

Default, Transition, and Recovery:

2017 Inaugural Infrastructure Default Study And Rating Transitions

November 20, 2018

Key Takeaways

- Infrastructure experienced positive rating movement in 2017, with 114 upgrades and 87 downgrades, reversing negative trends in 2015 and 2016. There were also seven defaults in the year.
- The rated global infrastructure sector has experienced essentially uninterrupted growth over the past 25 years. The majority of the sector is rated 'A' or 'BBB' by S&P Global Ratings. However, the proportion of speculative-grade ratings has increased in the past decade.
- Movement of infrastructure ratings has trended negative since 1981, and all industries within infrastructure except social infrastructure exhibit negative rating movement. Over the long term, infrastructure credits show a lower likelihood of default and higher ratings stability than the broader nonfinancial segment.
- The stability of infrastructure ratings has been consistent with historical default experience at different time horizons. From 1981-2017, the one-, three-, and five-year Gini coefficients were 80%, 71%, and 65%, respectively.
- However, Gini coefficients were not as high for certain subsectors. Social infrastructure, transportation, and utility coefficients over a three-year horizon were high, at 99.5%, 83.5%, and 68.9%, respectively, but power and oil and gas had low Gini coefficients of 42.9% and 9.7%, respectively. The very low Gini coefficient for oil and gas reflects a small number of defaulters, including some that were investment grade at some point within the three-year horizon.
- Infrastructure defaults show some regional concentrations, with the U.S. accounting for 90 of the 127 defaults (or 71%) in infrastructure, followed by Latin America with 16%; Europe, the Middle East, and Africa (EMEA) with 13%; and Asia-Pacific with less than 1%.
- Recoveries are generally higher for infrastructure than for nonfinancial corporates. In addition, within infrastructure, corporate infrastructure ratings have higher recovery rates than project finance infrastructure.

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The rated global infrastructure sector has grown substantially over the years, while maintaining lower risk than the overall nonfinancial corporate sector. By most measures, infrastructure credits rated by S&P Global Ratings have shown lower default rates, lower ratings volatility, and higher recovery prospects than nonfinancial corporates. Some of this is attributable to the infrastructure sector's stronger ratings profile, but most of these trends hold true at comparable rating levels as well.

Nonetheless, differences exist among subsectors within infrastructure. The infrastructure project finance subsector tends to exhibit more frequent defaults and greater ratings volatility than infrastructure corporates. Meanwhile, within infrastructure corporates, the utilities subsector shows particularly stable performance, largely due to its high proportion of regulated utilities.

Rating movement was positive in infrastructure in 2017, with 114 upgrades and 87 downgrades, reversing negative trends in 2015 and 2016. In addition, there were seven defaults in the year, the same number as in 2016. The 2017 figure includes two obligations that were not rated at the beginning of 2017 and thus do not qualify for rating transition calculations, which are defined by various time horizons of one year or longer.

Infrastructure has undergone one episode of especially high default rates, during the 2000-2003 cycle, which coincided with the Argentine financial crisis and the deregulation of the energy sector in the U.S. The broader nonfinancial corporate segment also saw its default rate spike during the same period, largely as a result of the challenges faced at the time by the telecommunications and high technology sectors. The other notable default cycles for nonfinancials occurred during the 1990-1991 recession and the 2008-2009 financial crisis, the second of which infrastructure traversed relatively unscathed.

Infrastructure rating movement has typically been negative since 1981. Over the decades, five of six industries within infrastructure have had more downgrades than upgrades. The industries with the most downgrades (including defaults) relative to upgrades are power and transportation, each with more than 1.5 downgrades to each upgrade. Utility and oil and gas ratings are also lowered more frequently than they are raised, while social infrastructure ratings are raised more frequently than lowered. Note that in this study, the oil and gas sector consists of entities that are essentially in the midstream, liquefied natural gas, and refining industries, but not exploration and production.

Default patterns by industry vary, although less than rating movement varies. Among the designated industries, power--the sector most likely to experience downgrades rather than upgrades--has the second-highest number of defaults since 1981, despite having fewer ratings than all sectors besides social infrastructure and uncategorized infrastructure. In addition, a low Gini index coefficient for power suggests that significant downward movement for ratings in the sector may precede a default within a time horizon of three years. This suggests that volatility from some source, perhaps power or commodity prices, can ultimately result in downgrades for unexpected issuers. Conversely, oil and gas, social infrastructure, and transportation account for just 12 of the 127 infrastructure defaults since 1981 that are included in our default rate and rating transition calculations.

This inaugural infrastructure default study and rating transition report expands on and supersedes project finance default studies published by S&P Global Fixed Income Research in previous years. The data herein encompass project finance ratings from past reports and add ratings from other segments within infrastructure. The advantage of this report over its predecessors is that it broadens the perspective of the former studies and includes a larger data set. This expansion enables more conclusions, increases the statistical validity of the findings, and enables comparisons between industries, sectors, and time periods.

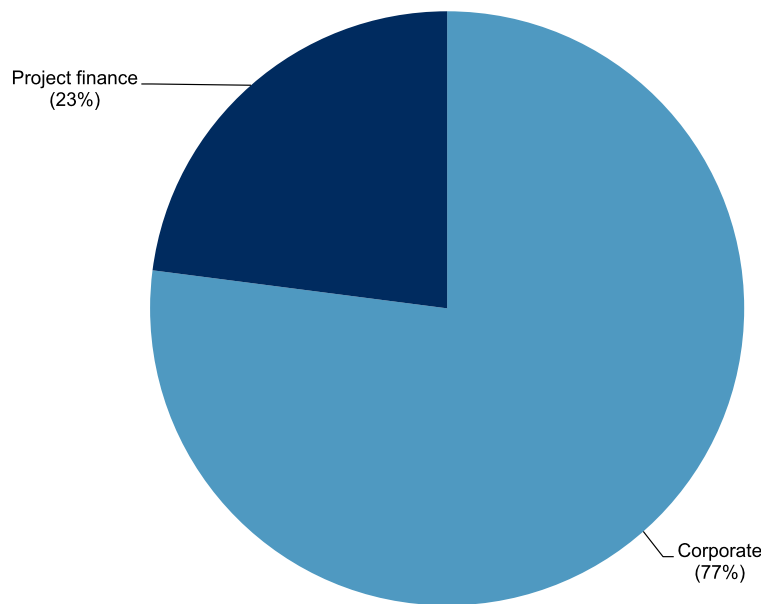
A central question in creating this study was how to determine which entities to include in the data set. Infrastructure investment is broadly defined as investment exposure (debt or equity) to real assets vital to a country's economic development and prosperity that provide essential services for the orderly operations of an economy, such as transportation networks, health and education facilities, communication networks, and water and energy distribution systems. Key risks are in design, permitting, construction, operations, volume, and maintenance, with debt repaid predominantly by cash generated from the assets themselves.

Characteristics of infrastructure entities vary, and the range of risks managed by infrastructure investments is broad (such as greenfield/brownfield, contracted/regulated/merchant, and availability/demand risk). Characteristics sought by investors in infrastructure include longevity, strong competitive advantages, high barriers to entry and monopolistic characteristics, low volatility, differentiation between return and volatility, and inflation-linked or predictable cash flows.

This study covers 1,076 infrastructure ratings in utilities, oil and gas, transportation, power, social infrastructure, and other industries. Included among these ratings are those analyzed in prior project finance default and rating transition reports--a universe of 247 as of Jan. 1, 2018. For the purpose of this study, our definition of infrastructure does not include U.S. public finance rated infrastructure assets.

Chart 1

Infrastructure Ratings By Project Finance And Corporate Designation



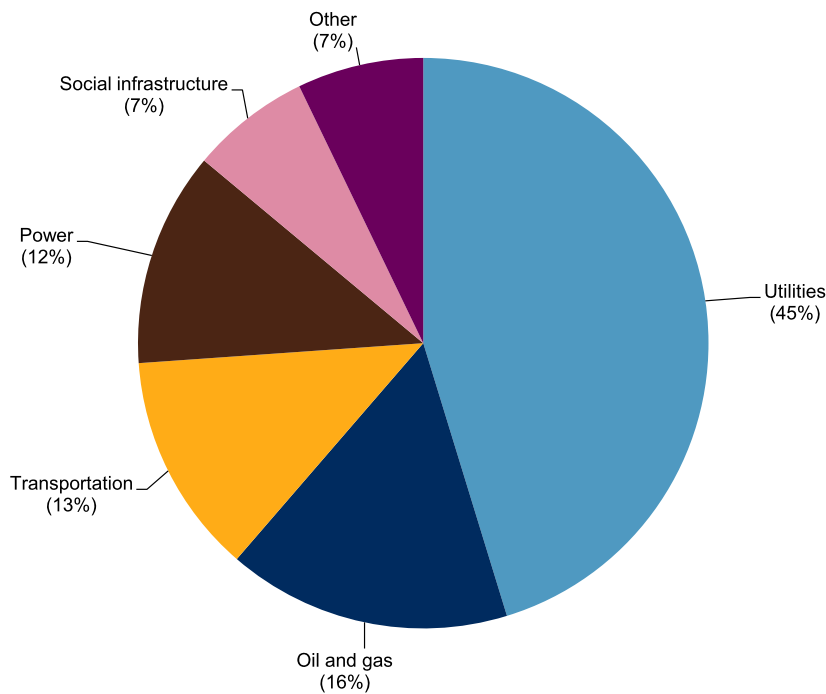
Data as of Jan. 1, 2018. Source: S&P Global Fixed Income Research.
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Growth In Ratings

Our report covers the period from 1981 to the present. The choice of this time frame ensures a sufficient number of records in terms of years and entities rated. From 1981-1992, the number of ratings remained stable at about 300. In 1993, the number of ratings increased to 335 from 310 in 1991, then steadily climbed at a rate of 53 ratings each year to 831 in 2002. The pace of growth has slowed since then, with the number of ratings having risen by an average of 15 through the start of 2018.

Chart 2

Infrastructure Ratings By Industry (Jan. 1, 2018)



Source: S&P Global Fixed Income Research.

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Utilities make up the largest group of ratings, with 487, all of which are in corporate finance. These entities are corporations that offer essential or near-essential infrastructure products, commodities, or services with little or no practical substitute (mainly electricity, water, and gas)--a business model that is shielded from competition (naturally, by law, by shadow regulation, or by government policies and oversight) and subject to comprehensive regulation by a regulatory body or implicit oversight of its rates (sometimes referred to as tariffs), service quality, and terms of service. The regulators in developed markets base the rates they set on some form of cost recovery, including an economic return on assets, rather than relying on a market price. The regulated operations can vary from individual parts of the utility value chain (water, gas, and electricity networks or "grids," electricity generation, retail operations, etc.) to the entire integrated chain, from procurement to sales to the end customer. In some jurisdictions, S&P

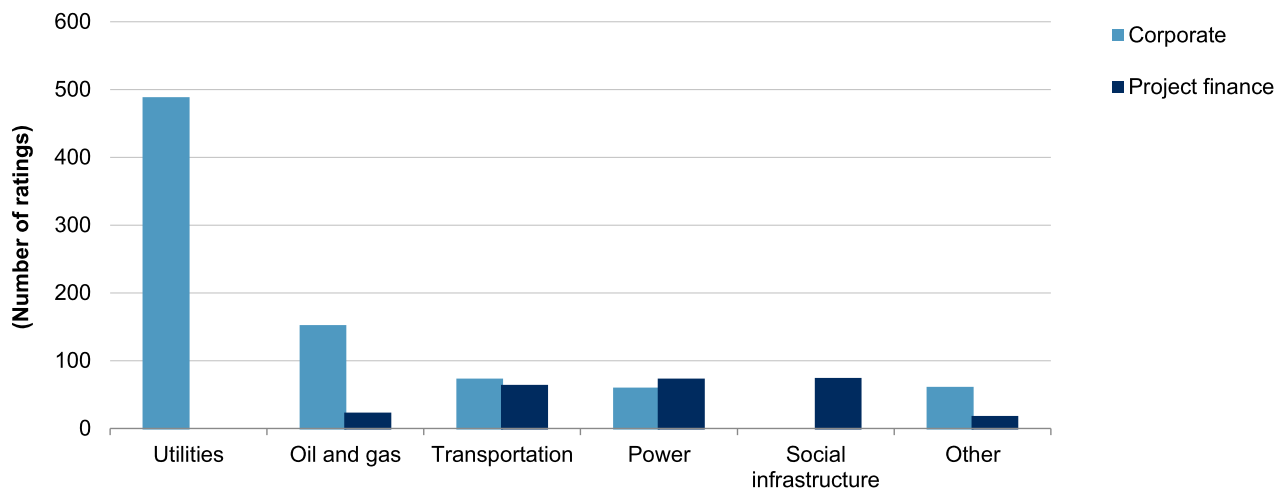
Global Ratings' view of government support can also affect the final rating outcome, as per our government-related entity criteria.

The oil and gas sector has the second-highest number of ratings, at 173. Of these, 151 are in corporate infrastructure and 22 are in project finance. These numbers are further split between midstream oil and gas pipelines and refining, the latter being more exposed to margin volatility.

Transportation includes road, bridge, and tunnel projects. The sector has 135 ratings, 72 of which are in corporate groups and 63 in project finance. Transportation credits are frequently exposed to competitive pressures from other modes of transit. For instance, a toll road could be affected by neighboring roads or other modes of transportation that could draw drivers and their tolls from the toll road. Even in the absence of competition, transportation credits often correlate directly with the local economy because commuters increase with employment.

Chart 3

Infrastructure Ratings By Industry And Corporate Or Project Finance Designation



Data as of Jan. 1, 2018. Source: S&P Global Fixed Income Research.

