual projects, which are likely to change based on time from origination; and (2) they do not reflect the time-weighted population of active projects exposed to default.

Exhibit 21 shows simple average default rates by OECD/non-OECD and advanced economies/EMDEs regional subsets:

- OECD/non-OECD countries. Exhibit 21-23 have been prepared on the basis of the 35 OECD members at the of end of 2017— the list of OECD members is included in Appendix B (Glossary).
- Advanced economies/Emerging market and developing economies (EMDEs) (Exhibit 20B):
  - Advanced economies subsets:
    - EEA: A subset comprising projects located in countries in the European Economic Area (EEA), and
    - EEA/OECD subset: A subset comprising projects located in countries either in the EEA or in the OECD region. Projects located in countries within the EEA or OECD regions may qualify for lower regulatory capital under Solvency II, the European regulatory regime for insurers.
  - EMDEs:
    - EMDE-A: A subset comprising projects located in countries that were classified by the WBG as non-high-income (meaning upper-middle-income, lower-middle-income or low-income), on average over the period 1995-2017, but excluding certain US dependent territories. Classifying countries by their WBG income level category averaged over 1995-2017 is a change from our March 2018 study, in which we had classified countries based on their WBG income level category for 2016, but is consistent with our September 2018 addendum.
    - EMDE-B: A subset comprising projects in the EMDE-A subset, but excluding non-high-income EEA countries and non-high-income OECD countries.

EXHIBIT 21

Simple average default rates by regional subsets: OECD/non-OECD countries and advanced economies/EMDEs

		Basel Definition of Default		Moody's Definition of Default	
Region	Projects (Note 1)	Defaults (Note 2)	Average Default Rate %	Defaults (Note 3)	Average Default Rate %
OECD/Non-OECD					
OECD	6,592	422	6.4%	294	4.5%
Non-OECD	1,665	148	8.9%	132	7.9%
Advanced Economies/EMDEs					
EEA	3,621	218	6.5%	125	3.7%
EEA/OECD	6,622	426	6.8%	297	4.8%
EMDE-A	1,634	162	9.8%	137	8.8%
EMDE-B	1,233	135	10.4%	120	9.5%
Total Study Data	**8,257**	**570**	**6.9%**	**426**	**5.2%**

Notes:
1) Based on 8,257 projects included in total study data set.
2) Based on 570 defaults (Basel) included in total study data set.
3) Based on 426 defaults (Moody's) included in total study data set.
The advanced economies/EMDE subsets overlap (see Exhibit 20B) and therefore, project counts for these subsets will not add up to the total project count of the study data set.
Source: Data Alliance Project Finance Data Consortium

Exhibit 22 tabulates average cumulative default rates (Basel) for cohorts 1990-2017, broken down by different regional subsets: OECD/non-OECD countries and a comparison of certain subsets of advanced economies with the EMDE subsets.

EXHIBIT 22

Cumulative default rates by regional subsets: OECD/non-OECD countries and advanced economies/EMDEs 1990-2017 (Basel definition of default)

Years	1	2	3	4	5	6	7	8	9	10
OECD/Non-OECD										
OECD	1.18%	2.28%	3.17%	3.86%	4.40%	4.79%	5.03%	5.20%	5.31%	5.38%
Non-OECD	1.71%	3.30%	4.44%	5.24%	5.75%	6.05%	6.28%	6.46%	6.56%	6.65%
Advanced Economies/EMDEs										
EEA	0.98%	1.90%	2.70%	3.38%	3.89%	4.27%	4.51%	4.69%	4.80%	4.88%
EEA/OECD	1.19%	2.29%	3.19%	3.89%	4.43%	4.81%	5.06%	5.23%	5.34%	5.41%
EMDE-A	1.98%	3.80%	5.14%	6.09%	6.75%	7.13%	7.39%	7.59%	7.70%	7.79%
EMDE-B	2.23%	4.28%	5.73%	6.74%	7.41%	7.82%	8.12%	8.36%	8.51%	8.63%
Cumulative Default Rate (Basel) - Study Average	**1.29%**	**2.48%**	**3.42%**	**4.13%**	**4.66%**	**5.03%**	**5.27%**	**5.44%**	**5.55%**	**5.62%**
Moody's Baa (Note 1)	0.18%	0.46%	0.78%	1.15%	1.54%	1.93%	2.30%	2.67%	3.05%	3.46%
Moody's Ba (Note 1)	0.91%	2.57%	4.57%	6.66%	8.50%	10.15%	11.63%	13.01%	14.36%	15.70%

Note: For a list of countries included in each regional subset, please see the glossary in the appendix.
1) Comparative cumulative default rate data reproduced from Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018– see Exhibit 34
Source: Data Alliance Project Finance Data Consortium

Exhibit 23 charts the data presented in Exhibit 22.

Analysis of CDRs (Basel) by various regional subsets suggests that CDRs tend to vary by project jurisdiction with CDRs below or close to the study average in OECD countries, EEA countries and EEA/OECD countries.

Projects located in non-OECD countries, EMDE-A and EMDE-B countries exhibit on average higher CDRs than the total study average.

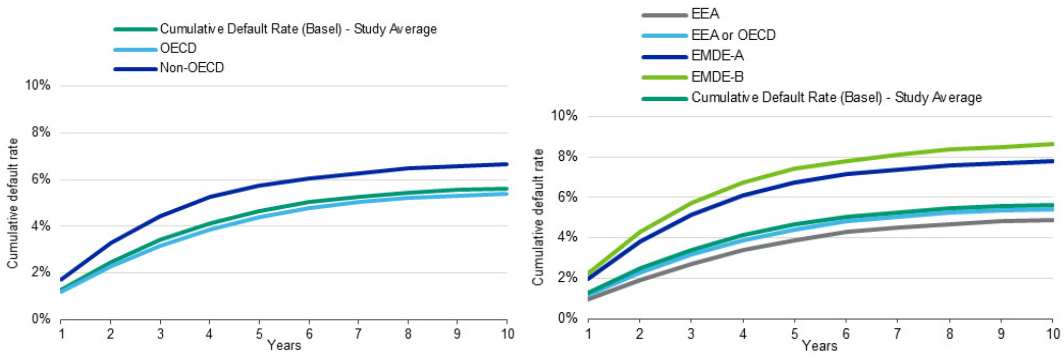
10-year CDRs (Basel) are highest in EMDE-B countries (8.6%), followed by EMDE-A countries (7.8%) and EEA/OECD countries (5.4%). Projects located in EEA countries have the lowest 10-year CDR of 4.9%. Classification by OECD (5.4%) and non-OECD (6.6%) countries shows limited variation in default rates.

Compared to the March 2018 study, 10-year CDR are lower based on this year's study data set across the various country classifications consistent with the lower study average.

Annual marginal default rates tend to decline over time and the differences in annual marginal default rates across subsets reduces as time passes from cohort formation consistent with our observation for the total study data set. As such, project jurisdiction tends to be a less critical driver of default risk once a project has started to build an operating track record.

EXHIBIT 23

Cumulative default rates (Basel) by OECD/non-OECD countries and advanced economies/EMDEs



Source: Data Alliance Project Finance Data Consortium

7.3 Average default rates by industry sector

Exhibit 24 shows simple average default rates by industry sector.

Caveat: The simple average default rates included in Exhibit 24 should be interpreted with caution because (1) they do not reflect the risk profiles of individual projects, which are likely to change based on time from origination; and (2) they do not reflect the time-weighted population of active projects exposed to default. In essence, the simple average default rate takes into account the total project count and total count of defaults during the study period, but ignores when each default occurs. The simple average default rate of 6.9% (Basel) for the total study data exceeds the 10-year CDR of 5.6% (Basel) because the simple average default rate is based on a longer time horizon than the 10-year CDR.

EXHIBIT 24

Simple average default rates by industry sector

		Basel Definition of Default		Moody's Definition of Default	
Industry Sector	Projects (Note 1)	Defaults (Note 2)	Average Default Rate %	Defaults (Note 3)	Average Default Rate %
Chemicals Production	172	16	9.3%	16	9.3%
Infrastructure	2,458	133	5.4%	78	3.2%
Leisure & Recreation	199	14	7.0%	12	6.0%
Manufacturing	74	15	20.3%	15	20.3%
Media & Telecom	420	50	11.9%	46	11.0%
Metals & Mining	276	35	12.7%	34	12.3%
Oil & Gas	985	74	7.5%	58	5.9%
Other	73	5	6.8%	2	2.7%
Power	3,600	228	6.3%	165	4.6%
Total	**8,257**	**570**	**6.9%**	**426**	**5.2%**

Notes:
1) Based on 8,257 total projects
2) Based on 570 total defaults (Basel)
3) Based on 426 total defaults (Moody's)

Source: Data Alliance Project Finance Data Consortium

It is apparent that simple average default rates calculated for the study data set vary significantly by industry: for example, simple average default rates for the infrastructure industry sector are substantially lower than simple average default rates for the manufacturing industry sector.

7.3.1 PPPs

The study data set contains 1,970 projects identified as PPP projects by the Data Consortium, many of which fall within the infrastructure industry sector, and 320 additional PPP projects compared to the March 2018 study. There is some subjectivity in the classification of projects as PPPs. The study data set contains 96 defaults (Basel) and 53 defaults (Moody's) of PPP projects. This year's study data set contains 15 additional defaults (Basel) and 12 additional defaults (Moody's).

The average 10-year CDRs of 3.8% (Basel) and 2.1% (Moody's) for PPP projects are lower than the corresponding 10-year CDRs of 4.1% (Basel) and 2.4% (Moody's) for the infrastructure industry sector, and are substantially below the 10-year CDRs of 5.6% (Basel) and 4.0% (Moody's) for the whole study data set. Ten-year CDRs for PPP projects for the period 1983-2017 declined from 4.3% (Basel) and 2.1% (Moody's) reported in last year's study because only a limited number of defaults were added to the study data set.

These results are consistent with the view held by many PPP advocates that default risk for such projects is low, especially when project revenues are based on availability-based payment mechanisms and are not exposed to market risk. We comment further on our analysis of PPP projects in Appendix H (Default and Recovery Analysis for PPP projects).

7.3.2 Power

The power industry comprises 3,600 projects with 228 defaults (Basel) and 165 defaults (Moody's) in aggregate, corresponding to simple average default rates of 6.3% (Basel) and 4.6% (Moody's), respectively. Exhibit 25 shows simple average default rates within the power industry sector, split by US power and non-US power:

EXHIBIT 25

Simple average default rates within the power industry – US/non US

		Basel Definition of Default		Moody's Definition of Default	
Power	Projects (Note 1)	Defaults (Note 2)	Average Default Rate %	Defaults (Note 3)	Average Default Rate %
US Power	1,229	86	7.0%	74	6.0%
Non-US Power	2,371	142	6.0%	91	3.8%
Total Power	**3,600**	**228**	**6.3%**	**165**	**4.6%**
Total Study Data	**8,257**	**570**	**6.9%**	**426**	**5.2%**
Concentration of Power	**43.6%**	**40.0%**		**38.7%**	

Notes:
1) Based on 8,257 total projects
2) Based on 570 total defaults (Basel), of which 228 are in the power industry sector
3) Based on 426 total defaults (Moody's) of which 165 are in the power industry sector

Source: Data Alliance Project Finance Data Consortium

» The US power industry subsector comprises 1,229 projects with 86 defaults (Basel) and 74 defaults (Moody's), corresponding to simple average default rates of 7.0% (Basel) and 6.0% (Moody's), higher than the simple average default rates of 6.9% (Basel) and 5.2% (Moody's) for the whole study data set but a decline compared to the March 2018 study. Simple average default rates for the US power industry declined from the 7.3% (Basel) and 6.2% (Moody's) reported in last year's study, as additional

projects were added to the data set while the number of defaults in the US remained largely unchanged.

» The non-US power industry subsector comprises 2,371 projects with 142 defaults (Basel) and 91 defaults (Moody's), corresponding to simple average default rates of 6.0% (Basel) and 3.8% (Moody's), substantially lower than US power. However, the simple average default rate decreased from 6.5% (Basel) and 4.4% (Moody's) reported in last year's study largely driven by the additional projects in our data set.

We comment further on this finding in Section 7.4 (Incidence of Defaults).

Exhibit 26 tabulates cumulative CDRs (Basel) for cohorts 1990-2017, broken down by industry sector.

Exhibit 27 tabulates CDRs (Moody's) for cohorts 1990-2017, broken down by industry sector.

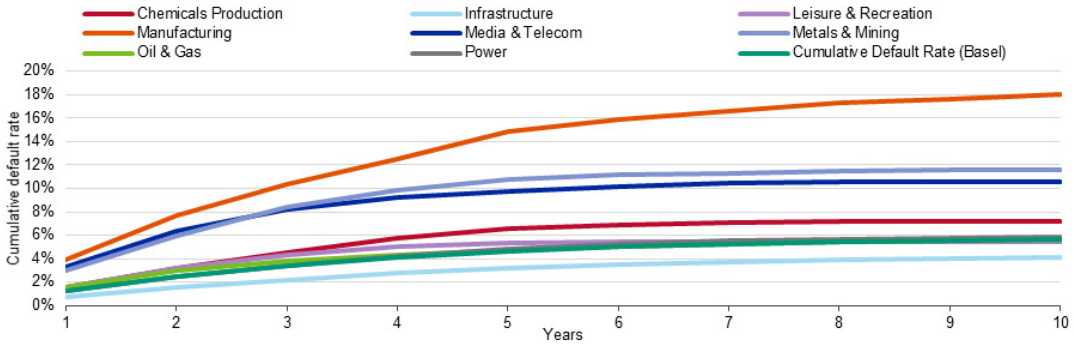
This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis, including Exhibits 26 and 27, has been withheld at the request of the Data Consortium.

Exhibit 28 shows cumulative default rates (Basel) by industry.

Caveat: The cumulative default rates shown in Exhibit 28 should be interpreted with caution, since in certain instances sample sizes are small and do not support statistically robust conclusions.

EXHIBIT 28

Cumulative default rates (Basel) by industry



Source: Data Alliance Project Finance Data Consortium

Exhibit 28 shows CDRs (Basel) for each industry sector. Various industry subsets flatten out after five to six years. However, certain subsets such as manufacturing only flatten out after years eight and nine. Notably, default counts included in the data set for chemicals production (16 defaults (Basel)) and manufacturing (15 defaults (Basel)) are relatively low and need to be interpreted with caution. We anticipate that additional data will improve the statistical robustness of a future analysis based on an updated and expanded data set.