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Power, which includes electricity generation and transmission power projects, has 131 ratings, 72 of which are in project finance and 59 in corporate sectors. These ratings are primarily for fossil-fuel power plants, although renewable energy plants are included. Power plants range from small, aging coal plants to newer, highly efficient natural gas projects. Included within power are eight ratings for project developers. We define a project developer as a corporate entity, typically structured as a holding company, that owns, develops, and operates assets mainly in the energy and infrastructure sectors. Typically, a developer conducts its business mainly through operating subsidiaries. The operating subsidiaries are generally financed with nonrecourse debt, either on a corporate finance or project finance basis. Developers have little or no operations of their own and rely on distributions--such as dividend and fee income received from a diversified portfolio--to service their debt and other expenses. Operating assets are mainly in the energy, infrastructure, utility, and transportation industries. Common examples include power plants, toll roads, electric utilities, drill ships, and ports. Developers are rated using corporate infrastructure criteria, but for

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this study and administrative purposes, they are included as project finance. The small number of developer ratings does not affect the conclusions of this study.

Social infrastructure has 73 ratings, all in project finance. Financings in this area cover:

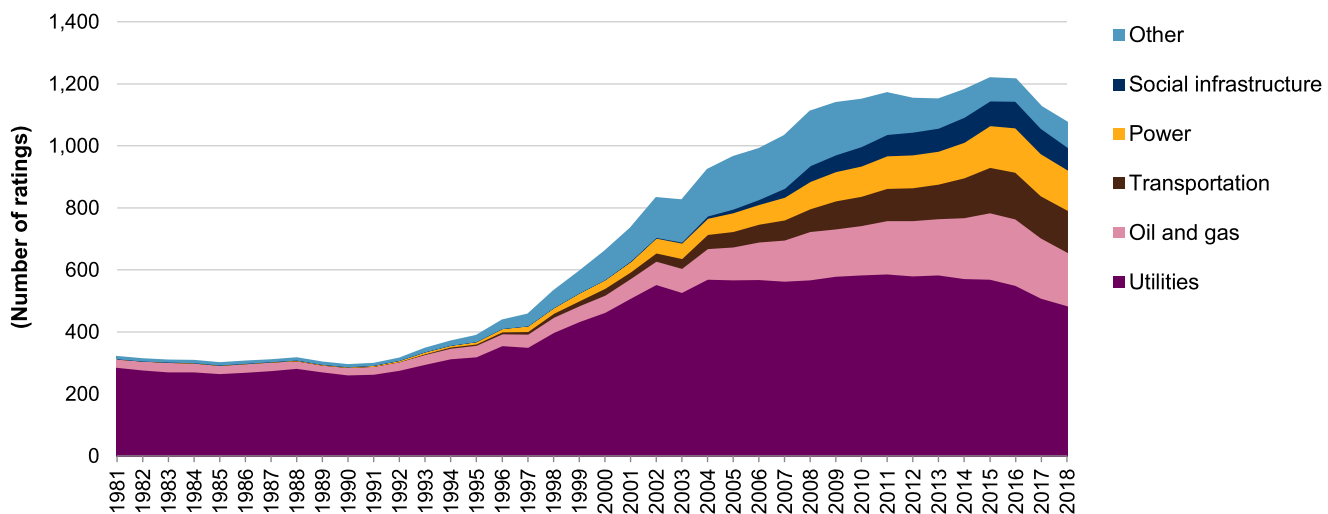
- primary and secondary schools and tertiary teaching facilities;
- health care projects, from large and relatively complex regional hospitals to smaller local primary care and psychiatric facilities;
- social housing, military barracks, and student accommodations; and
- detention centers (prisons) and judicial facilities.

Finally, this study includes 77 other ratings. This number of uncategorized ratings has fluctuated over time, with the highest count being 170 in 2008. These ratings are primarily project finance ratings that don't fit into one of the categories above or international public finance ratings that finance infrastructure but are rated with different criteria. Such entities include social housing developers and ports.

The current total of 1,076 ratings is lower than the peak of 1,218 in 2015. Going back to 1981, the lowest number of ratings was 293, in 1990. Utilities have always been the largest industry within infrastructure. In 1981, there were 287 utility ratings, representing the highest proportion of ratings of any industry at any time since, and that number has increased to 487. Oil and gas ratings started at 27 in 1981. The number of oil and gas ratings remained below 30 through 1992 and has increased by a factor of more than five to 173. Transportation ratings have increased in all but three years since the first ratings were assigned in 1993. Power ratings have had a similar growth pattern, with one rating in 1981, and after that increasing in all but four years through the start of 2018. The first social infrastructure rating was not assigned until 2000, and the number of social infrastructure ratings peaked in 2016 before declining slightly at the start of 2017 and 2018.

Chart 4

Infrastructure Ratings By Industry



Data as of Jan. 1. Source: S&P Global Fixed Income Research.

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Ratings By Industry

Energy-related industries have been the main combined category of infrastructure ratings. At the start of 2018, 74% of ratings were in the utilities, oil and gas, and power sectors, marking the lowest percentage that these industries have represented. From 1981-2012, these three sectors were individually the largest within infrastructure, with transportation recently claiming the third-highest number of ratings. As a combined group, these industries have accounted for as much as 99% of infrastructure ratings, and the average percentage of infrastructure ratings in these industries since 1980 is 86%.

Since 2000, the fastest-growing group of ratings on a percentage basis has been social infrastructure, whose tally increased to 73 from one, followed by transportation, which increased by a factor of six, and power, which is almost three times larger than in 2000. Growth trends suggest that the largest sectors will continue to lead in the number of ratings for the foreseeable future. Social infrastructure has had rapid growth, but this has slowed recently, with the number of ratings declining by 12 since 2016. Utilities, the largest sector, has lost 102 ratings since 2011, but it still has at least 314 more ratings than any other industry. Energy-related sectors together have grown 45% since 2000, which is impressive given the large number of ratings they began with in the period.

Ratings By Category

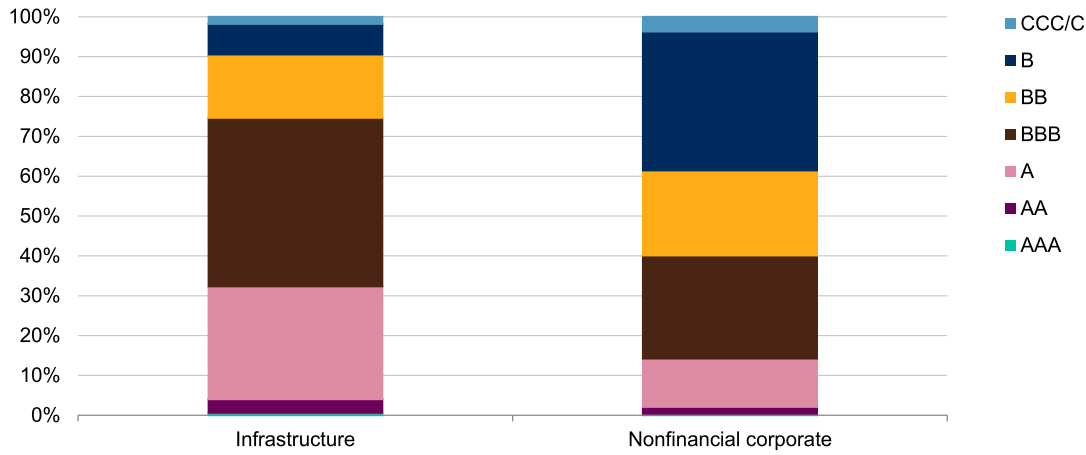
Before the global financial crisis, the proportion of investment-grade ratings ('BBB' category or higher) was higher for both infrastructure and nonfinancial corporates. At the start of 2006, 49% of nonfinancial corporates were rated investment grade, but by the start of 2018, this share fell to 40%. Among infrastructure credits, a decline in the proportion of investment-grade ratings also occurred over this time frame, but to a lesser extent (to 75% from 81%).

By region, North America represented 50% of total infrastructure credits by 2018, down from 93% in 1991. In contrast, the Europe, Middle East, and Africa (EMEA) region represented 31% of total credits by 2018, up from 3%. S&P Global Ratings rated only one issue in Latin America in 1993, but that number grew to 119 (11% of the total) by 2018, reflecting growth of capital markets and of infrastructure as an asset class outside the U.S.

About 77% of infrastructure corporate ratings and 68% of project finance ratings were investment grade at the start of 2018, compared with only 40% of nonfinancial corporate ratings.

Chart 5

Infrastructure And Nonfinancial Corporate Rating Category Distribution

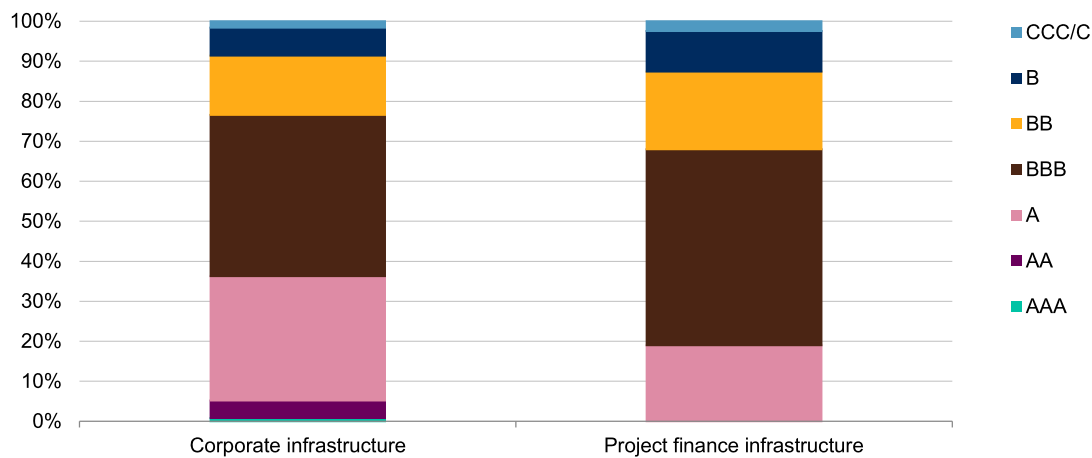


Data as of Jan. 1, 2018. Source: S&P Global Fixed Income Research.
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Within infrastructure, corporate ratings tend to be higher than project finance ratings. About 5% of corporate infrastructure ratings are high investment grade ('AA' category or higher), while 'A' is the highest rating category for project finance infrastructure. At the lower end of the rating scale, 24% of corporate infrastructure ratings are speculative grade ('BB' category or lower), while 31% of project finance infrastructure ratings are at this level. The 'BBB' category is the largest for both groups but is larger for project finance. In comparison, the number of 'A' category ratings is closer to the number of 'BBB' category ratings for corporate infrastructure than it is for project finance infrastructure.

Chart 6

Infrastructure Rating Distribution Comparison

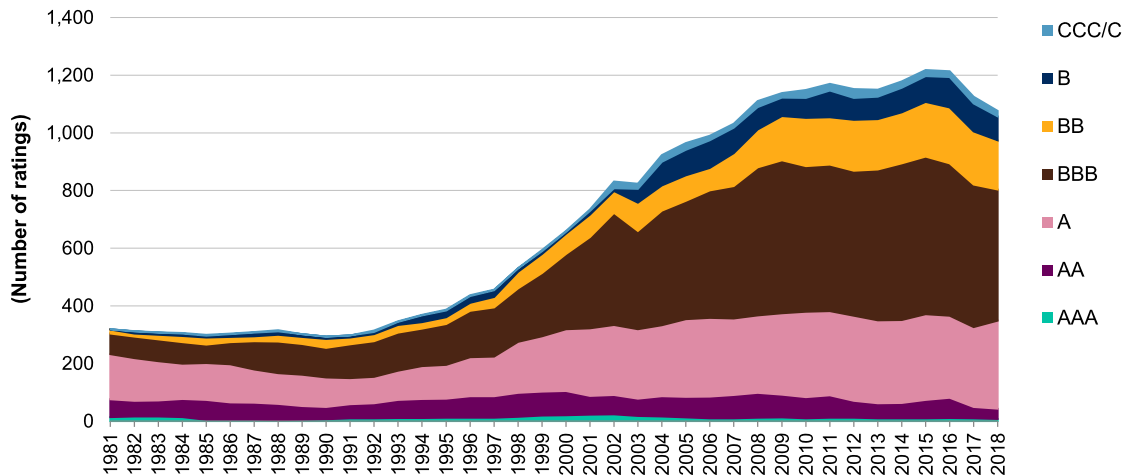


Source: S&P Global Fixed Income Research.
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The 'BBB' category has been the largest every year since 1990. About 42% of infrastructure ratings are in the 'BBB' category, and the proportion of 'BBB' category ratings has been above 40% since 2000. Since the financial crisis, the percentage of speculative-grade ratings has steadily grown. The combined total proportion of speculative-grade ratings was 18% in 2006 and remained at that level or grew every year through 2017. The percentage of speculative-grade ratings was 21% just after the financial crisis, at the start of 2010, reached 25% at the beginning of 2017, and declined slightly, to 24%, by the start of this year.

Chart 7

Infrastructure Ratings By Category



Data as of Jan. 1. Source: S&P Global Fixed Income Research.

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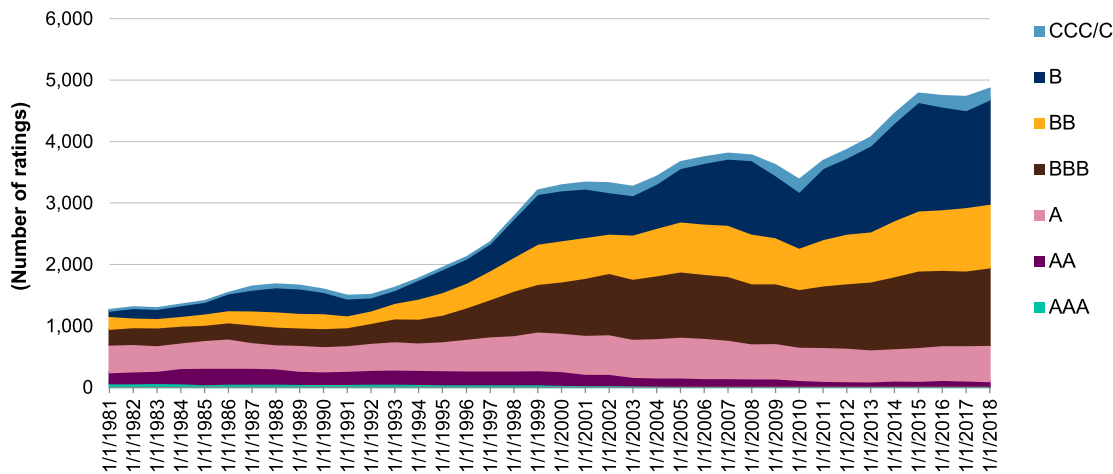
Social infrastructure has the strongest ratings profile of all the infrastructure subsectors, with more 'AA' category ratings than any other industry despite having the fewest ratings overall. Utilities has the highest total number of ratings, the most ratings in the 'A' and 'BBB' categories, and is tied with oil and gas for the most 'BB' category ratings. Oil and gas has the most 'B' category and 'CCC'/'C' category ratings. Oil and gas also has the highest percentage of speculative-grade ratings, at 49%, nearly twice the proportion of the next-closest industry, power, at 25%. In transportation, 21% of ratings are speculative grade.

Infrastructure ratings are higher than nonfinancial corporate ratings. The largest category for nonfinancial corporate ratings is 'B', which has been the case every year since 2007 except 2010. Three-quarters of infrastructure ratings are investment grade, while just 40% of nonfinancial corporate ratings have that status.

There has been a consistent number of ratings in the 'AA', 'A', and 'BBB' categories for both infrastructure and nonfinancial corporate ratings, but the primary growth in nonfinancial corporate ratings has come from the 'B' category, while infrastructure's growth has been mostly in the 'BBB' category and, to a lesser extent, the 'A' category.

Chart 8

Nonfinancial Corporate Ratings By Category



Source: S&P Global Fixed Income Research.

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Ratings By Industry And Category

The industries within infrastructure have different ratings profiles, rating movement, and default patterns. Among the sectors with at least 100 ratings, power and oil and gas have the lowest ratings. About 49% of oil and gas ratings are speculative grade, as are 23% of transportation and power ratings. The percentage of speculative-grade ratings in oil and gas dropped to 11% in 2000 from 38% in 1990 and has since climbed to its current peak of 49%. Power ratings had historically been almost entirely investment grade until 2003, when the rate of speculative-grade ratings increased to 17%, from 9% in 2002. The percentage reached a peak of 29% in 2016 before declining in the past two years to its current level.

Transportation ratings remained at least 90% investment grade through 2009, but two years later fell below 80%. The speculative-grade share in transportation has since consistently been at least 20%. Social infrastructure has 82% investment-grade ratings and has had at least 80% investment grade in every year on record.

For infrastructure corporates, the large proportion of regulated utilities contributes much to the sector's overall high credit quality. Regulated utilities benefit from being essential services with high barriers to entry (often operating as natural monopolies) and a limited ability to add debt.

Despite having higher leverage than infrastructure corporate peers, infrastructure project finance has a majority of investment-grade ratings because of the protections inherent to project finance, such as security packages, structural elements (including offtake agreements, hedging, reserve accounts, distribution traps, and legal separateness), and limitations on new debt and asset sales.

Table 1

Infrastructure Rating Distribution (Jan. 1, 2018)

	Utilities	Oil and gas	Transportation	Power	Social infrastructure	Other
Number of ratings						
AAA	1	0	1	0	0	5
AA	17	0	10	1	0	8
A	192	11	30	5	25	42
BBB	217	77	65	50	35	11
BB	45	45	20	42	13	6
B	12	32	6	28	0	5
CCC/C	3	8	3	5	0	0
Total	487	173	135	131	73	77
Speculative grade	60	85	29	33	0	11
Percentage of ratings (%)						
AAA	0.21	0.00	0.74	0.00	0.00	6.49
AA	3.49	0.00	7.41	0.76	0.00	10.39
A	39.43	6.36	22.22	3.82	34.25	54.55
BBB	44.56	44.51	48.15	38.17	47.95	14.29
BB	9.24	26.01	14.81	32.06	17.81	7.79
B	2.46	18.50	4.44	21.37	0.00	6.49
CCC/C	0.62	4.62	2.22	3.82	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Speculative grade	12.32	49.13	21.48	25.19	0.00	14.29

Source: S&P Global Fixed Income Research.

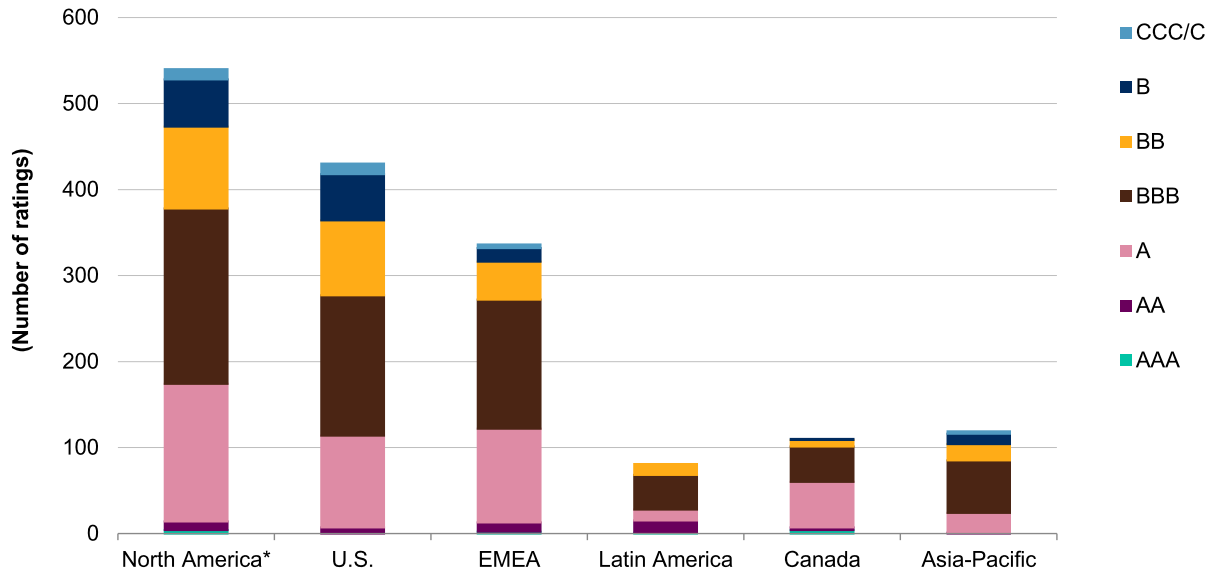
Ratings By Region And Country

Ratings in 58 countries are included in this study. The U.S. accounts for 430 of the ratings, with the U.K. far behind with the second-highest total, at 160. The only other country with more than 100 ratings is Canada, with 110.

Regionally, North America is largest, with 540 ratings between the U.S. and Canada. EMEA is the second-largest region, with 336 ratings, 309 of which are in Europe. Latin America follows with 81 and Asia-Pacific with 119.

Chart 9

Infrastructure Ratings By Region Or Country



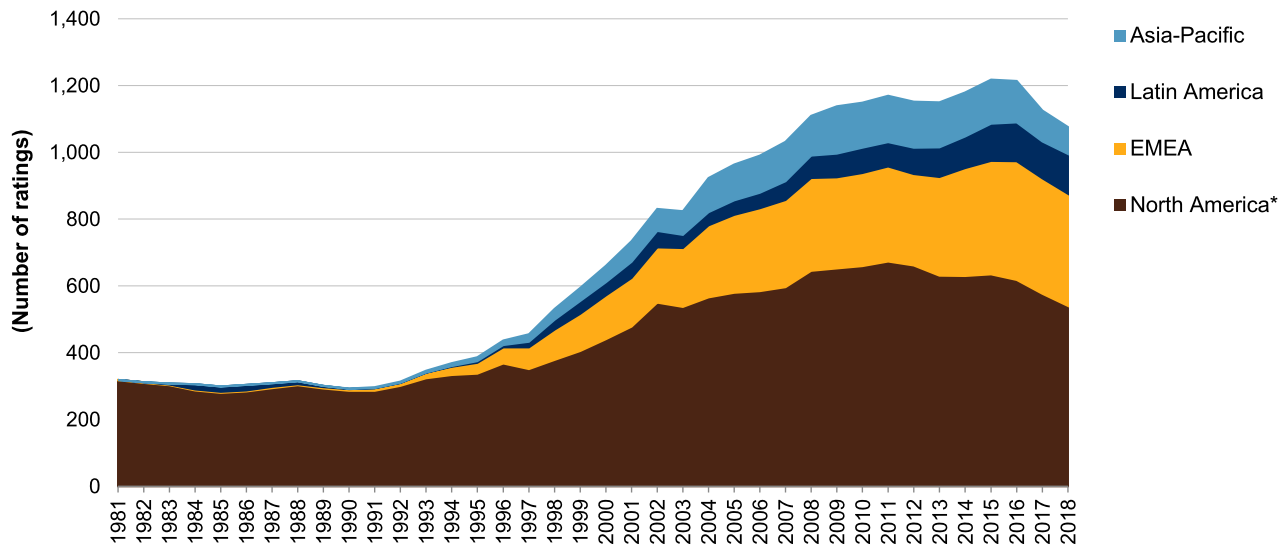
*U.S. and Canada. EMEA--Europe, Middle East, and Africa. Data as of Jan. 1, 2018. Source: S&P Global Fixed Income Research.

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For about a decade, virtually all infrastructure ratings were from North America, until ratings in other regions began to increase in the mid-1990s. Since then, ratings in North America and other regions have increased significantly, more than tripling the total number of ratings. Most new ratings have come from outside North America, which retains the majority of all ratings. In 1981, only one of 319 ratings was from outside North America, compared with 536 in 2018. The number of ratings in all regions took off in 1997, by which time Europe had established itself as the second-largest region for infrastructure ratings.

Chart 10

Infrastructure Ratings Over Time By Region



*U.S. and Canada. EMEA--Europe, Middle East, and Africa. Data as of Jan. 1. Source: S&P Global Fixed Income Research.

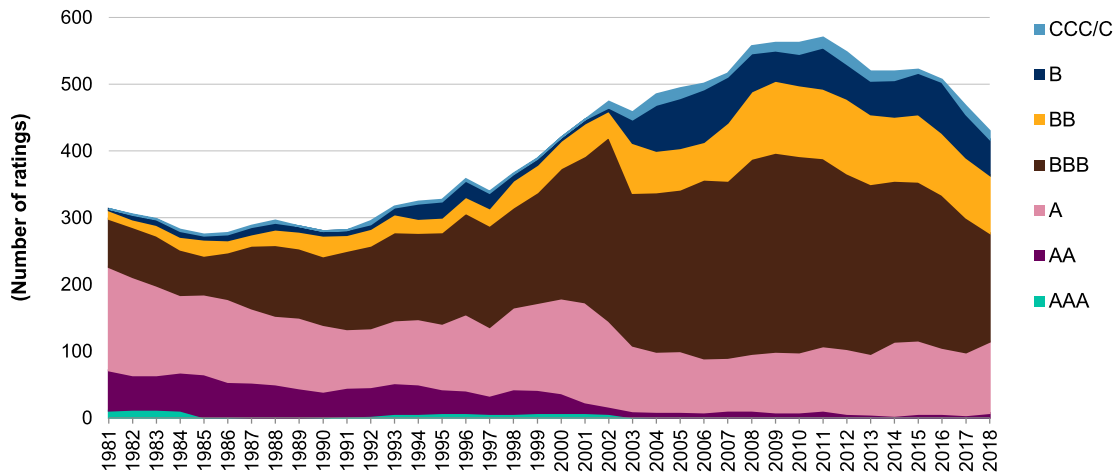
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Ratings category dispersion throughout most regions resembles that of infrastructure as a whole. The U.S., with 40% of all ratings, has a significant influence on ratings throughout the world. Infrastructure ratings in the U.S. do skew slightly negative as compared with non-U.S. infrastructure ratings.

Over the past several decades, U.S. infrastructure ratings have drifted to lower categories. In 1981, 73% of U.S. infrastructure ratings were in the 'A' category or higher. By 1991, less than half of ratings were at least 'A-', and the 'BBB' category was the largest, as it remains. More recently, the last 'AAA' rating disappeared in 2004, while speculative-grade ratings have grown to 123 in 2003 from 56 in 2002 and have hovered around 160 for the past 12 years.

Chart 11

U.S. Infrastructure Ratings Over Time By Category



Source: S&P Global Fixed Income Research.

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The U.S. rating distribution is lower than the distribution for infrastructure overall in all investment-grade categories and higher in all speculative-grade categories. By these measures, U.S. ratings are lower than those of any other region, but this is probably due more to obligor acceptance and investor tolerance of lower ratings in the U.S., rather than lower credit profiles of infrastructure entities in the U.S. Canada and Latin America have above-average concentrations of investment-grade ratings and lower proportions of speculative-grade ratings.