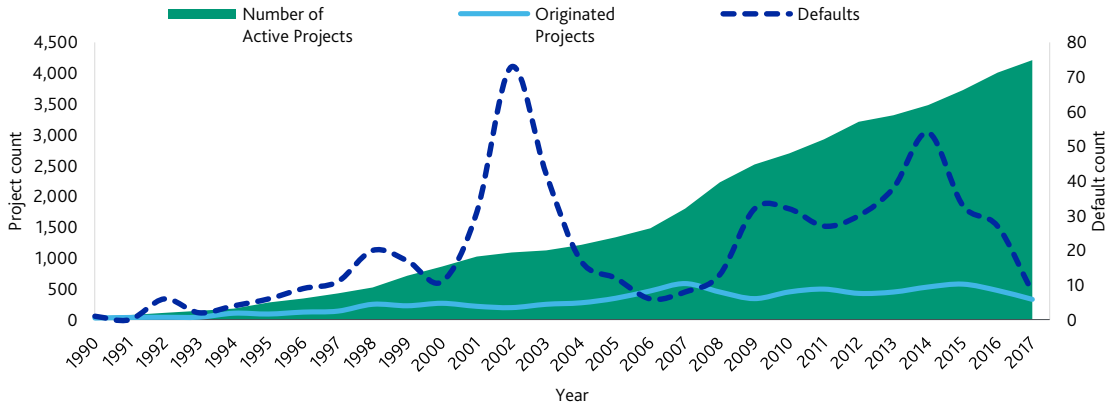
The 10-year CDR for the infrastructure industry sector is 4.1% (Basel), better than the study average of 5.6% (Basel) and the 4.7% (Basel) rate reported for the sector in the March 2018 study. The infrastructure industry sector represents approximately 29.8% of the study data set by number of projects. We comment further on the stress affecting the infrastructure industry sector during 2009-15 in Section 7.4.3.

7.4 Incidence of defaults (Basel definition of default)

Exhibit 29 shows the incidence of project loans originated, active loans as of 1 January in the relevant year, and the incidence of defaults (Basel).

EXHIBIT 29

Incidence of projects originated, active and defaulted by year



Source: Data Alliance Project Finance Data Consortium

Supporting data for Exhibit 29 is set out in Exhibit 30.

As reported last year, incidence of defaults (Basel) spiked sharply in 2002 and 2003. This may be partially explained by the stress affecting the power and media & telecom industry sectors in 2001-04. The elevated number of defaults between 2009-2016 should be considered in relation to the size of the population of active projects when those defaults occurred. We comment further on these points in Sections 7.4.1 and 7.4.2.

We comment on the breakdown of defaults (Basel) by sector over the period 2008-16 in Section 7.4.3 below.

EXHIBIT 30

Supporting data for Exhibit 29

		Basel Definition of Default		Moody's Definition of Default	
Year of Origination	Originated Projects	Number of Active Projects	Defaults	Number of Active Projects	Defaults
1989 and prior	49				
1990	27	49	1	49	1
1991	36	75	0	75	0
1992	39	111	6	111	6
1993	41	144	2	144	2
1994	105	180	4	179	4
1995	92	279	6	278	6
1996	123	344	9	343	8
1997	139	427	11	426	9
1998	250	523	20	523	17
1999	226	714	17	719	15
2000	266	863	11	870	11
2001	217	1,025	31	1,030	30
2002	196	1,091	73	1,099	70
2003	250	1,125	42	1,135	38
2004	274	1,214	17	1,228	14
2005	348	1,338	12	1,351	9
2006	467	1,484	6	1,498	5
2007	586	1,803	8	1,816	6
2008	449	2,230	13	2,244	12
2009	342	2,520	32	2,534	22
2010	451	2,700	32	2,726	22
2011	496	2,928	27	2,958	16
2012	427	3,213	30	3,258	25
2013	449	3,319	38	3,375	18
2014	531	3,484	54	3,551	26
2015	577	3,727	33	3,812	18
2016	474	4,011	27	4,106	15
2017	330	4,214	8	4,316	1
Total	**8,257**	**N/A**	**570**	**N/A**	**426**

Note:
1) The number of active projects is stated as of 1 January of the relevant year
Source: Data Alliance Project Finance Data Consortium

7.4.1 Incidence of defaults within certain industries (Basel definition of default)

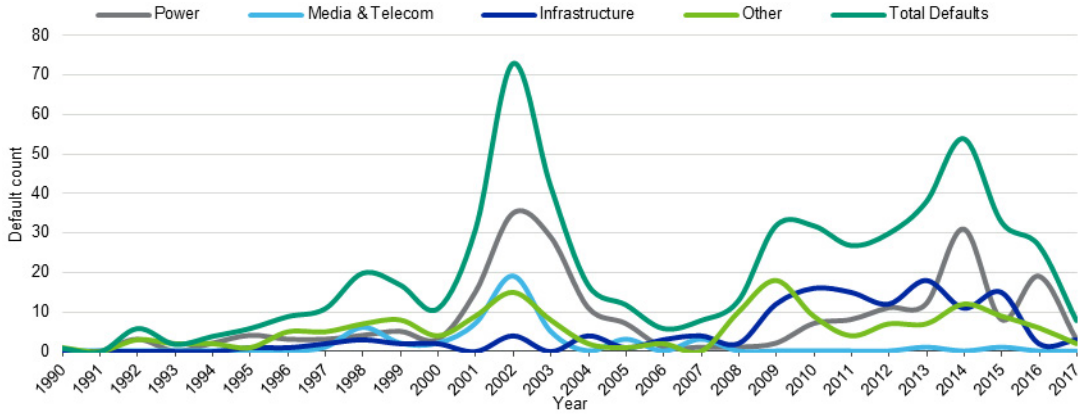
Exhibit 31 shows the incidence of defaults (Basel) for the following industry sectors: (1) power, (2) media & telecom, (3) infrastructure and (4) other; and illustrates their respective contributions to aggregate defaults (Basel).

It is apparent from Exhibit 31 that the spike in defaults (Basel) in 2002-03 was substantially due to stress affecting the power and media & telecom industry sectors. While defaults in the total data set substantially trailed off after 2003, Exhibit 31 also shows an increased incidence of defaults (Basel) in 2008-16. As discussed in Section 7.4.3 below, defaults (Basel) occurring during 2008-16 were concentrated in the oil & gas, infrastructure and power sectors. The oil & gas subset is included in the other category in Exhibit 31.

Supporting data for Exhibit 31 is tabulated in Exhibit 33.

EXHIBIT 31

Incidence of defaults (Basel) within certain industry sectors

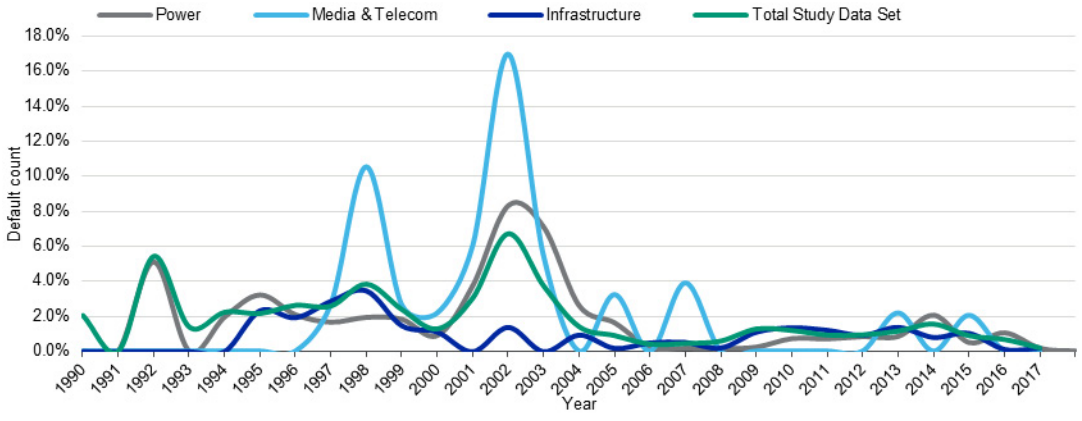


Source: Data Alliance Project Finance Data Consortium

Exhibit 32 shows the incidence of defaults (Basel) within certain industry sectors relative to the number of active projects in each year by industry sector. This Exhibit highlights that the incidence of defaults as a percentage of active projects for 2008-16 are fairly low in contrast to the distribution of default counts shown in Exhibit 31. In general, the ratios of default counts (Basel) to active projects trailed-off substantially after 2003.The number of active projects in the media & telecom industry is lower than in the power and infrastructure industry sectors, which results in a greater volatility of the ratio of defaults counts to active projects.

EXHIBIT 32

Incidence of defaults (Basel) within certain industry sectors as a percentage of active projects



Source: Data Alliance Project Finance Data Consortium

7.4.2 Incidence of defaults 2001-2004 (Basel definition of default) in the power and media & telecom industries

Exhibit 33 shows that 31 of the 50 total defaults (Basel) in the media and telecom industry sector occurred during 2001-03.

In relation to the stress affecting the power industry during 2001-04, we observe.

» As noted in Exhibit 25, the power industry comprises 3,600 projects and 228 defaults (Basel), corresponding to a simple average default rate of 6.3%. 39.5%, or 90 of the 228, of total defaults (Basel) in the power industry occurred during 2001-04.

» Exhibit 25 also shows that simple average default rates for US power are higher than for non-US power:

- The US power subsector comprises 1,229 projects and 86 defaults (Basel), corresponding to a simple average default rate of 7.0%, consistent with the simple average default rate of 6.9% for the whole study data set.
- The non-US power subsector comprises 2,371 projects and 142 defaults (Basel), corresponding to a simple average default rate of 6.0%, somewhat lower than the simple average default rate of 6.9% for the whole study data set.

» Further analysis of the incidence of defaults (Basel) in the US power and non-US power subsectors show that the concentration of defaults between 2001-04 is very high, particularly for US power:

- The 86 defaults (Basel) in the US power subsector represent 37.7% of all 228 defaults (Basel) in the power industry sector included in the study data set. Of these 86 defaults (Basel), 45 occurred during 2001-04, representing 50.0% of the 90 defaults (Basel) that occurred in the power industry sector during 2001-04.
- The 142 defaults (Basel) in the non-US power subsector represent 62.3% of all 228 defaults (Basel) in the power industry sector included the study data set. Of these 142 defaults (Basel), 45 occurred during 2001-04, representing 50.0% of the 90 defaults (Basel) that occurred in the power industry sector during 2001-04.

Exhibit 33 tabulates supporting data for Exhibit 31.

EXHIBIT 33

Supporting data for Exhibit 31 – defaults split by power, media & telco, infrastructure and other

	Basel Definition of Default					Moody's Definition of Default				
Year of Default	Power	Media & Telecom	Infrastructure	Other	Defaults	Power	Media & Telecom	Infrastructure	Other	Defaults
1990	0	0	0	1	1	0	0	0	1	1
1991	0	0	0	0	0	0	0	0	0	0
1992	3	0	0	3	6	3	0	0	3	6
1993	0	0	0	2	2	0	0	0	2	2
1994	2	0	0	2	4	2	0	0	2	4
1995	4	0	1	1	6	4	0	1	1	6
1996	3	0	1	5	9	3	0	1	4	8
1997	3	1	2	5	11	3	1	2	4	10
1998	4	6	3	7	20	2	4	3	7	16
1999	5	2	2	8	17	4	2	1	8	15
2000	3	2	2	4	11	4	2	2	5	13
2001	15	7	0	9	31	13	6	0	8	27
2002	35	19	4	15	73	33	19	4	15	71
2003	29	5	0	8	42	26	5	0	7	38
2004	11	0	4	2	17	9	1	3	2	15
2005	7	3	1	1	12	5	1	1	1	8
2006	1	0	3	2	6	0	0	3	2	5
2007	1	3	4	0	8	0	3	2	0	5
2008	1	0	2	10	13	1	0	0	10	11
2009	2	0	12	18	32	2	0	5	13	20
2010	7	0	16	9	32	7	0	10	7	24
2011	8	0	15	4	27	3	0	8	3	14
2012	11	0	12	7	30	7	0	9	7	23
2013	12	1	18	7	38	5	1	9	3	18
2014	31	0	11	12	54	15	0	8	8	31
2015	8	1	15	9	33	4	1	5	8	18
2016	19	0	2	6	27	10	0	0	6	16
2017	3	0	3	2	8	0	0	0	1	1
Total	**228**	**50**	**133**	**159**	**570**	**165**	**46**	**77**	**138**	**426**

Notes:
1) 2008 other includes 5 oil & gas defaults (Basel)
2) 2009 other includes 13 oil & gas defaults (Basel)
3) 2010 other includes 6 oil & gas defaults (Basel)

Source: Data Alliance Project Finance Data Consortium

7.4.3 Incidence of defaults 2008-2017 (Basel definition of default)

Exhibit 34 shows the breakdown of defaults during 2008-17, split by the following industry sectors: (1) oil & gas, (2) infrastructure, (3) power and (4) other.

In relation to the oil & gas industry sector during 2008-17 we observe:

- The study data set contains 74 defaults (Basel) in the oil & gas industry sector for 1983-2017, representing 13.0% of all 570 defaults (Basel) in the study data set.
- Of these 74 defaults (Basel), 24 occurred in 2008-10, representing 32.4% of all defaults (Basel) in the oil & gas industry. It is likely that the crash in global oil prices following historic highs in July 2008 contributed to the financial distress of a number of oil & gas projects exposed to commodity price risk.
- In addition, the oil & gas industry sector experienced 15 defaults (Basel) in 2014-15 (20.3% of oil & gas defaults (Basel)) during a period of low global oil prices in late 2014 and 2015.

In relation to the infrastructure industry sector during 2008-17, we observe:

- The study data set contains 133 defaults (Basel) in the infrastructure industry sector, representing 23.3% of all 570 defaults (Basel) in the study data set. Of these defaults (Basel), 99 occurred in 2009-15 and 106 during 2008-17.
- Of the 106 defaults (Basel) that occurred in the infrastructure industry sector in 2008-17, 65 were transportation projects (primarily under-utilized toll roads) 17 were ports projects and 12 were social infrastructure building projects.
- Based on Moody's definition of default, there were 54 defaults that occurred in the infrastructure industry sector during 2008-17, substantially fewer than the 106 defaults (Basel) during the same period. The Basel definition captures a wider range of defaults than our definition of default, including circumstances in which the reporting lender considers that the obligor is unlikely to pay its credit obligations in full. For example, under the Basel definition, defaulted credits would also include debt obligations where (1) the bank puts the credit obligation on non-accrued status; or (2) the bank makes a charge-off or account-specific provision resulting from a significant perceived decline in credit quality.

In relation to the power industry sector during 2008-17, we observe:

- The study data set contains 228 defaults (Basel) in the power industry sector, representing 40.0% of all 570 defaults (Basel) in the study data set for the entire study period. Of these defaults (Basel), 102 occurred in 2008-17.
- The power industry sector experienced an elevated count of defaults (Basel) between 2013-14 (43 defaults (Basel)) and 2016 (19 defaults (Basel)). Twenty-four of the defaults in 2013 and 2014 were concentrated in Spain. The Spanish government enacted several reforms of the electricity sector in 2013 and 2014, which had a significant impact on the economics of the Spanish renewable sector[18]. Defaults (Basel) in 2016 were still concentrated on the renewable sector but show a diversity across countries.