Table 2

Infrastructure Rating Distribution By Region Or Country

	North America*	U.S.	EMEA	Asia-Pacific	Canada	Latin America	Total
Number of ratings							
AAA	4	0	2	1	4	0	7
AA	10	7	11	14	3	1	36
A	160	107	109	13	53	23	305
BBB	204	163	150	40	41	61	455
BB	95	87	44	13	8	19	171
B	55	54	16	0	1	12	83
CCC/C	12	12	4	0	0	3	19
Percentage rating distribution (%)							
AAA	0.74	0.00	0.60	1.23	3.64	0.00	0.65
AA	1.85	1.63	3.27	17.28	2.73	0.84	3.35
A	29.63	24.88	32.44	16.05	48.18	19.33	28.35
BBB	37.78	37.91	44.64	49.38	37.27	51.26	42.29

Table 2

Infrastructure Rating Distribution By Region Or Country (cont.)

	North America*	U.S.	EMEA	Asia-Pacific	Canada	Latin America	Total
BB	17.59	20.23	13.10	16.05	7.27	15.97	15.89
B	10.19	12.56	4.76	0.00	0.91	10.08	7.71
CCC/C	2.22	2.79	1.19	0.00	0.00	2.52	1.77
Variance in rating distribution from total							
AAA	0.09	(0.65)	(0.06)	0.58	2.99	0.00	0.00
AA	(1.49)	(1.72)	(0.07)	13.94	(0.62)	(2.51)	0.00
A	1.28	(3.46)	4.09	(12.30)	19.84	(9.02)	0.00
BBB	(4.51)	(4.38)	2.36	7.10	(5.01)	8.97	0.00
BB	1.70	4.34	(2.80)	0.16	(8.62)	0.07	0.00
B	2.47	4.84	(2.95)	(7.71)	(6.80)	2.37	0.00
CCC/C	0.46	1.02	(0.58)	(1.77)	(1.77)	0.76	0.00

*U.S. and Canada. EMEA--Europe, Middle East, and Africa. Data as of Jan. 1, 2018. Source: S&P Global Fixed Income Research.

Canada has the highest ratings among the nations with large numbers of ratings. About 4% of Canadian infrastructure ratings are 'AAA', compared with less than 1% in infrastructure overall. Canada's proportion of 'AA' category ratings is 1 percentage point lower than infrastructure's, but its proportion of 'A' category ratings is 20 percentage points higher. The higher percentage of ratings in these categories reduces the proportion of ratings in the 'BBB' and lower categories to below that of infrastructure overall.

Asia-Pacific and EMEA have higher distributions of ratings, with the former having more 'AAA' and 'AA' category ratings than other regions and EMEA having more 'AA' and 'A' category ratings than most regions.

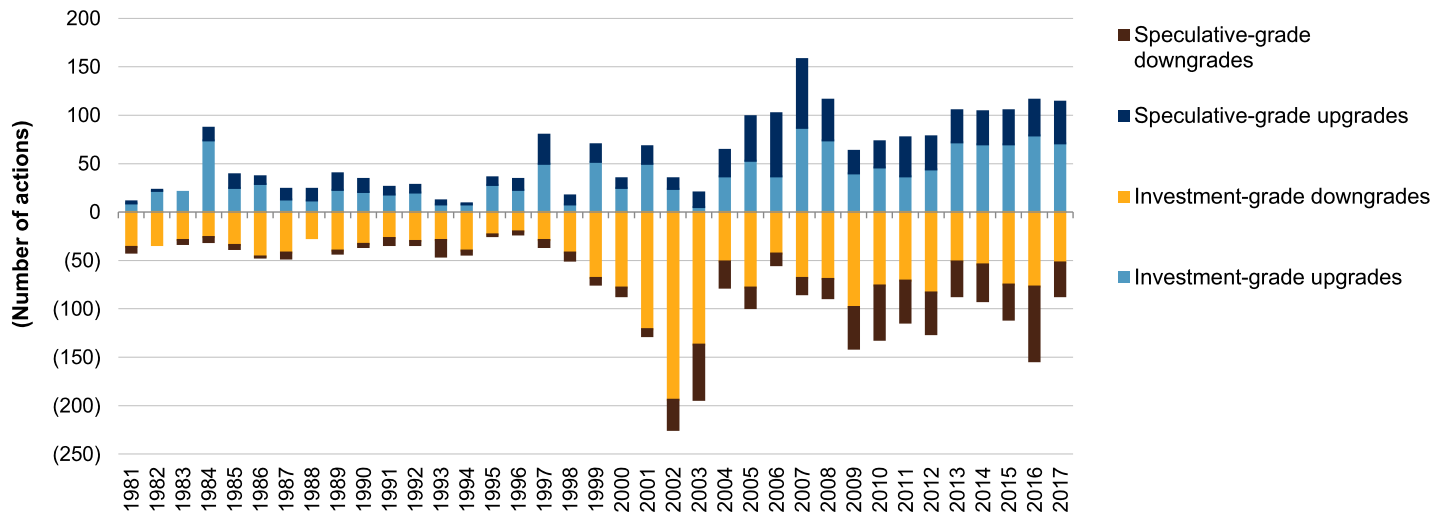
Latin America has a similar distribution to the U.S., with fewer high investment-grade ratings and a slightly higher concentration of speculative-grade ratings. Latin America has the highest concentration of 'BBB' category ratings.

Rating Movement

Rating movement has historically been negative. Downgrades have outnumbered upgrades 2,830 to 2,184 through 2017, and downgrades have surpassed upgrades in 25 years since 1981, compared with 12 years with more upgrades. More recently, trends have been favorable. There have been more upgrades than downgrades in seven of the past 13 years. The number of downgrades peaked in 2002 and 2003 with a total of 419, or 15% of all downgrades since 1981. Two of the highest years for upgrades were 2007 and 2008, which combined for 274 upgrades, 13% of all positive rating movements since the 1980s.

Chart 12

All Infrastructure Rating Actions



Note: Negative numbers indicate downgrades. Source: S&P Global Fixed Income Research.

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The higher incidence of downgrades accelerated in the early 2000s. The growth in downgrades came mainly from the utility sector, which was experiencing credit stress during a time of deregulation. From 2000-2004, there were 712 downgrades in infrastructure, compared with 222 upgrades. Some of the more notable defaults occurred during this time. The table below details the spike in infrastructure downgrades from 2000-2004. Utility downgrades exceeded the downgrades of all other groups combined each year during this period, reaching a peak of 158 in 2002. The following year, the ratio of downgrades to upgrades for utilities reached 17 to 1. Power and oil and gas had similar trajectories, combining for six downgrades in 2000 and 39 downgrades in 2002.

Table 3

Infrastructure Rating Actions Per Year (2000-2004)

	2000	2001	2002	2003	2004
Utilities					
Upgrades	23	52	23	8	48
Downgrades	75	107	158	138	41
Defaults	0	6	12	4	1
Power					
Upgrades	0	2	0	4	6
Downgrades	2	8	18	9	7
Defaults	0	0	3	10	0

Table 3

**Infrastructure Rating Actions Per Year
(2000-2004) (cont.)**

	2000	2001	2002	2003	2004
Oil and gas					
Upgrades	1	10	5	5	4
Downgrades	4	4	21	14	20
Defaults	0	1	0	0	0
Transportation					
Upgrades	2	0	0	1	1
Downgrades	1	1	1	3	0
Defaults	0	0	1	0	0
Social infrastructure					
Upgrades	0	0	0	0	0
Downgrades	0	0	0	0	0
Defaults	0	0	0	0	0
Other					
Upgrades	9	4	7	2	5
Downgrades	5	8	27	30	10
Defaults	0	1	1	0	1

Source: S&P Global Fixed Income Research.

The period from 2005-2008 was positive, with 147 more upgrades than downgrades. From 2009-2012, there were 222 more downgrades than upgrades. In the transportation sector, several Australian ratings were lowered in association with demand risk. The power sector was also impacted as merchant energy producers, especially older baseload coal plants, faced falling electricity prices brought on by the increase in gas-fired plants taking advantage of the shale gas boom in the U.S. Renewable energy also played a role as countries around the world increased the proportion of green energy sources to meet emission-reduction targets.

Table 4

Infrastructure Rating Actions Per Year (2009-2012)

	2009	2010	2011	2012
Utilities				
Upgrades	40	34	45	26
Downgrades	63	61	62	64
Defaults	4	3	5	3
Power				
Upgrades	5	9	6	2
Downgrades	19	19	10	16
Defaults	0	0	0	0

Table 4

Infrastructure Rating Actions Per Year (2009-2012) (cont.)

	2009	2010	2011	2012
Oil and gas				
Upgrades	5	10	15	29
Downgrades	9	8	8	20
Defaults	0	0	0	0
Transportation				
Upgrades	0	7	4	8
Downgrades	16	15	13	17
Defaults	0	0	0	0
Social infrastructure				
Upgrades	4	5	6	5
Downgrades	11	6	6	2
Defaults	0	0	0	0
Other				
Upgrades	9	8	1	8
Downgrades	23	23	15	7
Defaults	2	4	1	8

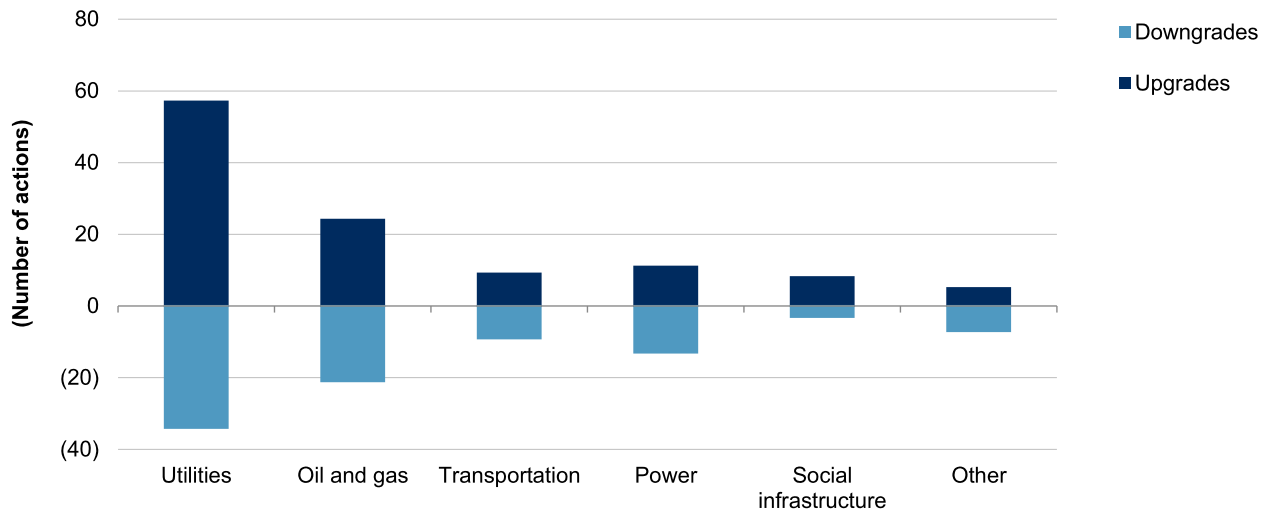
Source: S&P Global Fixed Income Research.

Investment-grade ratings have moved more often than speculative-grade ratings, for both upgrades and downgrades. This outcome is mostly the result of the overall distribution of infrastructure ratings, at least 73% of which have been investment grade every year since 1981. However, since 2009, speculative-grade ratings have taken more prominence among downgrades. In 2009, nearly a third of downgrades were for speculative-grade entities, which represented one-fifth of infrastructure ratings. From 2010-2017, an average of 25% of infrastructure ratings were speculative grade, while 45% of downgrades were to speculative-grade entities. From 1981-2008, the proportion of downgrades and the overall proportion of speculative-grade ratings were nearly identical, with 16% of all downgrades occurring among speculative-grade entities, which made up 13% of all infrastructure ratings.

Social infrastructure had the highest upgrade-to-downgrade ratio in 2017, with 2.67 upgrades for every downgrade. Utilities and oil and gas were also positive, with 1.68 and 1.14 upgrades for every downgrade, respectively. Transportation was even, with nine upgrades and nine downgrades, and power nearly matched, with 11 upgrades and 13 downgrades.

Chart 13

Infrastructure Rating Actions In 2017



Note: Does not include defaults. Source: S&P Global Fixed Income Research.

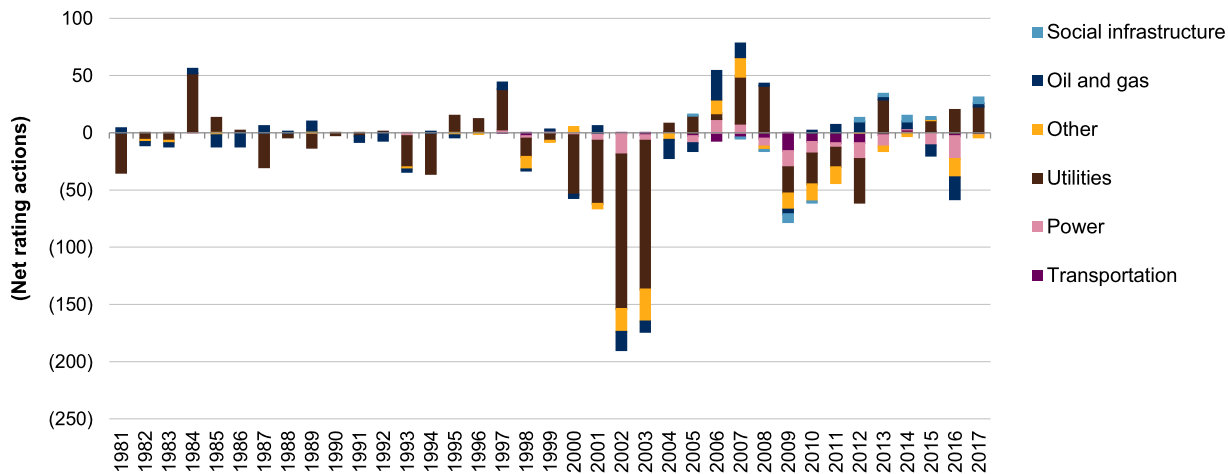
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The periods of highest downward rating movement were those with difficulties in the utilities, power, and oil and gas sectors. Most notable was the period of energy deregulation around 2001-2003 in the U.S. The sheer number of utility ratings means the subsector has a disproportionate impact on many infrastructure statistics. For example, while the utilities sector has a markedly low overall volatility rate, it often accounts for a majority of rating actions. In terms of upgrades versus downgrades, the utilities sector is more stable than the power sector, given its more regulated nature, especially since the performance problems of the 2001-2003 period.

The chart below depicts the net rating movement of each sector on an annual basis. Subtracting downgrades from upgrades shows how rating movement affected each sector's rating profile. Transportation had more downgrades than upgrades each year from 2005-2013, the longest negative streak among infrastructure industries, resulting in negative net rating movement of 63 downgrades over upgrades. Utilities had a shorter streak, from 1998-2003, but a much larger excess of downgrades over upgrades, at 394 during that time. Social infrastructure is more likely to have more upgrades than downgrades in any year, with 14 years of more upgrades or equal numbers of downgrades and upgrades and four years with more downgrades than upgrades.

Chart 14

Infrastructure Upgrades Less Downgrades By Industry



Source: S&P Global Fixed Income Research.

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All sectors except social infrastructure have downgrade-to-upgrade ratios of at least 1.07 to 1. Since 1980, the highest surplus of negative ratings actions has been among power ratings, with 1.87 downgrades for every upgrade. That ratio was higher in both 2015 (2.83) and 2016 (3.0). The category of other infrastructure follows with 1.71 downgrades for every upgrade, and transportation is next, with 1.68 downgrades for every upgrade. Transportation has stabilized in recent years, with 53 upgrades and 52 downgrades from 2014-2017.

Table 5

Infrastructure Rating Movement (1981-2017)

	Upgrades	Downgrades	Difference	Downgrades/upgrades
Power	127	237	(110)	1.87
Transportation	99	166	(67)	1.68
Utilities	1,408	1,749	(341)	1.24
Oil and gas	330	352	(22)	1.07
Social infrastructure	59	51	8	0.86
Other	161	275	(114)	1.71
Total	2,184	2,830	(646)	1.30

Note: Does not include defaults. Source: S&P Global Fixed Income Research.

Project finance ratings are more likely to default than corporate infrastructure ratings, and corporate ratings are more likely to be raised. The percentage of lowered ratings is essentially the same for the two groups. The downgrade percentage in project finance has averaged 11.75%, slightly higher than 11.39% for corporate. The annual average default rate is higher for project finance, at 0.71% annually, than for the corporate segment, at 0.35%. The corporate nonfinancial

default rate averages 1.82%. Corporate infrastructure ratings are raised at an average annual rate of 9.18%, compared with 5.86% for project finance infrastructure.

Table 6

Infrastructure Project Finance And Infrastructure Corporate Rating Movement

	--Upgrades--		--Downgrades--		--Defaults--	
	Number	Average annual %	Number	Average annual %	Number	Average annual %
Project finance	282	5.86	467	11.75	40	0.71
Corporate	1,902	9.18	2,363	11.39	87	0.35
All infrastructure	2,184	8.94	2,830	11.46	127	0.40

Source: S&P Global Fixed Income Research.

Rating Transitions

Transition tables provide detail on the speed with which infrastructure ratings change. Table 7 shows average one-, three-, and five-year rating transition rates from 1981-2017. Each cell indicates the average percentage of ratings maintaining the same rating category at the end of each time horizon. The rows indicate the starting rating, and the columns show the rating category after each designated period. Note the large percentages of withdrawn ratings ("NR," or not rated) as time increases. The high frequency of rating removal for redemption, maturity, or any other reason makes longer time horizons of up to 20 years impractical for infrastructure.

The highest values in the transition matrix are along the diagonal, indicating that as expected, most ratings do not move in a given period. However, by reading to the left of the diagonal and the right of the diagonal, one can determine the ratings that have transitioned to higher (left) and lower (right) categories.

In one year, about 3%-9% of investment-grade ratings move to lower rating categories. In three years, about 4%-18% of investment-grade ratings move into lower rating categories. In five years, about 6%-22% of investment-grade ratings are lower. The 'BBB' category is typically the most stable, and 'AA' category ratings are the most likely to move to a lower category at each time horizon.

Within infrastructure, project finance ratings are more likely to be lowered than corporate ratings. Furthermore, the lack of variable inputs in project finance significantly restricts upgrade movement. For project finance, about 9% of 'A' category and 11% of 'BBB' category ratings are lowered within three years. Just 1% of 'A' category corporate ratings are lowered in three years, and for 'BBB' category ratings, the rate is 2%. In five years, 10% of 'A' category project finance ratings are lowered, which is actually less than the 16% of lower corporate ratings over five years. In the 'BBB' category, project finance ratings are lowered more frequently than corporate ratings over three years and five years. Upgrades are relatively rare in project finance because for many 'BBB' projects, future cash flows are more governed by contracts that cap revenues to fixed prices or escalated at CPI. Over five years, just 4% of project finance ratings in the 'BBB' category are raised, compared with 8% of corporate ratings.

Table 7

Infrastructure Average Transition Rates (1981-2017)

(%)

Rating	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	84.27	7.04	0.00	0.00	0.00	0.00	0.23	0.00	8.45
AA	0.34	82.38	8.70	0.46	0.17	0.08	0.00	0.00	7.86
A	0.04	1.37	82.92	6.02	0.12	0.06	0.06	0.09	9.31
BBB	0.00	0.00	3.33	83.40	2.48	0.25	0.25	0.12	10.17
BB	0.00	0.00	0.25	9.18	70.00	6.09	0.93	0.39	13.16
B	0.00	0.10	0.38	1.34	11.40	66.09	6.03	1.44	13.22
CCC/C	0.00	0.00	1.05	0.00	1.05	13.59	56.45	16.72	11.15
Three years									
AAA	55.91	12.56	2.22	1.97	0.00	0.00	0.74	0.00	26.60
AA	0.79	58.22	16.70	1.81	0.57	0.00	0.00	0.00	21.90
A	0.08	2.75	57.25	12.68	0.67	0.26	0.13	0.27	25.91
BBB	0.00	0.00	7.56	58.90	3.80	1.17	0.54	0.69	27.33
BB	0.00	0.00	0.51	17.78	36.24	7.25	1.70	1.36	35.16
B	0.00	0.00	0.99	6.16	19.25	28.82	6.82	4.95	33.00
CCC/C	0.00	0.00	0.00	1.59	2.78	11.90	19.05	28.17	36.51
Five years									
AAA	33.94	11.66	2.33	6.22	0.00	0.00	0.78	0.00	45.08
AA	1.07	39.88	18.52	3.11	0.88	0.00	0.00	0.00	36.54
A	0.10	2.75	40.54	14.22	0.83	0.35	0.17	0.54	40.50
BBB	0.00	0.00	8.30	42.09	3.52	1.50	0.68	1.11	42.79
BB	0.00	0.00	1.19	18.12	18.64	5.14	1.05	2.96	52.90
B	0.00	0.00	1.15	9.04	16.94	10.19	4.97	6.37	51.34
CCC/C	0.00	0.00	0.00	2.76	1.38	7.83	7.37	29.95	50.69

NR--Not rated. Source: S&P Global Fixed Income Research.

Nonfinancial corporate ratings move more rapidly than infrastructure ratings. In one year, about 4%-9% of investment-grade ratings move to lower rating categories. In three years, about 10%-22% of investment-grade ratings move into lower rating categories. In five years, about 14%-29% of investment-grade ratings are lower. As with infrastructure ratings, the 'BBB' category is typically the most stable, although 'AAA' ratings are as likely as 'AA' category ratings to move into a lower category at each time horizon.

Not surprisingly, the percentage of ratings that fall to 'D', or default, is higher at almost every category and time horizon for nonfinancial corporates. The high percentage of infrastructure ratings that have been withdrawn, as indicated in the "NR" column, obscures the data and conclusions drawn from it. After five years, 43% of infrastructure ratings in the 'BBB' category have been withdrawn, compared with 23% of nonfinancial corporate ratings in the same category.

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

There is no indication of whether the removed ratings would have remained in the same category or moved positively or negatively, but direct comparisons become less precise because of the withdrawn ratings. However, negative transition trends are consistent across all time horizons among surviving ratings.

Table 8

Nonfinancial Corporate Average Transition Rates (1981-2017)

(%)

Rating	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	86.97	8.34	0.84	0.00	0.07	0.00	0.00	0.00	3.78
AA	0.55	86.81	7.72	0.69	0.09	0.12	0.00	0.00	4.02
A	0.04	1.27	87.72	6.29	0.38	0.17	0.02	0.03	4.08
BBB	0.01	0.05	3.01	86.75	3.79	0.50	0.10	0.14	5.65
BB	0.02	0.02	0.11	4.59	77.53	7.17	0.54	0.67	9.36
B	0.00	0.02	0.08	0.15	4.87	74.21	4.58	3.68	12.40
CCC/C	0.00	0.00	0.14	0.24	0.48	12.78	43.01	28.36	15.00
Three years									
AAA	66.55	18.65	3.56	0.28	0.14	0.07	0.00	0.00	10.75
AA	1.26	66.05	18.11	2.48	0.57	0.30	0.02	0.03	11.18
A	0.07	2.99	68.04	14.61	1.45	0.61	0.08	0.12	12.02
BBB	0.03	0.16	7.42	66.46	7.67	1.85	0.28	0.73	15.40
BB	0.01	0.04	0.45	10.45	47.49	12.36	1.30	4.10	23.80
B	0.00	0.03	0.19	0.67	9.89	40.94	4.80	13.05	30.43
CCC/C	0.00	0.00	0.12	0.63	1.62	15.92	10.36	43.34	28.01
Five years									
AAA	52.68	23.41	5.51	1.16	0.29	0.07	0.00	0.00	16.88
AA	1.59	49.89	24.43	4.45	0.86	0.52	0.03	0.10	18.15
A	0.08	3.77	54.30	19.06	2.31	0.97	0.12	0.34	19.05
BBB	0.03	0.23	9.33	53.77	8.58	2.60	0.36	1.65	23.44
BB	0.01	0.06	0.89	12.10	32.04	11.91	1.34	7.90	33.75
B	0.02	0.02	0.22	1.40	10.09	24.59	2.96	19.60	41.11
CCC/C	0.00	0.00	0.09	0.80	2.57	11.57	2.57	49.60	32.80

NR--Not rated. Source: S&P Global Fixed Income Research.

All industries except utilities exhibit negative rating movement at the 'BBB' category. Focusing on the 'BBB' category, which is the largest rating category, allows for comparison between infrastructure subsectors. Oil and gas ratings are the most likely to remain in the 'BBB' category from one to five years. Utilities have positive rating transitions over one year, three years, and five years. Social infrastructure ratings are slightly more likely to fall to a lower rating category than they are to move to a higher category over one year, but are more likely to reach a higher category in three and five years. Power and transportation have significant downward shifts at all horizons,

and this is more pronounced in the power sector.

Table 9

'BBB' Category Transition Rates By Industry (1981-2017)

(%)											--% transition--		
	AAA	AA	A	BBB	BB	B	CCC/C	D	NR		Higher	Lower	Total
One year													
Oil and gas	0.00	0.00	1.60	86.21	3.21	0.36	0.00	0.00	8.61	1.60	3.57	5.18	
Utilities	0.00	0.00	3.87	83.04	2.24	0.14	0.26	0.12	10.32	3.87	2.77	6.64	
Power	0.00	0.00	0.37	87.86	4.34	0.74	0.50	0.25	5.95	0.37	5.82	6.20	
Social infrastructure	0.00	0.21	2.76	90.45	2.76	0.21	0.00	0.00	3.61	2.97	2.97	5.94	
Transportation	0.00	0.00	1.77	86.15	2.58	0.48	0.81	0.00	8.21	1.77	3.86	5.64	
Other	0.00	0.00	0.80	80.88	4.68	0.67	0.27	0.27	12.43	0.80	5.88	6.68	
Three years													
Oil and gas	0.00	0.00	2.84	67.81	6.02	2.26	0.17	0.17	20.74	2.84	8.61	11.45	
Utilities	0.00	0.00	8.88	57.80	3.28	0.79	0.47	0.61	28.17	8.88	5.16	14.03	
Power	0.00	0.00	0.42	68.73	6.20	4.08	0.70	2.25	17.61	0.42	13.24	13.66	
Social infrastructure	0.00	0.52	7.24	76.74	8.01	0.78	0.00	0.00	6.72	7.75	8.79	16.54	
Transportation	0.00	0.00	4.48	62.73	6.31	1.22	2.24	0.81	22.20	4.48	10.59	15.07	
Other	0.14	0.00	2.20	50.82	5.49	3.30	2.75	0.96	34.34	2.34	12.50	14.84	
Five years													
Oil and gas	0.00	0.00	3.54	53.93	6.19	4.13	0.49	0.10	31.63	3.54	10.90	14.44	
Utilities	0.00	0.00	9.66	40.80	2.99	0.84	0.58	0.95	44.17	9.66	5.37	15.03	
Power	0.00	0.00	0.16	53.87	7.58	4.28	1.65	3.95	28.50	0.16	17.46	17.63	
Social infrastructure	0.00	0.65	10.13	66.34	11.76	0.98	0.00	0.00	10.13	10.78	12.75	23.53	
Transportation	0.00	0.00	4.68	43.80	8.26	4.96	1.10	2.20	34.99	4.68	16.53	21.21	
Other	0.43	0.00	2.43	30.71	5.43	2.57	2.43	1.86	54.14	2.86	12.29	15.14	

NR--Not rated. Source: S&P Global Fixed Income Research.