[18] See Sector In-depth report "Regulatory risk for EU renewables investors greatest in Spain, Italy", Oct 2015

EXHIBIT 34

Defaults occurring 2008-17 split by oil & gas, infrastructure, power and other

	Basel Definition of Default					Moody's Definition of Default				
Year of Default	Oil & Gas	Infra	Power	Other	All Defaults	Oil & Gas	Infra	Power	Other	All Defaults
2008	5	2	1	5	13	5	0	1	5	11
2009	13	12	2	5	32	9	5	2	4	20
2010	6	16	7	3	32	6	10	7	1	24
2011	2	15	8	2	27	3	8	3	0	14
2012	1	12	11	6	30	1	9	7	6	23
2013	3	18	12	5	38	0	9	5	4	18
2014	9	11	31	3	54	4	8	15	4	31
2015	6	15	8	4	33	4	5	4	5	18
2016	4	2	19	2	27	4	0	10	2	16
2017	2	3	3	0	8	1	0	0	0	1
Total	**51**	**106**	**102**	**35**	**294**	**37**	**54**	**54**	**31**	**176**

Source: Data Alliance Project Finance Data Consortium

8. Recovery analysis

8.1 Distribution of ultimate recovery rates

Exhibit 35 tabulates the distribution of recovery rates for ultimate recoveries and distressed sales in the study data set:

» The average recovery rate for ultimate recoveries of 77.5% (Basel) and 76.2% (Moody's), exceeds the average recovery rate for distressed sales of 49.4% (Basel) and 47.5% (Moody's). There are many reasons why an individual lender may choose to exit from a defaulted loan exposure via a distressed sale rather than participate in a work-out — see Section 8.8 (Cash-out or Work-out) for further comment.

» The majority of ultimate recoveries, 57.9% (Basel) and 56.6% (Moody's), were fully restructured or repaid with no economic loss calculated on a Net Present Value basis, as described in Section 4.3.

» 42.1% (Basel) and 43.4% (Moody's) of ultimate recoveries experienced an economic loss calculated on a Net Present Value basis, with average ultimate recovery rates for these projects of 46.7% (Basel) and 45.2% (Moody's).

EXHIBIT 35

Distribution of recovery rates

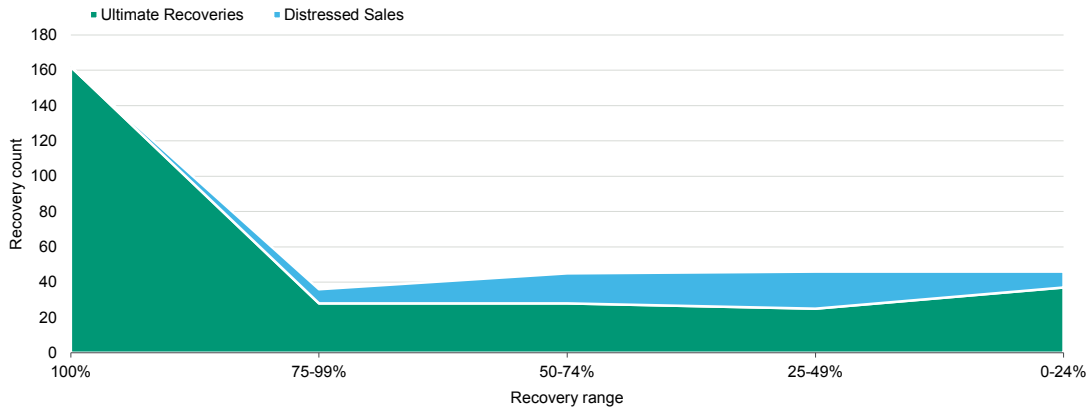
	Basel Definition of Default		Moody's Definition of Default	
Recovery Rates	Ultimate Recoveries	Distressed Sales	Ultimate Recoveries	Distressed Sales
100%	162		138	
75%-99%	28	8	23	4
50%-74%	28	17	26	14
25%-49%	25	21	22	15
0%-24%	37	9	35	9
Total	**280**	**55**	**244**	**42**
Average recovery rate	**77.5%**	**49.4%**	**76.2%**	**47.5%**
% of projects fully restructured without loss	57.9%	0.0%	56.6%	0.0%
Average recovery rate for projects experiencing a loss	46.7%	49.4%	45.2%	47.5%

Source: Data Alliance Project Finance Data Consortium

Exhibit 36 charts the distribution of recovery rate data presented in Exhibit 35 based on the Basel definition of default.

EXHIBIT 36

Distribution of recovery rates (Basel)



Source: Data Alliance Project Finance Data Consortium

The distribution of recovery rates for ultimate recoveries shows a higher proportion of transactions at either end of the recovery spectrum, which is consistent with our observations of ultimate recovery rates for corporate loans.

The study data set also includes 37 projects (13.2% of total recovery rates (Basel)) with ultimate recovery rates of 0%-24%. For project finance loans, very low ultimate recovery rates might be indicative of project abandonment or the occurrence of extreme loss scenarios originally assessed as low probability.

8.2 Ultimate recoveries by year of emergence (Basel definition of default)

Exhibit 37 displays average ultimate recovery rates for ultimate recoveries (Basel) by year of emergence from default during 1999-2017. This year's study data provides additional insight on average ultimate recovery rates in 2015-17 compared with the previous study because it now includes 23 ultimate recoveries (Basel) for 2015-17 compared to just two ultimate recoveries for the period 2015-16 in the previous study. As a result, the average ultimate recovery rate for 2015 improved to 76.1% (Basel) based on three ultimate recoveries from just 37.6% (Basel) based on one ultimate recovery in the March 2018 study.

We exclude calendar years prior to 1999 from Exhibit 37 on the basis that the number of projects emerging from default in each of those years is relatively small.

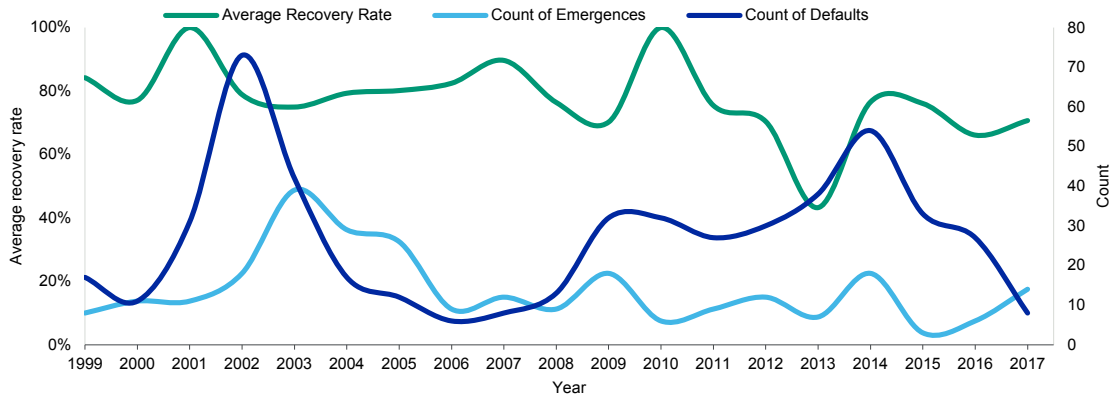
- With the exception of 2013, average ultimate recovery rates (Basel) for project finance bank loans emerging from default in 1999-2017 were 66.1%-100.0%.
- The average ultimate recovery rate (Basel) for 2013 was 43.2%, which appears to be unusually low. The average ultimate recovery rate for 2013 is based on seven projects that emerged from default — two power projects, two infrastructure projects (one of which was reported as a 100% loss), an oil & gas project (reported as a 100% loss), a media project and a manufacturing project. The underlying data does not suggest an emerging trend, and hence the low average recovery rate for 2013 seems to be an unusual outcome.
- Average ultimate recovery rates in 1999-2017 show substantial independence from the incidence of defaults as well as from the incidence of projects emerging from default.
- This observation contrasts with our research on corporate loans and bonds, which has previously found that ultimate recovery rates for defaulted corporate debt facilities are negatively correlated with default rates (meaning, ultimate recovery rates fall as default rates rise).[19]

[19] See Moody's Special Comment: "Syndicated Bank Loans: 2008 Default Review and 2009 Outlook," March 2009

» In Section 7.4.3 above, we highlighted the stress affecting the infrastructure industry sector in 2009-15, as illustrated by the 99 defaults (Basel) reported during that period. As these defaulted projects emerge from default, we will monitor the relationship between default rates and ultimate recovery rates in this sector with interest.

EXHIBIT 37

Average Recovery Rates for Ultimate Recoveries (Basel) by Year of Emergence



Source: Data Alliance Project Finance Data Consortium

Exhibit 38 tabulates average recovery rates for ultimate recoveries by year of emergence, and shows the number of emergences and defaults in each year.

EXHIBIT 38

Average recovery rates for ultimate recoveries by year of emergence

	Basel Definition of Default			Moody's Definition of Default		
Year of Emergence	Average Recovery Rate (Note 1)	Count of Emergences	Count of Defaults	Average Recovery Rate (Note 1)	Count of Emergences	Count of Defaults
1990			1			1
1991			0			0
1992	73.5%	2	6	73.5%	2	6
1993	100.0%	1	2	100.0%	1	2
1994	100.0%	2	4	100.0%	2	4
1995	92.0%	1	6	92.0%	1	6
1996	61.6%	4	9	61.6%	4	8
1997	79.1%	4	11	72.2%	3	9
1998	72.3%	1	20	72.3%	1	17
1999	84.2%	8	17	81.4%	6	15
2000	77.1%	11	11	77.1%	11	11
2001	100.0%	11	31	100.0%	9	30
2002	78.9%	18	73	76.2%	16	70
2003	74.9%	39	42	75.4%	37	38
2004	79.3%	29	17	77.8%	27	14
2005	80.1%	26	12	80.8%	22	9
2006	82.4%	9	6	80.2%	8	5
2007	89.6%	12	8	87.6%	10	6
2008	76.4%	9	13	76.4%	9	12
2009	70.2%	18	32	62.7%	14	22
2010	100.0%	6	32	100.0%	6	22
2011	75.4%	9	27	79.5%	7	16
2012	70.4%	12	30	56.6%	8	25
2013	43.2%	7	38	49.6%	7	18
2014	76.5%	18	54	65.6%	12	26
2015	76.1%	3	33	79.1%	4	18
2016	66.1%	6	27	70.3%	7	15
2017	70.7%	14	8	76.3%	10	1
Total	**77.5%**	**280**	**570**	**76.2%**	**244**	**426**

Notes:
1) Based on 280 total ultimate recoveries (Basel)
2) Based on 244 total ultimate recoveries (Moody's)
Source: Data Alliance Project Finance Data Consortium

8.3 Distribution of certain defaults and ultimate recoveries by region

Exhibit 39 tabulates certain defaults and ultimate recoveries by region. Some regions have small sample sizes and the results presented in the study may change significantly as the study data set is expanded and updated.

EXHIBIT 39

Distribution of certain defaults and ultimate recoveries by region

	Basel Definition of Default					Moody's Definition of Default				
Region	Defaults	Average Years to Default (Note 1)	Defaults (Note 2)	Average Ultimate Recovery Rate (Note 2)	Average Years to Emergence (Note 2)	Defaults	Average Years to Default (Note 3)	Defaults (Note 4)	Average Ultimate Recovery Rate (Note 4)	Average Years to Emergence (Note 4)
Africa	20	5.0	7	67.1%	3.4	17	4.7	7	67.1%	3.2
Asia	59	3.7	40	77.9%	3.6	53	3.6	38	76.8%	3.4
Eastern Europe	14	4.5	4	97.9%	2.0	10	4.4	3	100.0%	2.0
Latin America	64	3.0	32	74.0%	2.6	57	3.2	29	79.5%	2.5
Middle East	6	3.6	4	100.0%	2.0	5	3.4	4	100.0%	1.9
North America	171	3.9	94	76.5%	2.1	140	3.9	84	74.4%	2.1
Oceania	28	4.0	16	77.6%	2.0	25	4.0	16	79.3%	2.0
Western Europe	208	4.9	83	78.7%	2.0	119	4.6	63	74.3%	2.0
Total	**570**	**4.2**	**280**	**77.5%**	**2.3**	**426**	**4.0**	**244**	**76.2%**	**2.3**

Notes:
1) Based on 570 total defaults (Basel)
2) Based on 280 total ultimate recoveries (Basel)
3) Based on 426 total defaults (Moody's)
4) Based on 244 total ultimate recoveries (Moody's)

Source: Data Alliance Project Finance Data Consortium

Based on the Basel definition of default:

- The data shows a broad consistency of average ultimate recovery rates between Latin America, North America, Oceania, Asia and Western Europe, representing a total of 265 out of 280 ultimate recoveries (Basel) lying in the range of 74.0%-78.7%. Other regions such as Africa, Eastern Europe and the Middle East have sample sizes that are too small to support statistically robust conclusions about average ultimate recovery rates.
- The data shows limited variation of average years to default for Latin America, North America, Oceania, Asia, Western Europe, Africa and Eastern Europe, lying in the range of 3.0 to 5.0 years. The sample size for defaults in the Middle East is small and may not support statistically robust conclusions about average years to default.
- The data shows a marked variation of average years to emergence from default for Africa (3.4 years) and Asia (3.6 years) from the study average of 2.3 years. This difference may be due to differences in institutional structures and legal process between these regions. The other regions all have average years to emergence from default in line with the study average.

8.3.1 Distribution of certain defaults and ultimate recoveries by regional subsets

Exhibit 40 tabulates certain defaults and ultimate recoveries broken down by different regional subsets: OECD/non-OECD countries and a subsets of advanced economies/EMDEs. The list of countries included in each of these subsets can be found in Appendix B (Glossary).