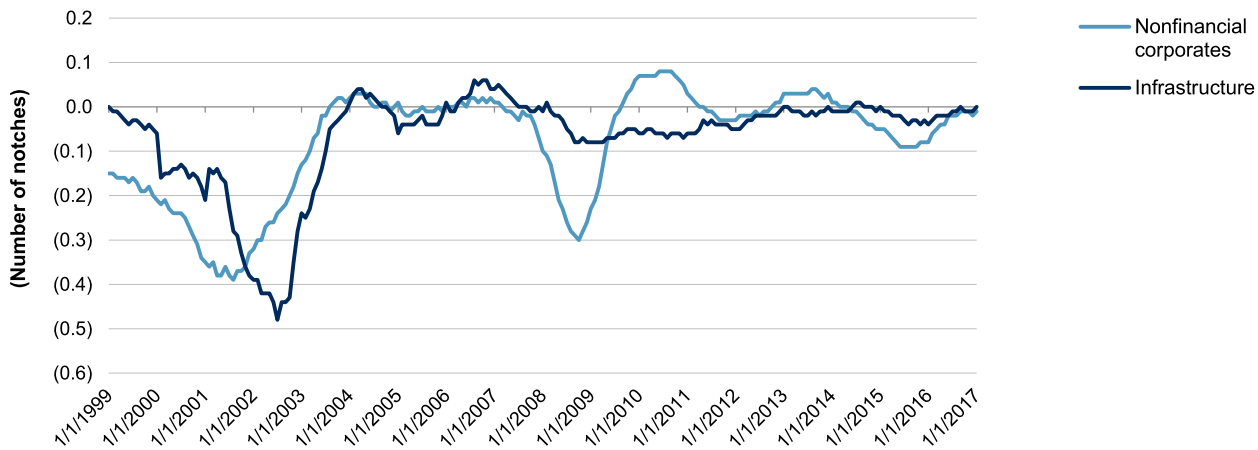
Rating Volatility

Losses on investment can occur even without a default, and transitions to lower ratings might have implications for investors such as pension funds and other institutional investors restricted from holding speculative-grade debt and, in some cases, even investment-grade debt below certain rating levels.

When we measure net rating changes (upgrades minus downgrades and defaults) as a percentage of the total issue and issuer base over a 12-month period, both infrastructure overall and the broader nonfinancial segment display rating changes in line with economic and default cycles. That said, rated infrastructure generally displays stronger ratings stability than do nonfinancial corporates.

Chart 15

Transition Rates And Average Change In Credit Quality



Source: S&P Global Fixed Income Research.

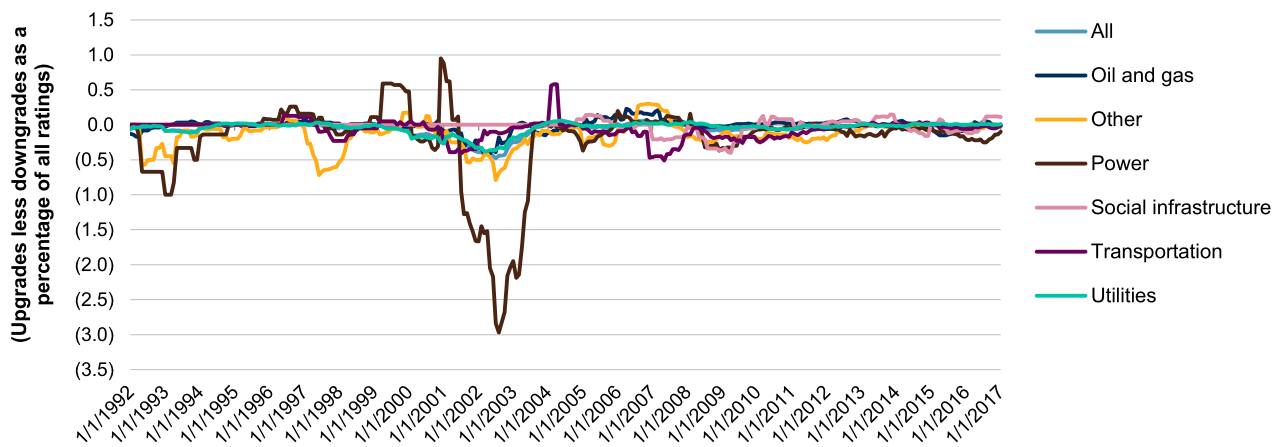
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Infrastructure saw its highest rate of credit degradation during the 2001-2003 period, which coincides with its peak default cycle. In terms of net rating changes, this cycle peaked slightly later than that of nonfinancial corporates. Some of this is a product of sector characteristics, such as that infrastructure project financings typically have dedicated debt service reserves and distribution traps, creating a delayed effect in times of broad or sustained economic stress. And as shown earlier, infrastructure has a much higher proportion of investment-grade ratings than do nonfinancial corporates. Even in periods of widespread stress, investment-grade ratings typically see slower credit degradation than speculative-grade ratings.

Since 1992, rating movement has been mostly negative and mostly subtle. To measure the direction and degree of rating change, we subtracted the number of downgrades, multiplied by the average number of notches for each downgrade, from the number of upgrades, multiplied by the notches per upgrade. Dividing this result by the number of total ratings provides a measure of volatility. The total ratings include those that did not change.

Chart 16

12-Month Credit Quality By Industry



Source: S&P Global Fixed Income Research.

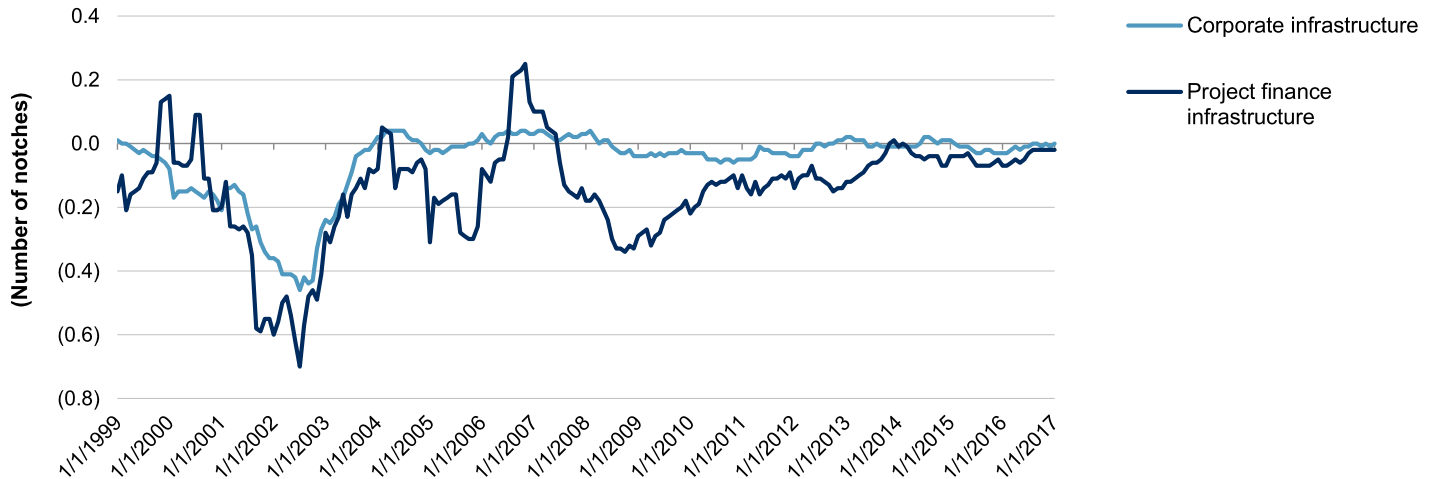
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This net rating change indicates that infrastructure ratings have typically declined by modest degrees in most periods, regardless of the length of time. The difference in notches between upgrades and downgrades has been 0.13 on a monthly basis since 1981. The power sector stands apart from the rest of infrastructure with a much higher rate of decline in ratings, at 0.20, and for 19 consecutive months in 2001 and 2002, power ratings had a negative net rating change between 0.96 and 2.97.

Finally, project finance infrastructure ratings have been more volatile than corporate infrastructure ratings, with significant declines in three periods, as well as generally steeper declines. The chart below shows the declines in 2001-2003, 2004-2006, and 2007-2013. Only in one period did project finance volatility result in more positive rating movement than corporate infrastructure experienced, from mid-2006 to mid-2007.

Chart 17

Comparison Of Credit Quality: Corporate Infrastructure and Project Finance Infrastructure



Source: S&P Global Fixed Income Research.

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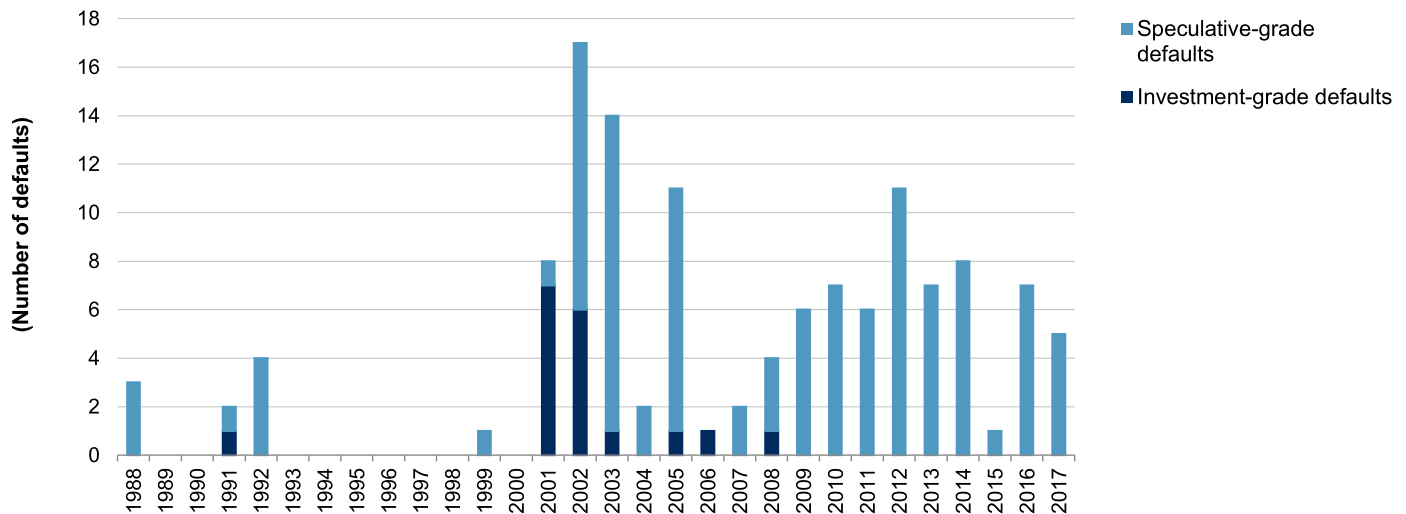
Defaults

There were seven infrastructure defaults in 2017, in three sectors and three countries. Four of the defaults were in the U.S., two were in the Cayman Islands, and another was in Venezuela. Four of the defaults were from the power sector, two were in the oil and gas industry, and one was in utilities. (Four of the defaults were in corporate infrastructure, and three were in project finance.) There were also seven defaults in 2016, following one default in 2015. The 2017 number includes two ratings that were not in existence at the start of the year and therefore do not appear in any calculations for rating transitions or default rates. This is because those calculations are based on ratings over time horizons of at least one year.

Since 1981, we have seen 133 infrastructure defaults, almost all since 2001. Defaults increased noticeably in two periods, the early 2000s and from the Great Recession through 2017. From 1993-2000, there was just one default in infrastructure, but then there were 39 from 2001-2003. There were 17 defaults, the most on record, in 2002. Defaults have surged from a total of four in 2008. Since then, there have been at least five defaults every year except 2015, when there were two.

Chart 18

Infrastructure Defaults By Year



Source: S&P Global Fixed Income Research.

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Speculative-grade ratings represent 85% of all defaults since 1981 and all defaults since 2008. The only years with significant numbers of defaults of investment-grade ratings were 2001 and 2002, which account for 13 of the 18 investment-grade defaults since 1981. Since the last investment-grade default, in 2008, the speculative-grade default rate has averaged 2.3%.

Table 10

All Infrastructure Default Summary

Year	Total defaults*	Rated defaults	Investment-grade defaults	Speculative-grade defaults	Default rate (%)		Investment-grade default rate (%)		Speculative-grade default rate (%)	
1981	0	0	0	0	0.00		0.00		0.00	
1982	0	0	0	0	0.00		0.00		0.00	
1983	0	0	0	0	0.00		0.00		0.00	
1984	0	0	0	0	0.00		0.00		0.00	
1985	0	0	0	0	0.00		0.00		0.00	
1986	0	0	0	0	0.00		0.00		0.00	
1987	0	0	0	0	0.00		0.00		0.00	
1988	3	3	0	3	0.95		0.00		7.69	
1989	0	0	0	0	0.00		0.00		0.00	
1990	0	0	0	0	0.00		0.00		0.00	
1991	2	2	1	1	0.67		0.38		3.23	
1992	4	4	0	4	1.27		0.00		10.81	

Table 10

All Infrastructure Default Summary (cont.)

Year	Total defaults*	Rated defaults	Investment-grade defaults	Speculative-grade defaults	Default rate (%)	Investment-grade default rate (%)	Speculative-grade default rate (%)
1993	0	0	0	0	0.00	0.00	0.00
1994	0	0	0	0	0.00	0.00	0.00
1995	0	0	0	0	0.00	0.00	0.00
1996	0	0	0	0	0.00	0.00	0.00
1997	0	0	0	0	0.00	0.00	0.00
1998	0	0	0	0	0.00	0.00	0.00
1999	1	1	0	1	0.17	0.00	1.25
2000	0	0	0	0	0.00	0.00	0.00
2001	9	8	7	1	1.09	1.10	1.04
2002	17	17	6	11	2.05	0.83	10.19
2003	16	14	1	13	1.70	0.15	7.93
2004	2	2	0	2	0.22	0.00	1.04
2005	11	11	1	10	1.14	0.13	5.00
2006	1	1	1	0	0.10	0.13	0.00
2007	2	2	0	2	0.19	0.00	0.92
2008	4	4	1	3	0.36	0.11	1.30
2009	7	6	0	6	0.53	0.00	2.58
2010	7	7	0	7	0.61	0.00	2.64
2011	6	6	0	6	0.51	0.00	2.14
2012	11	11	0	11	0.95	0.00	3.87
2013	7	7	0	7	0.61	0.00	2.53
2014	8	8	0	8	0.68	0.00	2.81
2015	1	1	0	1	0.08	0.00	0.33
2016	7	7	0	7	0.58	0.00	2.19
2017	7	5	0	5	0.44	0.00	1.64
Totals	133	127	18	109			

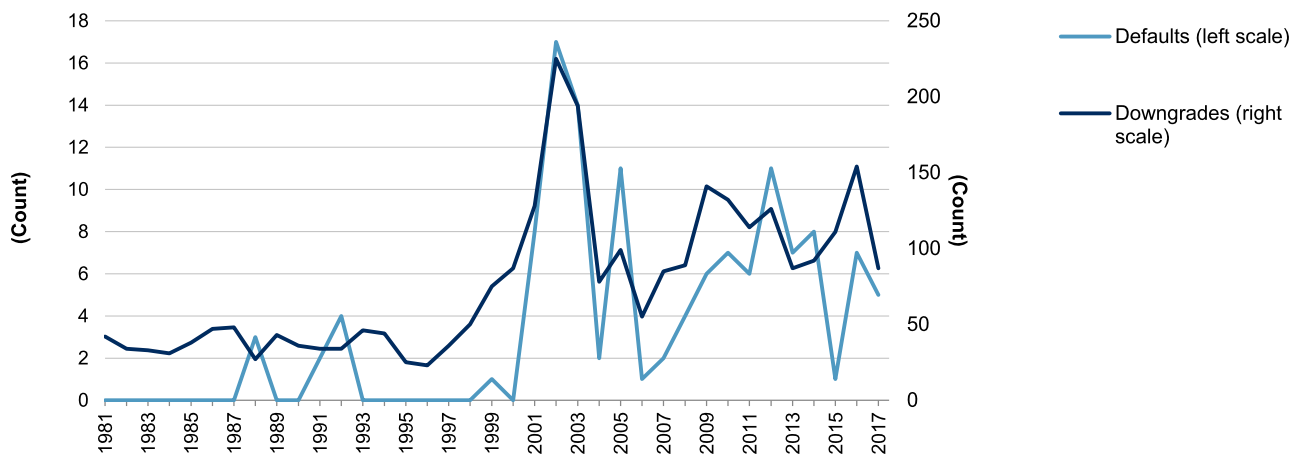
*Includes defaults that were observed in the same year as the initial rating and defaults of entities with ratings that were withdrawn at the start of the year in which they defaulted. Source: S&P Global Fixed Income Research.

Default rates are much higher among speculative-grade ratings. In 2002, the rate of speculative-grade defaults reached 10.19%, and the annual rate has exceeded 1% 15 times since 1995. Investment-grade default rates have been below 1% every year except 2001, when the rate was barely higher, at 1.10%.

Corporate infrastructure has lower average default rates than project finance infrastructure. The average default rate for corporate infrastructure is 0.35% since 1981, compared with 0.50% for project finance. When excluding power from corporate ratings, the percentage declines to 0.29%.

Chart 19

Infrastructure Defaults And Downgrades (1981-2017)



Source: S&P Global Fixed Income Research.

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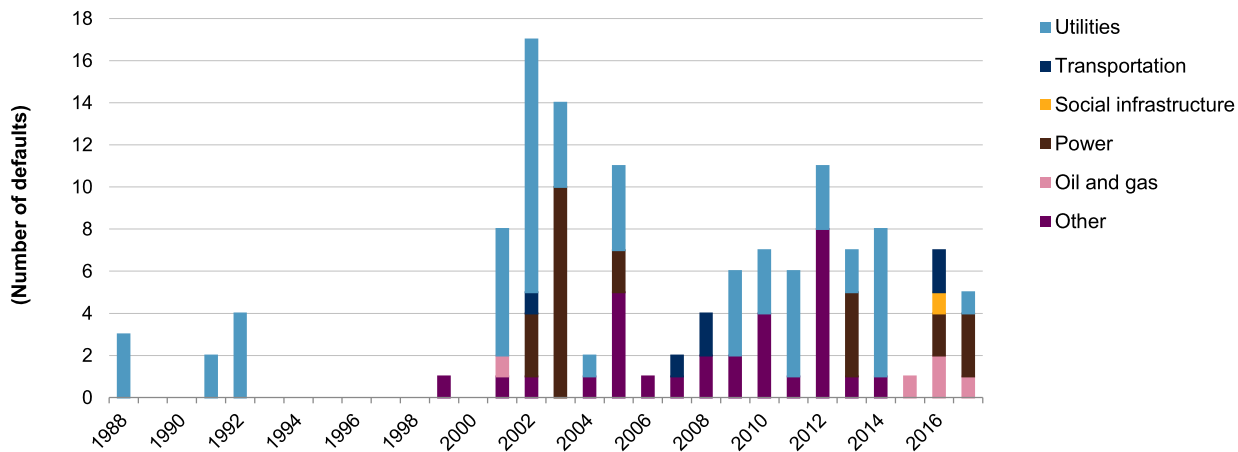
The number of defaults has moved in a similar direction as the number of total downgrades since the late 1990s. This suggests that defaults are not random but reflect rating trends and underlying credit conditions. In addition, there has been a pattern of a change in the number of downgrades preceding a similar change in defaults. The number of downgrades rose sharply every year from 1998-2002, and then defaults spiked in 2001-2003. Downgrades and defaults moved in the same direction each year from 2004-2009. More recent years generally follow the same trajectory. The only exception is 2015, which had just one default but 111 downgrades.

By subsector, utilities accounted for the highest number of infrastructure defaults, at 61, or 48%. Entities in the uncategorized group had the second-highest number of defaults, at 30. Power had 24 defaults. From there, numbers decrease considerably, to six defaults in transportation, five in oil and gas, and one in social infrastructure.

In terms of scale of representation relative to the rating distribution by industry, the utility sector's 48% of defaults is close to its 45% share of all ratings. Power defaults are more common than the number of ratings would suggest, at 19% of defaults and 12% of ratings. Power is characterized by high market risks (low barriers to entry; merchant pricing risk; unregulated, aggressive leverage; and lower-than-forecast demand), although this is not the case for contracted power. Oil and gas, transportation, and social infrastructure accounted for fewer defaults than their percentage of ratings. The most overrepresented group of defaults is in the other category--ratings that are not included in the other five groups. These are all project finance ratings, frequently for finance and holding companies.

Chart 20

Rated Annual Infrastructure Defaults By Industry



Source: S&P Global Fixed Income Research.

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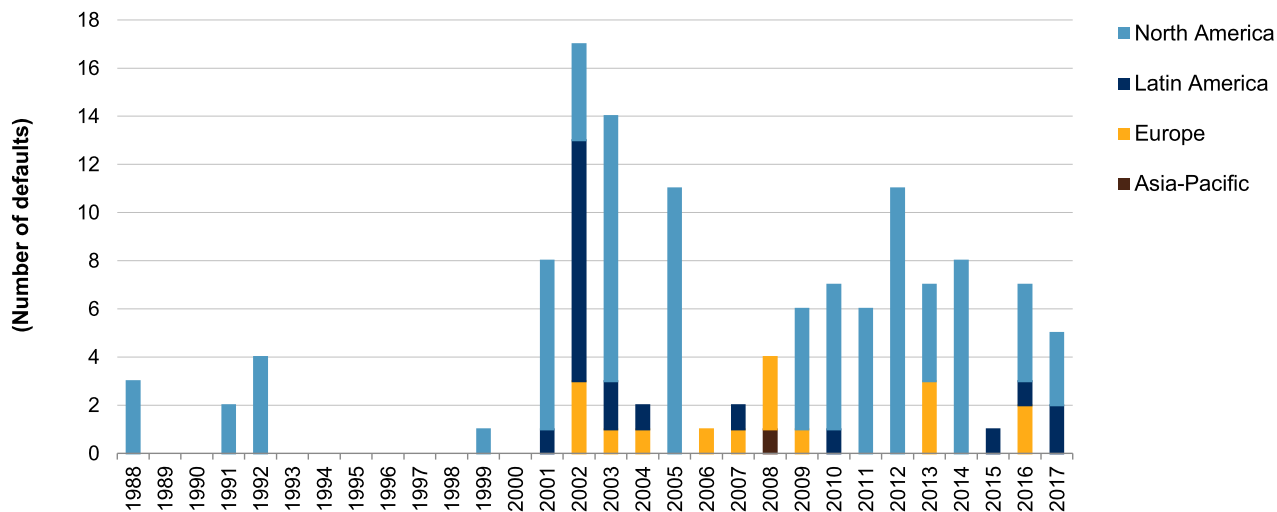
Infrastructure defaults occur mainly in the U.S. Of the 127 defaults, 90 have occurred in the U.S., far exceeding the next-closest nation, Argentina, with 11. No other country has had as many as 10 defaults. All but two of the North American (U.S. and Canadian) defaults are within the U.S., and North America accounts for 71% of infrastructure defaults. Latin America comes second with 16%. EMEA has 13%, and Asia-Pacific has just one default, or less than 1%.

On the positive side, Canada accounted for 10% of ratings at the start of 2018 but for just 2% of defaults in the 1988-2017 period. Meanwhile, the U.K. accounted for 15% of ratings in 2017 and 7% of defaults in the 1988-2017 period.

North American defaults dominate most periods. In just one year, 2002, were there significantly more defaults outside of North America than within it. There were 10 Latin American and three European defaults that year, compared with four North American defaults. The most defaults of any region in a year is 11, all in North America, which occurred three times, all in this century, most recently in 2012.

Chart 21

Rated Annual Infrastructure Defaults By Region

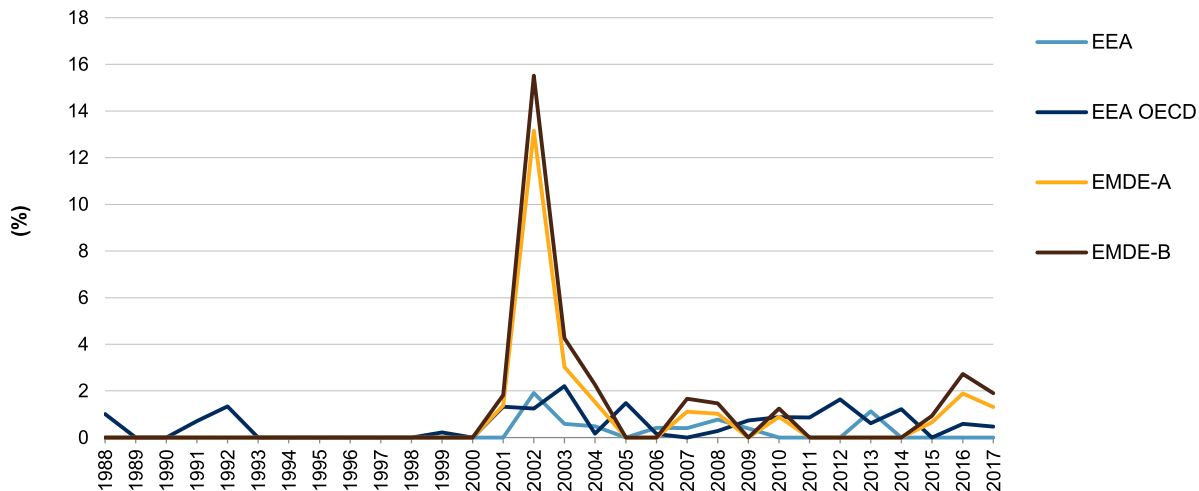


Source: S&P Global Fixed Income Research.
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The chart below shows the annual default rates by region. Default rates were low until the Asian financial crisis in 1995, and then they fell sharply by 2000. Since then, default rates have remained below 2% in all years until just after the Great Recession.