EXHIBIT 40

Distribution of certain defaults and ultimate recoveries by regional subsets: OECD/non-OECD countries and advanced economies/EMDEs

	Basel Definition of Default					Moody's Definition of Default				
Region	Defaults (Note 1)	Average Years to Default	Emergences from Default (Note 2)	Average Ultimate Recovery Rate (Note 2)	Average Years to Emergence (Note 2)	Defaults (Note 3)	Average Years to Default	Emergences from Default (Note 4)	Average Ultimate Recovery Rate (Note 4)	Average Years to Emergence (Note 4)
OECD/NON-OECD										
OECD	422	4.4	200	78.4%	2.0	294	4.2	170	76.0%	2.0
NON-OECD	148	3.6	80	75.4%	3.1	132	3.6	74	76.7%	3.1
Advanced Economies/EMDEs										
EEA	218	5.0	85	79.1%	2.0	125	4.6	64	74.7%	2.0
EEA/OECD	426	4.4	201	78.4%	2.0	297	4.2	170	76.0%	2.0
EMDE-A	162	3.6	87	77.4%	3.1	137	3.7	80	79.1%	3.0
EMDE-B	135	3.6	74	74.9%	3.2	120	3.6	69	76.5%	3.1
Total study	**570**	**4.2**	**280**	**77.5%**	**2.3**	**426**	**4.0**	**244**	**76.2%**	**2.3**

Notes:
1) Based on 570 defaults (Basel) included in the total study data set
2) Based on 280 ultimate recoveries (Basel) included in the total study data set
3) Based on 426 defaults (Moody's) included in the total study data set
4) Based on 244 ultimate recoveries (Moody's) included in the total study data set
Default counts for the various advanced economies and EMDE subsets overlap (see Exhibit 20B) and default counts of each subset will not add up to the total study defaults.
Source: Data Alliance Project Finance Data Consortium

Based on the Basel definition of default:

- The average time to default for projects located in OECD countries is modestly higher than the average time to default for projects located in non-OECD countries. Similarly, the average time to default for projects located in EEA and EEA/OECD countries is modestly higher than for projects located in EMDE-A and EMDE-B countries.
- The data indicates a broad consistency of average ultimate recovery rates between OECD and non-OECD countries and also between EEA, EEA/OECD countries and EMDE-A and EMDE-B countries. This result points to the effectiveness of the structural features that characterize project finance and mitigate loss given default (LGD), particularly in emerging market transactions.
- The data shows a marked difference between average years to emergence from default (Basel) for OECD countries (2.0 years) and non-OECD countries (3.1 years) as well as between EEA (2.0 years), EEA/OECD countries (2.0 years) and EMDE-A (3.1 years) and EMDE-B countries (3.2 years). This result indicates that on average projects emerge faster from default in more advanced economies, likely as a result of established institutional structures and predictable legal processes.

8.4 Distribution of certain defaults and ultimate recoveries by industry

Exhibit 41 tabulates certain defaults and ultimate recoveries by industry. It should be noted that some industry sectors have small sample sizes and the results presented in the study may change significantly as the study data set is expanded and updated.

EXHIBIT 41

Average ultimate recovery rate (Basel) by industry

	Average Ultimate Recovery Rate (Basel)				
Project Phase	**0%-20%**	**20%-40%**	**40%-60%**	**60%-80%**	**80%-100%**
Chemicals Production					√
Infrastructure				√	
Leisure & Recreation				√	
Manufacturing				√	
Media & Telecom				√	
Metals & Mining				√	
Oil & Gas				√	
Power					√
Total				√	

Based on 280 total ultimate recoveries (Basel)

Source: Moody's Analytics Project Finance Data Consortium

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Based on the Basel definition of default:

- The data shows a divergence of average ultimate recovery rates between industry sectors within a range of 60%-100%.
- Average ultimate recovery rates differ by industry. Average ultimate recovery rates by industry are disclosed within broad ranges – more detailed information has been withheld at the request of the Data Consortium.
- Ranges of average ultimate recovery rates (Basel) by industry are consistent with those reported in the March 2018 study.
- The data shows a divergence of average years to default between industry sectors within 2.6-5.3 years. It is perhaps unsurprising that the average time to default differs by industry because we would expect to see heterogeneous risk exposures and divergence of transaction features across different industries, which reflect the specific characteristics of each industry.
- The data also shows a divergence of average years to emergence from default between industry sectors for chemicals production, infrastructure, leisure & recreation, manufacturing, media & telecom, metals & mining, oil & gas, and power, within a range 1.3-4.5 years. Other industry sectors have sample sizes that are too small to support statistically robust conclusions about average years to emergence in each of those industries.

8.4.1 PPPs

The study data set contains 1,970 projects identified as PPP projects by the Data Consortium, many of which fall within the infrastructure industry sector. We note, however, that there is some subjectivity in the classification of projects as PPPs.

» The study data set contains 96 defaults (Basel) and 53 defaults (Moody's) in the PPP subsector.

» The study data set contains 28 ultimate recoveries (Basel) and 22 ultimate recoveries (Moody's) in the PPP subsector.

We comment further on our analysis of the PPP subsector in Appendix H (Default and Recovery Analysis for PPP projects).

8.5 Distribution of certain defaults and ultimate recoveries by construction/operations phase

Exhibit 42 tabulates certain defaults and ultimate recoveries, based on whether a loan default occurred during a project's construction or operations phase, meaning whether the default occurred before or after project completion. The Basel default date was used in the analysis to calculate years to default for projects under the Basel definition of default; whereas the actual payment default date was used to calculate years to default under the Moody's definition of default.

EXHIBIT 42

Distribution of defaults and ultimate recoveries by project phase

	Basel Definition of Default					Moody's Definition of Default				
Project Phase	Defaults (Note 1)	Average Years to Default (Note 1)	Count of Emergences (Note 2)	Average Ultimate Recovery Rate (Note 2)	Average Years to Emergence (Note 2)	Defaults (Note 3)	Average Years to Default (Note 3)	Count of Emergences (Note 4)	Average Ultimate Recovery Rate (Note 4)	Average Years to Emergence (Note 4)
Construction	82	2.6	40	69.8%	2.7	61	2.6	37	69.8%	2.8
Operations	476	4.5	234	78.9%	2.3	357	4.3	205	77.4%	2.5
Total	**558**	**4.2**	**274**	**77.5%**	**2.4**	**418**	**4.0**	**242**	**76.3%**	**2.5**

Notes:
1) Based on 558 defaults (Basel)
2) Based on 274 ultimate recoveries (Basel)
3) Based on 418 defaults (Moody's)
4) Based on 242 ultimate recoveries (Moody's)

Source: Data Alliance Project Finance Data Consortium

» There is a material difference between (1) the average ultimate recovery rate for construction phase defaults, of 69.8% (Basel, Moody's); and (2) the average ultimate recovery rate for operations phase defaults, of 78.9% (Basel) and 77.4% (Moody's). Project finance lenders typically seek loan margins that are higher during the construction phase than during early stage operations, for example, banks often price-in incremental risk during a project's construction phase.

» The data shows a difference between (1) the average years to default from financial close for construction phase defaults, of 2.6 years (Basel, Moody's); and (2) the average years to default from financial close for operations phase defaults, of 4.5 years (Basel) and 4.3 years (Moody's). In theory, we would expect construction phase defaults to cluster around key construction milestones and/or completion dates because this is when success or failure becomes apparent. Moreover, this may explain why the average years to default for construction phase defaults (2.6 years (Basel, Moody's)) are consistent with construction programs, which are often scheduled to complete within two to four years from financial close. The short average years to default for projects in operations (4.5 years (Basel) and 4.3 years (Moody's)) indicates that some projects have defaulted just shortly after construction completion, or in the initial phase of operations when start-up challenges are common and demand/volumes can turn out to fall substantially short of initial expectations. We include an analysis of the primary causes of default in Appendix J.

» The data shows a similarity between the average years to emergence for construction phase defaults (Basel) of 2.7 years and operations phase defaults (Basel) of 2.3 years. These results align with our expectation that a work-out process following a construction phase default would likely be more

complex and take longer than a work-out process following an operations phase default. The study data set contains several construction phase projects that defaulted just prior to commercial operations and were subsequently restructured within a very short time frame. These incidents have lowered the average time to emergence for construction phase defaults.

» Findings reported above are consistent with the previous study's findings for defaults and recovery rates by project phase.

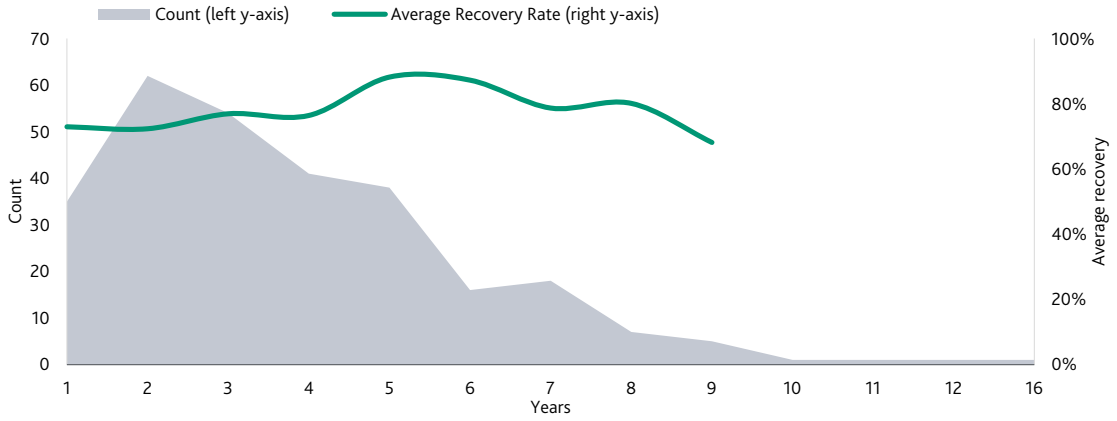
8.6 Average ultimate recovery rates by number of years to default (Basel definition of default)

Exhibit 43 charts average ultimate recovery rates for the 280 ultimate recoveries (Basel), by time to default.

The study data set shows no discernable relationship between average ultimate recovery rates and when the defaults occurred. In making this observation, we have ignored certain defaults (Basel) occurring ten or more years after financial close, since sample sizes are too small to support statistically robust conclusions about average ultimate recovery rates in those years.

EXHIBIT 43

Average ultimate recovery rates by number of years to default (Basel definition of default)



Source: Data Alliance Project Finance Data Consortium

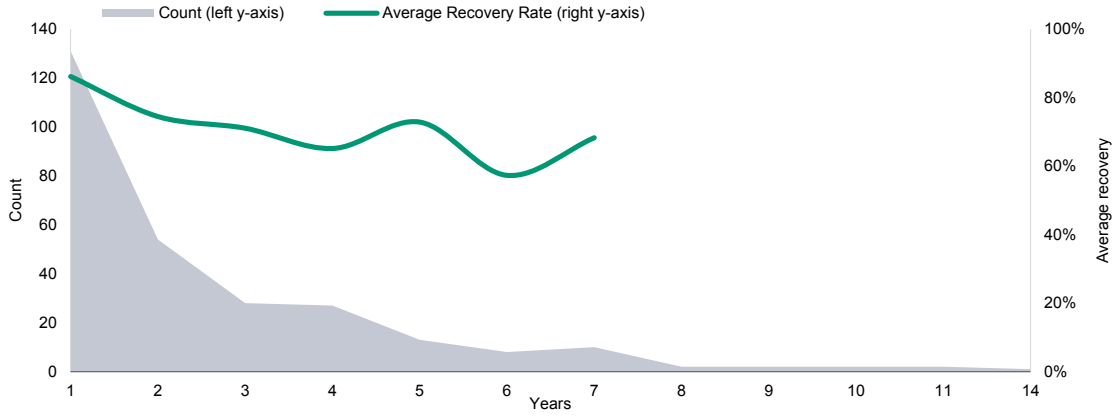
8.7 Average ultimate recovery rates by number of years to emergence (Basel definition of default)

Exhibit 44 charts average ultimate recovery rates for the 280 ultimate recoveries (Basel), by time to emergence from default.

The data indicates that average ultimate recovery rates are lower for project finance bank loans that take longer to emerge from default. However, the results shown in Exhibit 44 should be interpreted with caution where the number of loans emerging from default after t years spent in default are low (i.e., for $t \geq 8$ years).

EXHIBIT 44

Average ultimate recovery rate by number of years to emergence (Basel definition of default)



Source: Data Alliance Project Finance Data Consortium

8.8 Cash-out or work-out?

A key conclusion for the study data set is that the average recovery rate for ultimate recoveries, of 77.5% (Basel) and 76.2% (Moody's) exceeds the average recovery rate for distressed sales, of 49.4% (Basel) and 47.5% (Moody's) (see Exhibit 35).

The data shows that when a lender chooses to realize recoveries from a defaulted loan via a distressed sale, the average economic loss is likely to be substantially higher than if the lender "worked-out" the defaulted loan.

We have observed similar results for corporate bank loans. Indeed, our Ultimate LGD Database shows that ultimate recoveries for loans exceeded the corresponding trading price 30 days after default in most cases. However, there are many reasons why an individual lender may choose to exit from a defaulted loan exposure via a distressed sale rather than participate in a work-out. For example:

- Risk aversion: The work-out process carries a number of risks and uncertainties for lenders, including:
- Uncertainty over the timing of emergence from default following a work-out
- Uncertainty over the timing and amount of ultimate recovery cash flows
- Potential exposure to incremental costs or cash calls
- Potential exposure to liability following assumption of control of a defaulted project
- Portfolio exposure limits may constrain a lender's ability to work-out multiple defaults simultaneously
- Resource intensive nature of work-outs:
  - The cost of deploying suitably experienced staff to monitor and participate in a work-out process can be considerable.
  - The consumption of senior management and credit oversight time may also be a significant burden.
- Preferences: time-value of money; cash flow and accounting impact:
  - Based on an analysis of the likely ultimate recovery prospects and risks, the lender may view a prospective bidder's price as attractive.
  - An exit from a defaulted loan position via a distressed sale will accelerate cash flow recoveries, compared to a work-out process. As indicated in Sections 8.3 and 8.4, for the study data set, the

average time to emergence from default for ultimate recoveries (Basel) is 2.4 years, although the timeframe for emergence from default may vary significantly between projects.

- The decision to exit from a defaulted loan position via a distressed sale will almost certainly result in a different profit and loss (P&L) impact compared to a work-out process. The significance of this differential P&L impact will depend on the individual lender's circumstances. However, it may give rise to a preference for either exiting via an immediate distressed sale, or deferring such a decision and continuing with the work-out process.

9. Analysis of time to default and time to emergence by industry

In this section, we further examine the relationship between time to default and time to emergence by industry sector.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

10. Exposure at default

Exposure at default (EAD) is calculated as the ratio of the amount outstanding at the time of default to the committed exposure at the time of default.

The average EAD for the study data set is 82.7% (Basel). Approximately 49.3% of the observations had an EAD of 100%.

Exhibit 53 tabulates exposure at default by region.

EXHIBIT 53

Regional analysis of exposure at default

	Basel Definition of Default		Moody's Definition of Default	
Region	Defaults (Note 1)	EAD	Defaults (Note 2)	EAD
Africa	7	92.4%	7	92.4%
Asia	40	80.6%	38	81.5%
Eastern Europe	4	100.0%	3	100.0%
Latin America	32	73.4%	29	72.8%
Middle East	4	88.9%	4	88.9%
North America	94	84.0%	84	83.7%
Oceania	16	71.3%	16	71.3%
Western Europe	83	85.9%	63	87.9%
Total	**280**	**82.7%**	**244**	**82.9%**

Notes:
1) The data presented above is based on 280 ultimate recoveries (Basel)
2) The data presented above is based on 244 ultimate recoveries (Moody's)
Source: Data Alliance Project Finance Data Consortium

Exhibit 54 tabulates exposure at default by industry.

EXHIBIT 54

Industry analysis of exposure at default

	Basel Definition of Default		Moody's Definition of Default	
Industry Sector	Defaults (Note 1)	EAD	Defaults (Note 2)	EAD
Chemicals Production	11	69.6%	11	69.6%
Infrastructure	41	91.3%	33	90.8%
Leisure & Recreation	3	100.0%	3	100.0%
Manufacturing	14	72.2%	14	72.2%
Media & Telecom	40	76.6%	36	76.7%
Metals & Mining	25	85.2%	24	85.8%
Oil & Gas	35	84.9%	34	83.5%
Power	109	82.4%	89	84.1%
Total	**280**	**82.7%**	**244**	**82.9%**

Notes:
1) The data presented above is based on 280 ultimate recoveries (Basel)
2) The data presented above is based on 244 ultimate recoveries (Moody's)
Source: Data Alliance Project Finance Data Consortium

11. Time horizon 1995-2017

Overview of regional subsets for time horizon 1995-2017

Exhibit 55 tabulates the 10-year CDR (Basel) and average ultimate recovery rate (Basel) by regional subset for a curtailed time horizon from 1 January 1995 to 31 December 2017. Ten-year CDRs (Basel) for the curtailed time horizon are modestly below those for the study period 1983-2017 across all regional subsets. Average ultimate recovery rates (Basel) show some differences for the curtailed time horizon but remain overall consistent with our findings for the extended time horizon and do not exhibit a consistent trend across regional subsets as observed for the 10-year CDR (Basel).

EXHIBIT 55

Key findings by regional subset – time horizon 1995-2017 (Basel definition of default)

Region	Project Count	Default Count (Basel definition)	10-year Cumulative Default Rate (Basel definition)	Average Ultimate Recovery Rate
OECD/Non-OECD				
OECD (1995-2017)	6,370	382	5.8%	78.2%
Non-OECD (1995-2017)	1,590	132	5.9%	73.0%
Advanced Economies/EMDEs				
EEA (1995-2017)	3,561	210	4.8%	78.4%
EEA/OECD (1995-2017)	6,400	386	5.1%	78.3%
EMDE-A (1995-2017)	3,561	144	6.9%	74.9%
EMDE-B (1995-2017)	1,169	119	7.6%	72.1%
All subsets (1995-2017)	7,569	505	5.4%	76.7%
Total Study (1995-2017)	**7,960**	**514**	**5.2%**	**76.7%**

1) Please see Appendix B (Glossary) for a list of countries and definition of each of the regional subsets.
2) Subsets for Advanced Economies/EMDEs and exclude certain projects included in the total study data set (see Exhibit 20B).
Source: Data Alliance Project Finance Data Consortium

12. Appendices

Appendix A: Summary and list of ultimate recoveries

Summary of ultimate recoveries – by region and by industry

Appendix A summarizes the study data set's ultimate recoveries by region and by industry.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Appendix B: Glossary

Basel III Framework	See "Basel III: Finalising post-crisis reforms", December 2017, published by the Basel Committee on Banking Supervision.
Corporate Bank Loan Data Set	A data set of corporate bank loans (predominantly senior secured) derived from Moody's Ultimate LGD Database, as further described in Appendix D (Comparison of LGD behavior of Project Finance and Corporate Loans).
Cumulative Default Rates	Cumulative default rates are calculated from the weighted average marginal default rates (hazard rates) for all cohorts, based on the methodology described in Section 7.1 (Cohort Analysis: 1990-2017).
Moody's Analytics Data Alliance – Project Finance Data Consortium	A consortium of leading project finance lenders and investors that provide historical portfolio and credit loss data to Moody's Analytics for the purpose of creating an aggregate data set. For further information see the About the Moody's Analytics Data Alliance on page 78.
Default (Basel)	A default based on the Basel III definition of default. We include below, relevant extracts from the Basel III Framework (page 93): "… *220. A default is considered to have occurred with regard to a particular obligor when either or both of the two following events have taken place.* » *The bank considers that the obligor is unlikely to pay its credit obligations to the banking group in full, without recourse by the bank to actions such as realising security (if held).* » *The obligor is past due more than 90 days on any material credit obligation to the banking group. Overdrafts will be considered as being past due once the customer has breached an advised limit or been advised of a limit smaller than current outstandings.* *221. The elements to be taken as indications of unlikeliness to pay include:* » *The bank puts the credit obligation on non-accrued status.* » *The bank makes a charge-off or account-specific provision resulting from a significant perceived decline in credit quality subsequent to the bank taking on the exposure.* » *The bank sells the credit obligation at a material credit-related economic loss.* » *The bank consents to a distressed restructuring of the credit obligation where this is likely to result in a diminished financial obligation caused by the material forgiveness, or postponement, of principal, interest or (where relevant) fees.* » *The bank has filed for the obligor's bankruptcy or a similar order in respect of the obligor's credit obligation to the banking group.* » *The obligor has sought or has been placed in bankruptcy* or similar protection *where this would avoid or delay repayment of the credit obligation to the banking group…"* This definition of default is the same as that published by the Basel Committee on Banking Supervision in its Basel II Framework.
Default (Moody's)	A default based on Moody's definition of default. Moody's definition of default is applicable only to debt or debt-like obligations (e.g., swap agreements). For details, please refer to Moody's Rating Symbols and Definitions.
Default In Work-Out (Basel)	A default (Basel) still in the work-out process.
Default In Work-Out (Moody's)	A default (Moody's) still in the work-out process.
Distressed Sale (Basel)	A default (Basel) for which a recovery has been realized following a distressed sale of a defaulted loan participation.
Distressed Sale (Moody's)	A default (Moody's) for which a recovery has been realized following a distressed sale of a defaulted loan participation.
Emergence From Default	For a loan which has defaulted, emergence from default is deemed to occur following any of the events set out below: » Repayment of overdue interest » Restructuring with no subsequent default » Restructuring with lender being taken out of the deal – for example, by repayment of the defaulted loan with no participation in a restructured debt facility » Material restructuring » Liquidation
EAD	Exposure at Default is calculated as the ratio of the amount outstanding at the time of default, to the committed exposure at the time of default.
EEA	The European Economic Area (EEA) is the area in which the agreement on the EEA provides for the free movement of persons, good, services and capital within the European Single Market. The EEA includes the 28 member countries of the European Union and Norway, Iceland and Liechtenstein. For additional information and a list of all EU Member States, please see: http://www.efta.int/eea and https://europa.eu/european-union/about-eu/countries_en

EEA/OECD	Projects located in countries within the EEA or OECD regions may qualify for lower regulatory capital under Solvency II, the European regulatory regime for insurers. For more information on the Solvency II Delegated Regulation, see https://eiopa.europa.eu/regulation-supervision/insurance/solvency-ii.
EMDE-A	Our EMDE-A subset comprises projects located in countries that were classified by the World Bank Group as non-high-income, on average, over the period 1995-2017 but excluding certain US dependent territories. The subset EMDE-A includes project finance bank loans in the following countries: Algeria, Angola, Argentina, Armenia, Azerbaijan, Bangladesh, Benin, Bolivia, Botswana, Brazil, Bulgaria, Burkina Faso, Cabo Verde, Cameroon, Chad, Chile, China, Colombia, Costa Rica, Croatia, Czech Republic, Democratic Republic of Congo, Djibouti, Dominican Republic, Ecuador, Egypt, El Salvador, Equatorial Guinea, Estonia, Ethiopia, Fiji, Gabon, Ghana, Guatemala, Guinea, Guyana, Honduras, Hungary, India, Indonesia, Iran, Ivory Coast, Jamaica, Jordan, Kazakhstan, Kenya, Lao PDR, Lebanon, Lesotho, Liberia, Lithuania, Macedonia, Madagascar, Malawi, Malaysia, Mali, Mauritania, Mauritius, Mexico, Moldova, Mongolia, Morocco, Mozambique, Namibia, Niger, Nigeria, Pakistan, Papua New Guinea, Peru, Philippines, Poland, Romania, Russia, Senegal, Sierra Leone, Slovakia, Solomon Islands, South Africa, Sri Lanka, Syria, Tanzania, Thailand, Timor-Leste, Tunisia, Turkey, Turkmenistan, Uganda, Ukraine, Uzbekistan, Venezuela, Vietnam, Yemen, Zambia, Zimbabwe.
EMDE-B	The EMDE-B subset consists of all countries included in subset EMDE-A but excludes those countries that are located in the EEA or are OECD countries (i.e. Bulgaria, Chile, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Mexico, Poland, Romania, Slovakia, Turkey).
Industry Data Set	The population of all project finance bank loans originated from 1 January 1983 – 31 December 2017, based on industry data provided by Refinitiv Project Finance International.
Marginal Default Rate	The marginal default rate (hazard rate) is the ratio of the number of project defaults in a specific time period divided by the number of projects exposed to the risk of default at the beginning of that time period. For the purposes of this study, marginal default rates have been calculated on a monthly basis.
Moody's Ultimate LGD Database	Moody's proprietary database which contains information on nearly 5,600 defaulted loans and bonds taken from over 1,100 non-financial US corporations that initially defaulted since 1987.
OECD	The OECD currently has 36 member countries: Australia, Austria, Belgium, Canada, Chile, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea, Latvia, Luxembourg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, United Kingdom, and United States. Latvia joined the OECD as its 35th member on July 1, 2016 and Lithuania joined the OECD on July 1, 2018. The study data set does not include yet any projects located in Lithuania in the OECD subset because it joined the OECD after the study period.
Project Finance	We reproduce below the Basel III definition of Project Finance: *"…* *8. In general, a corporate exposure is defined as a debt obligation of a corporation, partnership, or proprietorship. Banks are permitted to distinguish separately exposures to small- and medium-sized entities (SME), as defined in paragraph 54.* *9. In addition to general corporates, within the corporate asset class, five sub-classes of specialised lending (SL) are identified. Such lending possesses all the following characteristics, either in legal form or economic substance:* *» The exposure is typically to an entity (often a special purpose entity (SPE)) which was created specifically to finance and/or operate physical assets;* *» The borrowing entity has little or no other material assets or activities, and therefore little or no independent capacity to repay the obligation, apart from the income that it receives from the asset(s) being financed;* *» The terms of the obligation give the lender a substantial degree of control over the asset(s) and the income that it generates; and* *» As a result of the preceding factors, the primary source of repayment of the obligation is the income generated by the asset(s), rather than the independent capacity of a broader commercial enterprise.* *10. The five sub-classes of specialised lending (SL) are project finance, object finance, commodities finance, income-producing real estate, and high-volatility commercial real estate. Each of these sub-classes is defined below.* *Project finance* *11 Project finance (PF) is a method of funding in which the lender looks primarily to the revenues generated by a single project, both as the source of repayment and as security for the exposure. This type of financing is usually for large, complex and expensive installations that might include, for example, power plants, chemical processing plants, mines, transportation infrastructure, environment, and telecommunications infrastructure. Project finance may take the form of financing of the construction of a new capital installation, or refinancing of an existing installation, with or without improvements.* *12. In such transactions, the lender is usually paid solely or almost exclusively out of the money generated by the contracts for the facility's output, such as the electricity sold by a power plant. The borrower is usually an SPE that is not permitted to perform any function other than developing, owning, and operating the installation. The consequence is that repayment depends primarily on the project's cash flow and on the collateral value of the project's assets. In contrast, if repayment of the exposure depends primarily on a well-established, diversified, credit-worthy, contractually obligated end user for repayment, it is considered a secured exposure to that end-user…"* The Basel III definition of Project Finance is the same as that published by the Basel Committee on Banking Supervision in its Basel II Framework
PPP	A public sector procurement structured as a public private partnership. There exists no standard definition of what constitutes a PPP. A PPP is often defined as a long-term contractual agreement between a public sector governmental entity and a private developer to

	design, build, finance, operate and/or maintain an infrastructure asset for a specific period. The classification of a project as a PPP project in this addendum is based on its classification by the Data Consortium and involves some subjectivity. PPP projects are often referred to as P3 projects.
Study data set	The aggregated data set for the study, based on data provided by the Data Consortium. The study data set includes 8,257 projects which account for 69.4% of all project finance bank loans originated globally during a period from 1 January 1983 to 31 December 2017.
Ultimate Recovery (Basel)	A default (Basel) for which recoveries have been realized following emergence from default, as defined above.
Ultimate Recovery (Moody's)	A default (Moody's) for which recoveries have been realized following emergence from default, as defined above.
World Bank Group Country Classification	For the fiscal year 2019, the World Bank Group defines low-income economies as those with a gross national income (GNI) per capita of $995 or less in 2017; lower-middle-income economies as those with GNI per capita between $996 and $3,895; upper-middle-income economies are those with a GNI per capita between $3,896 and $12,055; high-income economies are those with a GNI per capita of $12,056 or more. For a full definition of World Bank Group Country Classification and list of countries by category, see https://datahelpdesk.worldbank.org/knowledgebase/articles/906519-world-bank-country-and-lending-groups.
Africa	Africa includes projects in Algeria, Angola, Benin, Botswana, Burkina Faso, Cabo Verde, Cameroon, Chad, Democratic Republic of the Congo, Côte d'Ivoire, Djibouti, Egypt, Equatorial Guinea, Ethiopia, Gabon, Ghana, Guinea, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Senegal, Sierra Leone, South Africa, Tanzania, Tunisia, Uganda, Zambia, Zimbabwe
Asia	Asia includes projects in Bangladesh, Brunei, China, Hong Kong, India, Indonesia, Japan, Kazakhstan, Lao PDR, Macau, Malaysia, Mongolia, Myanmar, Pakistan, Papua New Guinea, Philippines, Singapore, South Korea, Sri Lanka, Taiwan, Thailand, East Timor, Turkmenistan, Uzbekistan, and Vietnam
Eastern Europe	Eastern Europe includes projects in Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Lithuania, Macedonia, Moldova, Poland, Romania, Russia, Slovakia, Slovenia, and the Ukraine
Latin America	Latin America includes projects in Argentina, Aruba, Bahamas, Bolivia, Brazil, Cayman Islands, Chile, Colombia, Costa Rica, Dominican Republic, Ecuador, El Salvador, Guadeloupe, Guatemala, Guyana, Honduras, Jamaica, Panama, Peru, Puerto Rico, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela, and the Virgin Islands
Middle East	Middle East includes projects in Armenia, Azerbaijan, Bahrain, Iran, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syria, Turkey, United Arab Emirates, and Yemen
North America	North America includes projects in Bermuda, Canada, the United States of America, and Mexico
Oceania	Oceania includes projects in Australia, Fiji, Guam, Marshall Islands, New Zealand, and the Solomon Islands
Western Europe	Western Europe includes projects in Austria, Belgium, Cyprus, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Isle of Man, Italy, Jersey, Luxembourg, Malta, the Netherlands, Norway, Portugal, Spain, Switzerland, Sweden, and the United Kingdom

Appendix C: Overview of project finance characteristics

The study shows that project finance is a resilient class of specialized corporate lending. The 10-year CDR for project finance bank loans is consistent with 10-year CDRs for corporate issuers of low investment grade credit quality. The study also shows that marginal annual default rates improve significantly over time – in particular, marginal annual default rates are consistent with high speculative grade credit quality during an initial three year period following cohort formation, but fall significantly thereafter, trending towards marginal default rates consistent with single-A category corporate ratings by year seven from cohort formation.

The study shows that ultimate recovery rates for the project finance asset class have been consistently high over time, across regions and across industry sectors (although the variation of ultimate recovery rates by industry sector is marked), and that ultimate recovery rates for project finance bank loans are similar to ultimate recovery rates for senior secured corporate bank loans. This observation is despite features such as high gearing and long tenors that are typical for project finance loans, but generally associated with higher risk corporate loans.

While most project finance borrowers are highly leveraged, thinly capitalized special purpose vehicles with limited financial flexibility, project finance loans tend to be structured to be both highly robust to a wide range of potentially severe risks, and to minimize any post-default economic loss. The findings of the study suggest that the risk allocation, structural features, underwriting disciplines and incentive structures which characterize the project finance asset class have proved effective. We highlight a number of these features below, and discuss their significance in minimizing default risk and loss given default.

Typical characteristics which mitigate default risk

» Construction risk substantially transferred to a construction contractor through a bespoke turnkey construction contract to deliver a functional asset within an agreed timetable, to a fixed budget, and to meet required performance parameters. Contractor performance risk is typically mitigated through an appropriate incentive structure within the construction contract, including provisions for liquidated damages. Contractor counterparty credit risk would be mitigated as necessary by financial support instruments such as bank letter of credits, or other performance support instruments.

» Predictable, resilient revenue stream over the long term, especially where revenue risk is transferred through an offtake contract that mitigates project company's exposure to price risk and demand risk

» Detailed appraisal of whole life operating & maintenance costs, and periodic capital maintenance expenditures

» Covenant structure which controls the scope of the project, underpinning a predictable trajectory for the business of project company such that the business cannot evolve outside its pre-agreed core scope

» Protective forward-looking covenants, reserving mechanisms, cash traps and other structural features which mitigate liquidity risk — in other words, project company's ability to withstand transient cash flow strain. Project finance transactions are ideally structured to avoid refinancing risk by raising all necessary funding at an initial financial close — however, market tolerance of refinancing risk has evolved differently across geographical markets

» Detailed due diligence by lenders' advisors — for example, technical advisors, market consultants, legal advisors, insurance advisors, accounting & tax advisors, and/or other advisors as relevant. All concerns raised by lenders' advisors to be addressed to lenders' satisfaction

- Preparation of a detailed financial model based on lenders' base case assumptions and evaluation of the project's resilience to severe downside stress scenarios. The financial model and designated sensitivities would typically be subject to audit prior to financial close
- Detailed appraisal by lenders of all aspects of the project, and negotiation of key terms where relevant to ensure that key risks are identified, allocated and mitigated such that residual risk is within acceptable parameters – i.e., bankable
- Pro-active monitoring by agents, representatives and/or advisors acting on behalf of senior lenders. The scope of information provision by project company and monitoring oversight is typically greater than for traditional corporate borrowers. Enhanced reporting and monitoring controls may be triggered by poor technical performance, or weak cash flows

Typical characteristics which mitigate loss given default

- Senior secured lenders benefit from first ranking security interests over all material assets, including contractual rights and intellectual property held by project company. Such security interests would generally be perfected on or before financial close — i.e., legal, valid, binding and enforceable
- Step-in regime (i.e., step-in, cure, and step-out rights) pre-agreed with project company's key contractual counterparties to provide senior secured lenders with appropriate rights and sufficient time to remedy a default by project company. Threshold covenants may be triggered before senior lenders actually incur any economic loss
- Pre-agreed intercreditor arrangements, including decision-making and voting procedures that establish senior lender control rights up-front
- Structural mitigation of the risk that other creditor claimants might emerge during a bankruptcy or administration process to challenge pre-agreed intercreditor rights and security interests
- Strategic or essential nature of the project which underpins the project's ongoing profitable operation (although it might well be the case that while a defaulted project is profitable at the operating level it may be unable to meet its debt service obligations in full)
- The project's structure creates incentives for the various stakeholders to mitigate economic loss following a default

Appendix D: Comparison of LGD behavior of project finance and corporate loans

We compared corporate bank loan LGD data from our Ultimate LGD Database to the results of the LGD analysis for the study data set.

The corporate recovery data set (the Corporate Bank Loan Data Set) was created using Moody's Ultimate LGD Database, which contains information on nearly 5,600 defaulted loans and bonds taken from over 1,100 non-financial US corporations that initially defaulted since 1987. It should be noted that the average ultimate recovery rate for the instruments below represents the average ultimate recovery rate for defaulted debt — it does not represent the average firm-wide ultimate recovery rate for defaulted companies, which would likely be substantially lower.[20]

The results compare as follows:[21]

EXHIBIT D1

Corporate debt ultimate recovery rates by debt class, 1987-2017

	Emergence Year			Default Year		
Lien Position	2017	2016	1987-2017	2017	2016	1987-2017
Loans	81.3%	72.6%	80.4%	80.2%	78.3%	80.4%
Bonds						
Senior Secured Bonds	52.3%	35.9%	62.3%	57.5%	46.9%	62.3%
Senior Unsecured Bonds	54.1%	11.7%	47.9%	47.4%	29.2%	47.9%
Subordinated Bonds	4.5%	6.6%	28.0%	n.a.	8.0%	28.0%

Source: Moody's Investors Service

EXHIBIT D2

Ultimate recovery rates – corporate bank loan data set compared to the study data set, 1987-2017

Data Set	Average Recovery	Standard Deviation
Corporate Bank Loan Data Set (All Loans)	80.4%	30.5%
Corporate Bank Loan Data Set (Senior Secured Loans)	84.9%	26.1%
Study data set (Basel Definition Of Default)	77.5%	33.9%
Study data set (Moody's Definition Of Default)	76.2%	34.4%

Note: Exhibit D1 is taken from Moody's Data Report "Corporate Default and Recovery Rates, 1990-2017", published February 2018 and Exhibit D2 is taken directly from Moody's Database which might have been updated following publication of the Data Report.

Source: Moody's Investors Service

The senior secured loans within the Corporate Bank Loan Data Set averaged a recovery of 84.9% (versus 80.4% for all loans) between 1987-2017.

The study shows that ultimate recovery rates for project finance loans are substantially uncorrelated with a number of factors that are key determinants of ultimate recovery rates for corporate debt facilities:

[20] As stated in Moody's Special Comment "Lessons from 1,000 Corporate Defaults" November 2011, for 1988-2011, the average firm-wide ultimate recovery rate for defaulted companies was 54.5%

[21] See Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018

» We have stated in previous research on corporate debt that two of the most important variables in determining recovery rates of defaulted debt are the legal jurisdiction of a defaulted company and its debt structure. We comment below on the influence of these factors on ultimate recovery rates for both data sets.

» We also discuss below a significant emerging factor affecting recovery rates for defaulted corporate debt: type of default.

» We have stated in previous research on corporate debt that default rates are negatively correlated with recovery rates. We comment further below on the correlation of default rates and recovery rates.

Impact of legal jurisdiction

Although the legal jurisdiction of a defaulted company is an important determinant of recovery rates for corporate debt, the results of the study provide mixed findings with respect to the importance of the legal jurisdiction of a project's host country as a key determinant of recovery rates for project finance bank loans. Exhibit 40 shows that average ultimate recovery rates (Basel) for OECD and non-OECD countries and for advanced economies/EMDE subsets are similar and consistent with the study average.

For project finance transactions, project documentation and onshore security arrangements will typically be governed by local law, while finance documentation and offshore security arrangements will typically be governed by New York law or English law. Exhibit 39 (distribution of certain defaults and ultimate recoveries by region) shows a broad consistency of average ultimate recovery rates (Basel) for Latin America, North America, Oceania, Asia and Western Europe (representing a total of 265 out of 280 Ultimate Recoveries (Basel) lying in the range of 74.0%-78.7%).

Impact of debt structure

While debt structure is an important determinant of recovery rates for corporate debt, it is less significant for project finance transactions.

Corporate debt structures often include a sizable proportion of debt that is contractually subordinated to the bank debt as a percentage of total debt. This debt cushion enhances average ultimate recovery rates for senior lenders to corporates to levels similar to average ultimate recovery rates for the study data set.

The importance of debt structure in determining recovery rates for corporate debt was emphasized in Moody's Special Comment "Lessons from 1000 Corporate Defaults" published in November 2011:

At its simplest, the funding structure for a project finance transaction will comprise one or more pari passu senior secured debt facilities and sponsor equity. For complex international project financings, pari passu senior secured debt facilities might be raised from a number of different sources (for example, commercial banks, one or more export credit agencies, and/or a project bond). Potentially, subordinated secured debt facilities might also be raised from third-party funders. Although sponsor funding might be provided in the form of deeply subordinated unsecured debt rather than in the form of share capital, such debt facilities would generally be regarded as quasi-equity. Hence, typical project finance transactions would have no more than two layers of debt at most — i.e., senior secured debt facilities and third-party subordinated secured debt facilities.

Where third-party subordinated secured debt is raised, intercreditor arrangements are typically such that the security interests and intercreditor rights of subordinated secured funders are deeply subordinated and these creditors should not be able to materially or adversely impact the ability of senior secured creditors to enforce their first ranking security interests and exercise their own intercreditor rights. Accordingly, the

presence of third-party deeply subordinated debt should not materially impact on the project's senior secured debt capacity, nor should it materially affect the default and recovery experience of senior secured lenders. In other words, third-party subordinated debt in project finance transactions typically provides no beneficial debt cushion to senior secured funders. However, the presence of subordinated debt on terms which are less than deeply subordinated may actually increase default risk and erode recovery performance for senior secured lenders.

Impact of default type

Moody's definition of default includes the following four types of default events:

» a missed or delayed disbursement of a contractually obligated interest or principal payment (excluding missed payments cured within a contractually allowed grace period), as defined in credit agreements and indentures;

» a bankruptcy filing or legal receivership by the debt issuer or obligor that will likely cause a miss or delay in future contractually obligated debt service payments;

» a distressed exchange whereby 1) an issuer offers creditors a new or restructured debt, or a new package of securities, cash or assets, that amount to a diminished value relative to the debt obligation's original promise and 2) the exchange has the effect of allowing the issuer to avoid a likely eventual default;

» a change in the payment terms of a credit agreement or indenture imposed by the sovereign that results in a diminished financial obligation, such as a forced currency re-denomination (imposed by the debtor or the debtor's sovereign) or a forced change in some other aspect of the original promise, such as indexation or maturity.

We include distressed exchanges in our definition of default in order to capture credit events whereby issuers effectively fail to meet their debt service obligations but do not actually file for bankruptcy or miss an interest or principal payment. We employ fundamental analysis in assessing the likelihood of future default and considers various indicators in assessing loss relative to the original promise, which may include the yield to maturity of the debt being exchanged.

Moody's definition of default does not include so-called "technical defaults," such as maximum leverage or minimum debt coverage violations, unless the obligor fails to cure the violation and fails to honor the resulting debt acceleration which may be required. Also excluded are payments owed on long-term debt obligations that are missed due to purely technical or administrative errors which are (1) not related to the ability or willingness to make the payments; and (2) are cured in very short order (typically one to two business days). Finally, in select instances based on the facts and circumstances, missed payments on financial contracts or claims may be excluded if they are the result of legal disputes regarding the validity of those claims.

Correlation of default rates and recovery rates

In Moody's Special Comment: "Syndicated Bank Loans: 2008 Default Review and 2009 Outlook," March 2009, we note that default rates for corporate bank loans are negatively correlated with recovery rates.[22]

[22] The relationship between default rates and recovery rates on corporate debt facilities has been discussed in Moody's research, as well as external research. A negative correlation between default rates and recovery rates is consistent with the hypothesis that a larger supply of defaulted debt depresses the ultimate recovery and the prices of such defaulted debt. For further background discussion, see Moody's Special Comment Syndicated Bank Loans: 2008 Default Review and 2009 Outlook," March 2009.

In contrast, ultimate recovery rates (Basel) for the study data set appear to be substantially independent of both the economic cycle at default and the economic cycle at emergence. In particular, Exhibit 37 (average recovery rates for ultimate recoveries (Basel) by year of emergence) shows that:

With the exception of 2013 (average ultimate recovery rate (Basel) of 43.2%), average ultimate recovery rates (Basel) for project finance bank loans emerging from default between 1999-2017 ranged from 66.1%-100.0%, and show substantial independence from the incidence of defaults.

Similarly, average ultimate recovery rates 1999-2017 show substantial independence from the incidence of projects emerging from default.

We exclude calendar years prior to 1999 from our analysis on the basis that the number of projects emerging from default in each of those years is relatively small.

Summary

The average ultimate recovery rates for project finance bank loans and for senior secured corporate bank loans are similar. However, further review suggests that the two asset classes rely on different means to achieve robust recovery rates. While corporate lenders rely predominantly on debt cushion, project finance lenders focus on the proactive management of defaulted credits, facilitated by comprehensive creditor-friendly structural features which are a key characteristic of project finance.

We summarize key points of comparison below, but would observe that our analysis shows that project finance is a resilient class of specialized corporate lending, displaying high ultimate recovery rates that are substantially uncorrelated with a number of factors that are key determinants of ultimate recovery rates for general corporate debt facilities:

» Our research on corporate debt has previously found that the legal jurisdiction of a defaulted company is an important determinant of ultimate recovery rates for defaulted debt. The results of the study provide mixed findings with respect to the importance of the legal jurisdiction of a project's host country as a determinant of ultimate recovery rates for project finance bank loans. Classification by OECD/non-OECD countries and by advanced economies/EMDE subsets show limited variation of recovery rates across subsets.

» Our research on corporate debt has previously found that the debt structure of corporate loans (i.e., the presence of debt contractually subordinated to senior lenders) is an important determinant of ultimate recovery rates for defaulted senior loans to corporate borrowers. For project finance loans, we consider that the credit quality of senior secured project finance loans is typically structured to be substantially independent of the presence (or absence) of deeply subordinated debt.

» Our research on corporate debt has found that negotiated restructurings following a corporate default tend to produce higher ultimate recovery rates than a regular bankruptcy. This behavior, facilitated by creditor-friendly structural features, is already prevalent in project finance.

» Our research on corporate debt has previously found that ultimate recovery rates are negatively correlated with default rates. For the study data set, ultimate recovery rates appear to be substantially independent of both the economic cycle at default and the economic cycle at emergence.

Appendix E: Comments on certain aspects of Moody's research

Default rate calculations

The default analysis undertaken in the study is based on the Basel III definition of default. The study also provides comparable results based on Moody's definition of default. Moody's standard definition of default differs from the Basel definition of default. We set out below Moody's definition of default and comment on the impact of applying Moody's default definition on the results and observations described within this study.

Moody's definition of default

Moody's definition of default is applicable only to debt or debt-like obligations (for example, swap agreements). Four events constitute a debt default under Moody's definition:

» a missed or delayed disbursement of a contractually obligated interest or principal payment (excluding missed payments cured within a contractually allowed grace period), as defined in credit agreements and indentures;

» a bankruptcy filing or legal receivership by the debt issuer or obligor that will likely cause a miss or delay in future contractually obligated debt service payments;

» a distressed exchange whereby 1) an issuer offers creditors a new or restructured debt, or a new package of securities, cash or assets, that amount to a diminished value relative to the debt obligation's original promise and 2) the exchange has the effect of allowing the issuer to avoid a likely eventual default;

» a change in the payment terms of a credit agreement or indenture imposed by the sovereign that results in a diminished financial obligation, such as a forced currency re-denomination (imposed by the debtor or the debtor's sovereign) or a forced change in some other aspect of the original promise, such as indexation or maturity.

We include distressed exchanges in our definition of default in order to capture credit events whereby issuers effectively fail to meet their debt service obligations but do not actually file for bankruptcy or miss an interest or principal payment. We employ fundamental analysis in assessing the likelihood of future default and considers various indicators in assessing loss relative to the original promise, which may include the yield to maturity of the debt being exchanged.

Moody's definition of default does not include so-called "technical defaults," such as maximum leverage or minimum debt coverage violations, unless the obligor fails to cure the violation and fails to honor the resulting debt acceleration which may be required. Also excluded are payments owed on long-term debt obligations that are missed due to purely technical or administrative errors which are (1) not related to the ability or willingness to make the payments; and (2) are cured in very short order (typically, one to two business days). Finally, in select instances based on the facts and circumstances, missed payments on financial contracts or claims may be excluded if they are the result of legal disputes regarding the validity of those claims.

Basel III definition of default

We reproduce the Basel III definition of default in Appendix B (Glossary). In broad terms, the Basel III definition of default not only captures the events that are included in Moody's definition of default, but also captures a wider range of defaults, including circumstances in which the reporting bank considers that the obligor is unlikely to pay its credit obligations in full. For example, under the Basel III definition, defaulted credits would also include debt obligations where:

» The bank puts the credit obligation on non-accrued status.

» The bank makes a charge-off or account-specific provision resulting from a significant perceived decline in credit quality subsequent to the bank taking on the exposure.

In theory therefore, the number of defaults reported under the Basel III definition might differ materially from the number of defaults considered to have occurred under Moody's definition of default.

Impact: Moody's default definition vs. Basel III default definition

The study data set contains 570 defaults (Basel) and 426 defaults (Moody's).

The results summarized below are directionally consistent with the fact that the Basel III definition of default is broader than Moody's definition of default. We would expect the Basel III definition of default to result in a greater number of defaults with a higher average ultimate recovery rate than under Moody's definition of default.

» CDRs under the Basel definition of default are slightly higher than comparative CDRs calculated under Moody's definition of default (see Exhibit 13)

» Marginal default rates for under the Basel definition of default are slightly higher than comparative marginal default rates calculated under Moody's definition of default (see Exhibit 15)

» The study data set contains 280 ultimate recoveries (Basel) and 244 ultimate recoveries (Moody's).

» The average ultimate recovery rate under the Basel definition of default (77.5%) is consistent with the average ultimate recovery rate under Moody's definition of default (76.2%) (see Exhibit 35)

Recovery rate calculations

The calculation of recovery rates in the study is dependent on the definition of emergence from default. The definition of emergence from default used in the study has been adopted at the request of the Data Consortium.

We highlight that the determination of recovery rates in Moody's Special Comment "Default and Recovery Rates for Project Finance Debts, 1992-2008," published in November 2009 is based on 30-day post-default trading prices rather than ultimate recovery values. The use of post-default trading prices to measure recovery is common practice in the credit default swaps market. In our view, recovery rates measured in this way are most relevant for bond investors who liquidate their holdings shortly after default, as often required by their portfolio governance rules, or their own investment objectives.

We contrast this with the focus on ultimate recovery rates in the study, and highlight the material difference between average recovery rates for recoveries for ultimate recoveries and distressed sales — Section 8.1 (Distribution of Ultimate Recovery Rates) refers.

We comment further on the predictive content of 30-day post-default trading prices as measures of ultimate recovery in our Special Comment: "Trading Prices as Predictors of Ultimate Corporate Recovery Rates," published in March 2012.

Implications for the calibration of Moody's sector ratings

Our ratings represent a rank-ordering of creditworthiness, or expected loss — which is a function of the probability of default and the expected severity of loss given default. The study provides evidence of the default and recovery performance of a large sample of project finance debt obligations over an extended period. We consider the results of the study to be insightful in the context of enhancing the accuracy and

calibration of our own ratings. However, as we assess the potential impact of the study's results on our ratings, we are also mindful of the following considerations:

The standard deviation of the study data set's ultimate recovery rates is 33.9% (Basel) and 34.4% (Moody's), which is relatively large.

For consistency with our recovery research and findings for other sectors, Moody's will consider distressed sales as well as ultimate recoveries.

Behavioral drivers for bank lenders tend to differ from those of bond investors.

The past does not necessarily predict the future because default rates and recovery rates may change over time. For example, there may be changes to exogenous risk factors such as legal framework and market environment, and to endogenous variables such as project characteristics and structural features.

We also note that tenors of 20-30 years (or longer) are common within project finance, especially for PPPs. While the period covered by the study is long relative to most corporate loans, it is short relative to the typical tenor for project finance loans. Many loans within the study data set have yet to reach final maturity. This limits our ability to assess any changes in default or recovery that may emerge as these loans reach maturity because exposure to lifecycle risk and costs, or risks in meeting minimum handback requirements, may be significant.

Sector In-depth "Default and recovery rates for project finance bank loans, 1983-2016: Advanced economies vs emerging markets"

We highlight our Sector in-depth report: Default and recovery rates for project finance bank loans, 1983-2016: Advanced economies vs emerging markets", September 2018.

This addendum to our March 2018 study compares the credit performance of subsets of projects located in advanced economies with subsets of projects located in emerging market and developing economies (EMDEs) included in the study's larger data set of unrated project finance bank loans. We further segment these subsets by industry sector. Key findings include:

» The credit performance of projects in EMDEs remains resilient. Ten-year cumulative default rates for EMDE subsets range between 8.8%-9.6%, broadly consistent with equivalent default rates of Ba1-rated corporates (10.4%) but above those of projects in advanced economies (5.5%-6.1%) and the total study data average (6.4%). Recovery rates are consistent with the study data average of 79.3% across subsets.

» The year of project origination matters. Projects originated in the years 1999-2001 and 2006-08 experienced a higher count of defaults relative to the number of projects originated than is the case for 2002-05 and after 2008.

» Defaults in EMDEs are concentrated in countries that experienced sovereign crises during the study period.

» Credit performance varies across industry sectors. The infrastructure sector has higher 10-year cumulative default rates in EMDEs than in advanced economies. For the power sector, cumulative default rates are similar across regions, albeit slightly higher in advanced economies. The oil & gas sector experienced modestly higher cumulative default rates in EMDEs than in advanced economies.

» For the curtailed time horizon 1995-2016, 10-year cumulative default rates are slightly lower across regional subsets, in particular in EMDEs. The impact on ultimate recovery rates is limited and less consistent across subsets.

» Construction phase defaults take on average longer to emerge from default and have lower average ultimate recovery rates than operating phase defaults.

Sector In-depth "Default and recovery rates for project finance bank loans, 1983-2016: Green projects demonstrate lower default risk"

We highlight our Sector in-depth report: "Default and recovery rates for project finance bank loans, 1983-2016: Green projects demonstrate lower default risk", September 2018.

This addendum to our March 2018 study compares the credit performance of subsets of projects (1) based on use-of-proceeds eligibility criteria under the Green Bond Principles, and (2) by availability-based and non-availability-based revenue streams. In our analysis, we focus on projects within an "infrastructure basket", which combines various industry sectors that align with our definition of infrastructure. We further segment our analysis by advanced economy and emerging market and developing economy (EMDE) regions.

Key findings include:

» Green use-of-proceeds project finance bank loans experienced a lower default rate than non-green use-of-proceeds project loans**,** but the difference is likely due to subsample characteristics other than greenness because the default rate on loans whose use-of-proceeds could not be determined was lower than that of green loans.

» Availability-based public-private partnership (PPP) and non-PPP projects lie at the low end of the risk spectrum in advanced economies. The 10-year cumulative default rate for availability-based PPP projects is 2.0%, and 3.0% for availability-based, non-PPP projects in the EEA/OECD region. These default rates are much lower than those for demand risk projects in the EEA/OECD region (7.4%-11.1%).

» Projects with availability-based revenue streams are less prevalent in emerging markets and have had higher default rates than in advanced economies.

Data Report "Infrastructure Default and Recovery Rates, 1983-2017"

We highlight our Data Report: "Infrastructure Default and Recovery Rates, 1983-2017," September 2018 which reported on the historical performance of long-term infrastructure debt (including project finance debt) that we rate.

Our main findings are:

» In aggregate, infrastructure debts are less likely to incur credit losses than are non-financial corporate (NFC) issuers, especially over longer horizons. On average, a total infrastructure debt security loses 0.3% of its face value over a five-year horizon and 0.5% of its face value over a 10-year horizon, compared with 6.1% and 8.9%, respectively, for a typical NFC issuer.

» Infrastructure credits that we rate are rated predominantly investment grade. As of year-end 2017, 92% of total infrastructure securities held an investment grade rating compared with 40% of NFC issuers.

» Infrastructure ratings are more stable than NFC ratings, driven in large part by the stability of the US municipal infrastructure sector.

» Credit loss rates for A-rated and Baa-rated corporate infrastructure and project finance debt securities and NFC issuers are similar up through a five-year horizon.

  » As measured by the Average Position of Defaulters (AP), our corporate infrastructure and project finance debt ratings have been more accurate than NFC issuer ratings over a one-year horizon (91.7% versus 89.7%).

Data Report "Infrastructure default and recovery rates, 1995-2017: Advanced vs emerging markets"

We highlight our report: "Infrastructure default and recovery rates, 1995-2017: Advanced vs emerging markets", March 2019, which compares credit risk metrics for Moody's-rated corporate infrastructure and project finance debt securities in advanced economies with those in emerging market and developing economies (EMDEs). We also analyze credit risk metrics by industry, revenue resilience and financing structure. Our key findings are:

» Corporate infrastructure and project finance securities in EMDEs have experienced higher default rates relative to those in advanced economies. Over a five-year horizon, the average cumulative default rate (CDR) for EMDE securities was 8.4% for the EMDE-A region and 11.8% for the EMDE-B region (subsequently reported as 8.4%-11.8%), compared with 1.5%-2.3% for advanced economy securities. The average recovery rate for EMDE securities, as measured by post-default trading prices, was 50%, compared with 43%-62% for advanced economy securities. The elevated default risk demonstrated by EMDE securities is reflected in the lower ratings that were assigned to them relative to advanced economy securities over the period 1995 to 2017.

» The average credit quality of corporate infrastructure and project finance securities in EMDEs and advanced economies has converged over the study period. In 2000, the average rating for the EEA/OECD region was five notches higher than the average rating for the EMDE-A region. At year-end 2017, the average rating for the EEA/OECD region was only two and a half notches higher than that for the EMDE-A region. This trend suggests that the future credit performance of corporate infrastructure and project finance securities in advanced economies and EMDEs will become more similar than has been the case.

» Revenue-resilient infrastructure securities in EMDE regions have experienced low default rates. The average five-year CDR ranged from 3.9%-4.8%, reflecting the near investment- grade rating revenue-resilient infrastructure securities held on average from 1995 to 2017.

» Regulated electric and gas power securities in EMDE regions have experienced low default rates. Over a five-year horizon, the CDR for regulated electric and gas securities in EMDE regions averaged 4.1%-5.1%. Other industries within EMDEs had markedly weaker performance. Over a five-year horizon, the average CDR for EMDE unregulated electric and gas securities was 7.8%-12.0%, 5.6%-10.0% for EMDE transportation securities, and 19.4%-22.5% for other infrastructure securities in EMDEs, including energy-related projects.

Appendix F: Potential scope of work for follow-on research

We look forward to publishing further research based on an expanded and updated data set. However, we note that the results of a future study based on a different data set will necessarily be different.

The following list indicates the potential scope of work for follow-on research:

- Further analysis of the impact of economic cycle on default and recovery experience
- Further analysis of the default risk and recovery rates of renewable energy projects and non-renewable energy projects
- Further analysis of the impact of jurisdiction on default and recovery experience
- Further analysis of facility level recoveries
- Default and recovery analysis for ECA-backed or ECA-insured facilities
- Default and recovery analysis for projects in certain regions, such as the countries within the Gulf Cooperation Council region
- Analysis of 15-year and 20-year cumulative default rates
- Vintage analysis of project finance bank loans

Appendix G: Default and recovery analysis for power projects

In this appendix, we examine historic default and recovery behavior for key subsectors within the power industry sector, including renewable power generation.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Appendix H: Default and recovery analysis for PPP projects

In this appendix, we examine the historic default and recovery behavior for PPP projects within the study data set.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis, including Exhibits H1-H5, H7, has been withheld at the request of the Data Consortium.

Caveat: The observations noted below for projects identified as PPP projects should be interpreted with caution because (1) there is some subjectivity in the classification of projects as PPPs; and (2) the number of defaults is relatively small.

The study data set contains 1,970 projects identified as PPP projects with 96 defaults (Basel), 28 ultimate recoveries (Basel) and 10 distressed sales (Basel). Both the default count and the ultimate recoveries have increased from the previous study.

The 10-year CDR (Basel) is 3.8%, which has decreased modestly from the 4.3% (Basel) CDR reported in the March 2018 study, as additional data was added to the study data set. The 10-year CDR is modestly higher than the 10-year CDR for corporate issuers in the Baa ratings category of 3.5% (see Exhibit H4).[23]

The 10-year CDR (Basel) of 3.8% is slightly lower than the 10-year CDR (Basel) for the infrastructure industry sector of 4.1%, and lower than the 10-year CDR (Basel) for the study of 5.6% (see Exhibit 26).

Marginal annual default rates (Basel) are broadly stable and are borderline investment-grade, falling in between marginal default rates for Baa and Ba rated corporate issuers, for the initial four years from cohort formation, and decline thereafter to marginal annual default rates consistent with those of corporate issuers in the Baa ratings category or better (see Exhibit H8).

The average ultimate recovery rate is 79.3% (Basel) and falls within a range from 0%-100%, with a standard deviation of 29.3%. The average ultimate recovery rate has declined from 85.5% (Basel) reported in the previous study because we added 11 additional ultimate recoveries (Basel) to the data set.

Twenty six of the total 28 ultimate recoveries (Basel) were in the infrastructure industry sector and two were in the power sector. The decline in the average ultimate recovery rate for PPP projects to 79.3% (Basel) for this year's study is predominantly the result of nine additional recoveries in the transportation sector. We also added one additional ultimate recovery in the ports sector and two additional ultimate recoveries in the power sector.

The average ultimate recovery rate for the PPP subsector is now consistent with the average ultimate recovery rate of 77.5% (Basel) for the full study data set.

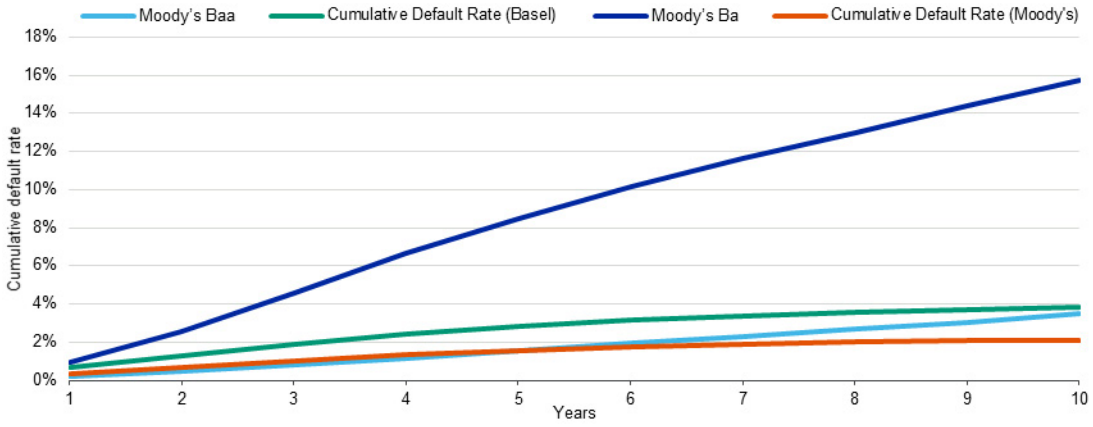
These results provide some evidence to support the view held by many market participants that PPP is a discrete subsector lying at the low-risk end of the project finance spectrum.

[23] The comparative 10-year cumulative default rate for the Baa3 rating category is 5.05% (see Exhibit 35 of Moody's Data Report "Corporate Default and Recovery Rates, 1920-2017," February 2018)

Exhibit H6 charts cumulative default rate data for the PPP subset within the study data set. For comparison, we have included cumulative default rate data derived from Moody's published research on default and recovery rates for corporate bond and loan issuers rated in the Baa and Ba rating categories.

EXHIBIT H6

Cumulative Default Rates for PPP Projects

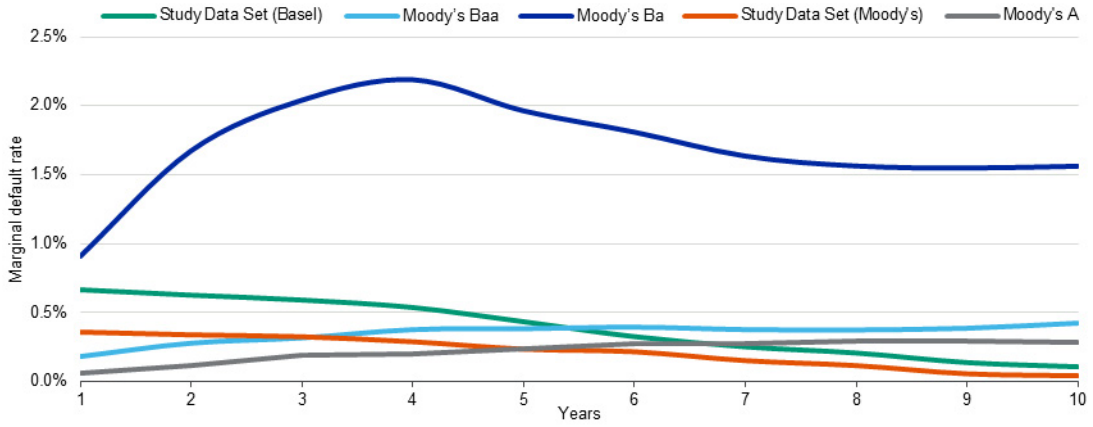


Source: Data Alliance Project Finance Data Consortium

Exhibit H8 charts marginal annual default rates for the subset of PPP projects within the study data set. For comparison, we have included marginal annual default rate data derived from our published research on default and recovery rates for corporate bond and loan issuers rated in the single-A, Baa and Ba rating categories.[24]

EXHIBIT H8

Marginal annual default rates for PPP projects



Source: Data Alliance Project Finance Data Consortium

[24] See Moody's Data Report: "Corporate Default and Recovery Rates, 1920-2017," February 2018"

Appendix I: The impact of causes of default on default and recovery experience

In this appendix, we examine the impact of causes of default on default and recovery experience.

The data was analyzed to determine the primary cause of default and categorized into the following categories.

1. **Defaults primarily due to construction risk:** Includes defaults caused by construction schedule delays, construction cost overruns, delays in the commencement of operations, failure to complete construction works to achieve minimum acceptance criteria, construction contractor default or non-performance, or the failure or inadequacy of financial or performance supports intended to mitigate construction risk. Notably, construction risk is not necessarily the cause of default for all projects that default during the construction phase.

2. **Defaults primarily due to counterparty credit or performance risk**: Includes defaults caused by default or non-performance of a key counterparty obligor under principal project contracts, e.g. offtake agreement, fuel supply agreement, feedstock supply agreement, maintenance agreement, or sponsor support agreement. Excludes construction-related defaults categorized in #1.

3. **Defaults primarily due to market risk:** Includes defaults caused by adverse variances in price and volume assumptions, for example, lower-than-expected output commodity prices; higher-than-expected input commodity prices; or lower-than-projected traffic volumes/demand/usage/patronage.

4. **Defaults primarily due to operational performance risk**: Includes defaults caused by weak operational performance, cost overruns or technical problems during the operations phase. For the purpose of this analysis, we also include in this category defaults arising from reserves risk (e.g., in relation to an oil & gas production project) or resource risk (e.g., in relation to a wind power project).

5. **Defaults primarily due to country risk**: Includes defaults caused by currency transfer or convertibility constraints, local currency devaluation, expropriation, imposition of discriminatory taxation or regulation, contract repudiation by a sovereign entity, political force majeure, or war & civil disturbance.

6. **Other causes of default:** Defaults for reasons other than categories 1-5 above.

The data in Exhibits I1 and I2 indicates that in EEA and EEA/OECD countries, the most prevalent cause of default is market risk (50.0% of defaults), while the share of defaults for which country risk is the primary cause of default is less than 2.0%.

However, in the EMDE-A and EMDE-B subsets, country risk is the most prevalent cause of default (38.3% and 42.9% respectively) followed by market risk (28.4% and 27.1% respectively). Almost all of the defaults attributed to country risk were caused by either (1) currency transfer or convertibility constraints, or (2) local currency devaluation. A significant number of defaults in the EMDE-A and EMDE-B subsets in Latin America and Asia coincided with sovereign crises in Argentina (2001-2), Brazil (1999, 2002), Indonesia (1997-2002) and Thailand (1997-2000), arising from the occurrence of a systemic banking crisis, currency crisis and/or sovereign debt crisis.

These findings are consistent with the results reported in the September 2018 addendum.

EXHIBIT I1

Causes of default (by count): advanced economy & EMDE regions (Basel definition of default)

Region	Construction	Counterparty/ Performance	Country	Market Risk	Operational Performance	Other	Total
EEA	8	9	1	36	14	4	72
EEA/OECD	19	29	3	88	28	9	176
EMDE-A	10	3	31	23	6	8	81
EMDE-B	7	3	30	19	4	7	70
All subsets	26	32	33	107	32	16	246
Total Study	27	32	33	110	33	16	251

Source: Data Alliance Project Finance Data Consortium

EXHIBIT I2

Causes of default (by share of defaults): advanced economy & EMDE regions (Basel definition of default)

Region	Construction	Counterparty/ Performance	Country	Market Risk	Operational Performance	Other	Total
EEA	11.1%	12.5%	1.4%	50.0%	19.4%	5.6%	100.0%
EEA/OECD	10.8%	16.5%	1.7%	50.0%	15.9%	5.1%	100.0%
EMDE-A	12.3%	3.7%	38.3%	28.4%	7.4%	9.9%	100.0%
EMDE-B	10.0%	4.3%	42.9%	27.1%	5.7%	10.0%	100.0%
All subsets	10.6%	13.0%	13.4%	43.5%	13.0%	6.5%	100.0%
Total Study	10.8%	12.7%	13.1%	43.8%	13.1%	6.4%	100.0%

Source: Data Alliance Project Finance Data Consortium

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium

Appendix J: The impact of market risk on default and recovery experience

In this appendix, we examine the impact of the components of market risk on default and recovery experience.

Defaults primarily due to market risk include defaults caused by adverse variances in price and volume assumptions, for example, lower-than-expected output commodity prices; higher than expected input commodity prices; or lower than projected traffic volumes/demand/usage/patronage.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Defaults due to market risk were further analyzed by price risk and volume/demand risk.

Appendix K: The impact of project size on default and recovery experience

In this appendix, we examine the impact of project size on default and recovery experience.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Appendix L: Expected loss

In this appendix, we report on expected losses and expected loss rates.

This sector in-depth report is an abridged version of a more comprehensive study undertaken using data provided by the Moody's Analytics Data Alliance Project Finance Data Consortium. Publication of certain analysis has been withheld at the request of the Data Consortium.

Appendix M: Industry sectors and subsectors

Exhibit M1 lists the industry sectors and subsectors that we use to categorize the study data.

We highlight that the Infrastructure industry sector largely comprises transportation projects (bridges, tunnels, roads, ports and terminals) and social infrastructure projects (public services & administration, accommodation, clean water, waste water and waste-to-energy projects).

EXHIBIT M1

Table of industry sectors and subsectors

Industry Sector	Industry Subsector
Chemicals Production	Chemicals Production (including petrochemicals & plastics)
Infrastructure	Infrastructure - Environment (waste to energy)
Infrastructure	Infrastructure - Environment (water systems; water desalination, waste treatment)
Infrastructure	Infrastructure - Other
Infrastructure	Infrastructure - Ports & terminals
Infrastructure	Infrastructure - Public services and administration (schools, hospitals, etc.)
Infrastructure	Infrastructure - Transport (bridges, tunnels, roads, railroads)
Leisure & Recreation	Leisure & Recreation (casinos, lodging and other - not "real estate")
Manufacturing	Manufacturing - Automotive (including parts)
Manufacturing	Manufacturing - Building materials (steel, cement, etc.)
Manufacturing	Manufacturing - Forest Products
Manufacturing	Manufacturing - Other
Media & Telecom	Media & Telecom - Media content (motion pictures, etc.)
Media & Telecom	Media & Telecom - Media distribution (cable & satellite television and radio, etc.)
Media & Telecom	Media & Telecom - Telephone (landline, cellular and satellite telephone systems)
Metals & Mining	Metals & Mining - Mining (ores, coal, etc.)
Metals & Mining	Metals & Mining - Processing (smelting, refining, foundries, etc.)
Oil & Gas	Oil & Gas - Biofuels
Oil & Gas	Oil & Gas - Distribution (pipelines)
Oil & Gas	Oil & Gas - Exploration & Production
Oil & Gas	Oil & Gas - LNG
Oil & Gas	Oil & Gas - Other
Oil & Gas	Oil & Gas - Refining
Oil & Gas	Oil & Gas - Storage
Other	Other
Power	Power - Electricity Transmission & Distribution
Power	Power - Non-renewable Electricity Generation
Power	Power - Renewable Electricity Generation

Source: Data Alliance Project Finance Data Consortium

Moody's related research

Default Research:

Default Research - Moody's Analytics Project Finance Data Consortium

- Default and recovery rates for project finance bank loans, 1983-2016: Green projects demonstrate lower default risk, September 2018 (1138618)
- Default and recovery rates for project finance bank loans, 1983-2016: Advanced economies vs emerging markets, September 2018 (1133364)
- Default and Recovery Rates for Project Finance Bank Loans, 1983-2016, March 2018 (1114036)

Default Research - Moody's-rated Infrastructure Debt Securities

- Infrastructure & Project Finance Infrastructure default and recovery rates, 1983-2017, September 2018 (1110153)
- Infrastructure default and recovery rates, 1995-2017: Advanced vs emerging markets, March 2019 (1144470)

Default Research - Moody's-rated Corporates

- Annual default study: Defaults will rise modestly in 2019 amid higher volatility, February 2019 (1156859)
- Emerging market corporate default and recovery rates, 1995-2018, January 2019 (1139918)
- Annual Default Study: Corporate Default and Recovery Rates, 1990-2017, February 2018, (1112754)
- US Corporate Default and Recoveries: Lessons from 25 Years of 'Chapter 22', December 2012 (147863)

Other Publications

- Guide to Moody's Default Research: January 2019 Update (180660)
- Sovereign default and recovery rates, 1983-2017, July 2018 (1110116)
- Regulatory risk for EU renewables investors greatest in Spain, Italy, October 2015 (1008007)
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- Hard Data for Hard Times, July 2010 (126338)
- After Black Swans, Now What?, May 2010 (124964)
- Default and Recovery Rates for Project Finance Debts, 1992-2008, November 2009 (120845)
- Syndicated Bank Loans: 2008 Default Review and 2009 Outlook, March 2009 (115212)
- Determinants of Recovery Rates on Defaulted Bonds and Loans for North American Corporate Issuers, 1983-2003, December 2004 (90593)

To access any of these reports, click on the entry above. Note that these references are current as of the date of publication of this report and that more recent reports may be available. All research may not be available to all clients.

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About the Moody's Analytics Data Alliance

The Moody's Analytics Data Alliance is one of the world's largest and most comprehensive data consortia covering Commercial & Industrial, Commercial Real Estate, Project & Infrastructure Finance, Asset Finance, and Agriculture. Built in partnership with over 100 leading global financial institutions, the Data Alliance database contains private firm financial statement, loan, default, and other key financial metrics. For more information please send an email to DataAlliance@moodys.com or to Kevin Kelhoffer, Moody's Analytics, Director – Data Intelligence, (Kevin.Kelhoffer@moodys.com).

The data presented in this Study is sourced from the Moody's Analytics Data Alliance. All analytics and statistics are compiled by Moody's Analytics; all market and industry commentary has been prepared by Moody's Investors Service.

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