Chart 22

Default Rates By Region



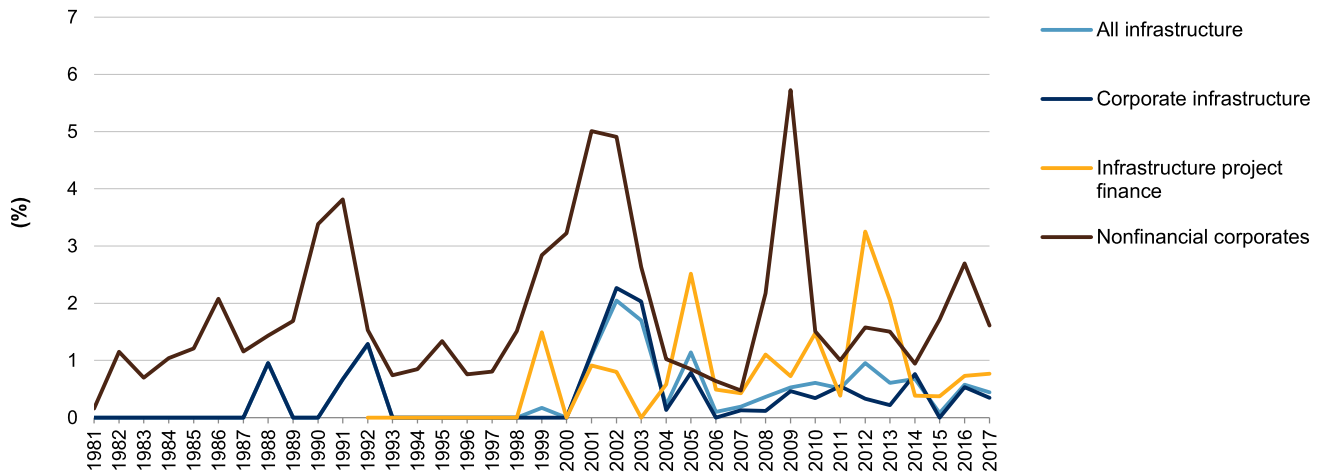
EEA--European Economic Area. EEA OECD--European Economic Area, Office of Economic Cooperation and Development. EMDE--Emerging market and developing countries. EMDE-A countries are non-high-income countries, plus East European countries in transition such as the Baltics, Poland, Hungary, and Slovakia. EMDE-B countries exclude EMDE-A, as well as non-high-income OECD countries such as Mexico, Turkey, Chile, Croatia, Bulgaria, and Romania. Source: S&P Global Fixed Income Research. Copyright © 2018 by Standard & Poor's Financial Services LLC. All rights reserved.

Historical Default Cycles: Infrastructure Dodges The Financial Crisis

In general, infrastructure saw relative peak default rates in line with those of nonfinancial corporates during the 1990-1991 U.S. recession and again during the 2000 recession. However, the sector made it through the most recent financial crisis relatively unscathed, with a peak default rate under 1%, compared with just under 6% for nonfinancial corporates. On a trailing-12-month basis, the overall infrastructure default rate was higher than that of nonfinancials only from January 2005 through December 2005, as a result of the Dec. 21, 2005, bankruptcy filing of Calpine Corp. (corporate infrastructure power developer and energy merchant company), which covered nine defaulting instruments in our data set.

Chart 23

Default Rates: Infrastructure And Nonfinancial Corporates

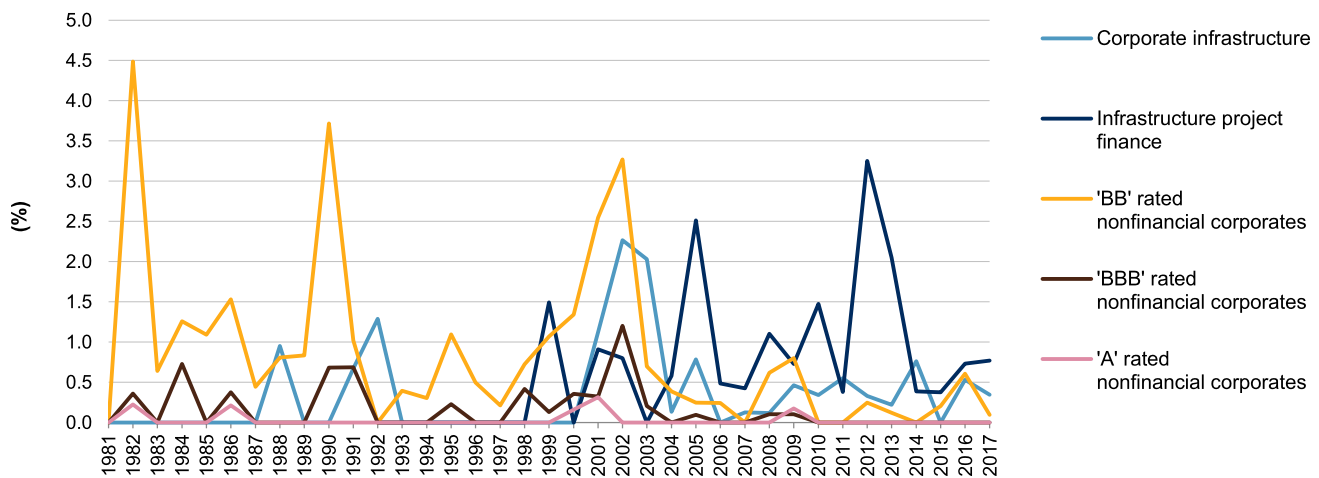


Source: S&P Global Fixed Income Research.

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Chart 24

Default Rates: Infrastructure And Nonfinancial Corporates By Rating Category

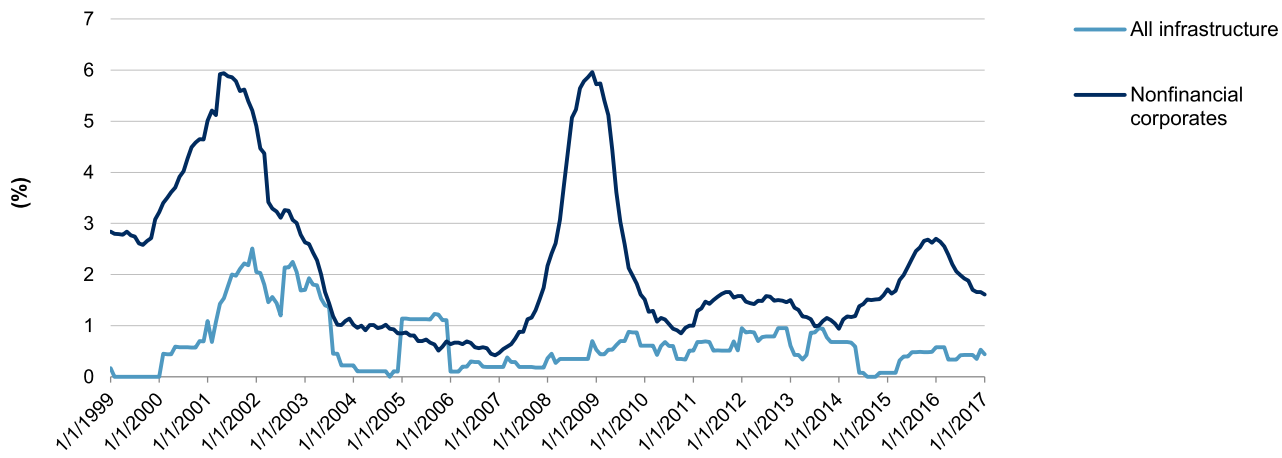


Source: S&P Global Fixed Income Research.

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Chart 25

Trailing-12-Month Default Rates



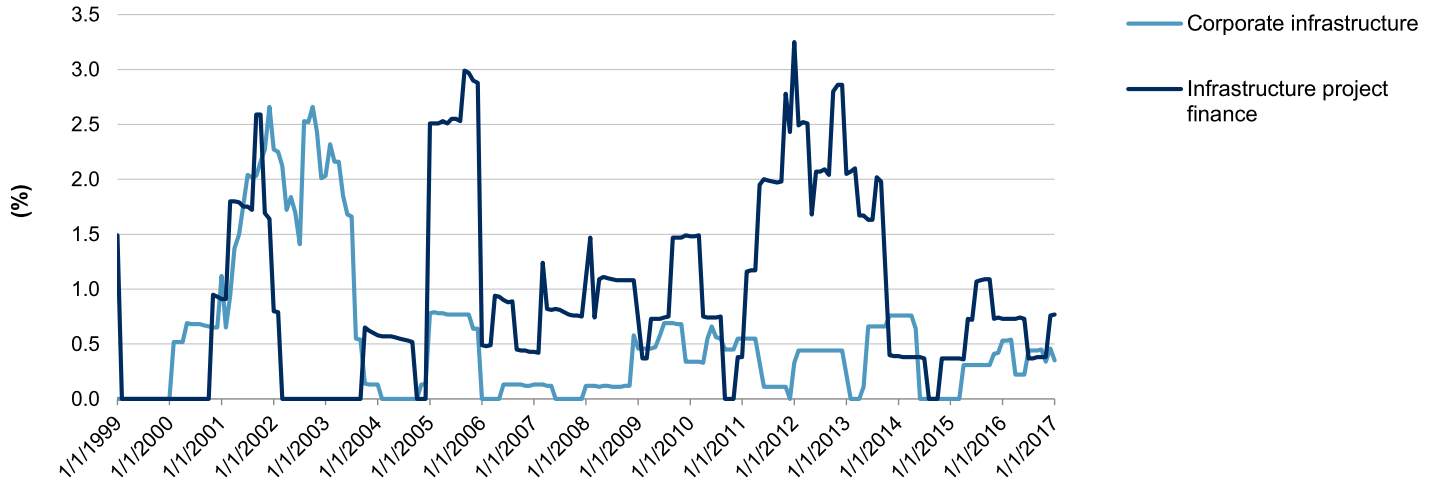
Sources: S&P Global Fixed Income Research.

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However, infrastructure project finance default rates tend to reach higher levels and remain elevated for longer stretches than default rates for infrastructure corporates (see chart 26). Nonetheless, within both subsectors, default rates are comparably low and have been trending lower over the past five years. The default rate for infrastructure project finance peaked in 2012 at 3.25%, while infrastructure corporates hit a peak default rate of 2.66% in 2001. The peak default rate of infrastructure corporates was largely propelled by high-risk sectors such as power. Excluding the power subsector, the peak default rate of infrastructure corporates drops to 1.93%.

Chart 26

Trailing-12-Month Default Rates: Corporate Infrastructure And Infrastructure Project Finance



Source: S&P Global Fixed Income Research.

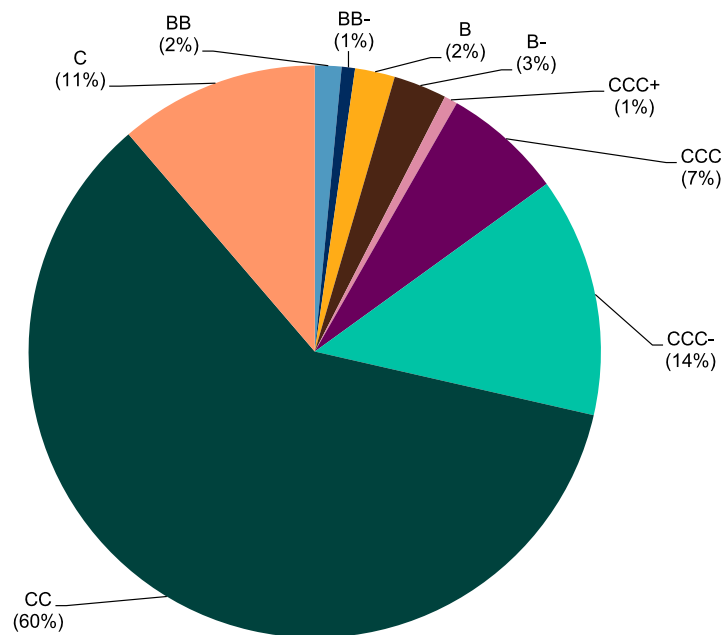
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Ratings At Default

Ratings on defaulting entities in infrastructure have shown a high tendency to reach 'CCC'/'C' immediately before default. About 93% of defaulting projects were rated in these categories immediately before default, with 5% rated in the 'B' category and 2% in the 'BB' category immediately prior to default.

Chart 27

Infrastructure Ratings Prior To Default



Source: S&P Global Fixed Income Research.
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Infrastructure ratings have been significantly less likely to encounter default than nonfinancial corporate ratings. A comparison of cumulative default rates up to 15 years by rating category shows that in just two out of 24 observations do infrastructure default rates exceed those of nonfinancial corporate ratings. The two instances of higher infrastructure default rates are insignificantly different from nonfinancial corporate rates. The average record of higher default rates for infrastructure ratings is 0.12%. In comparison, the rates of default are 6.07% higher for nonfinancial corporates than infrastructure ratings over 23 observations.

Over longer periods, the relative strength of infrastructure ratings grows stronger. By year five, the only rating categories in which the cumulative default rate of nonfinancial corporates does not exceed that of infrastructure ratings are 'AAA' and 'A'. By year 10, the default rates for nonfinancial corporate ratings are higher than those for infrastructure at all rating categories. Default among all 'AAA' ratings in the two groups is rare. However, there has never been a default among 'AAA' infrastructure ratings within 15 years, whereas the cumulative default rate of nonfinancial corporate 'AAA' ratings is 0.39% at 15 years.

The 'BBB' category, the most common rating category for infrastructure ratings, shows a similar pattern. Defaults are uncommon among both infrastructure and nonfinancial corporates in the 'BBB' category. For the first year, the default rate for infrastructure is slightly lower than for nonfinancial corporate ratings, at a difference of 0.02%. The difference rises to 0.48% at five years, 1.56% at 10 years, and 2.11% at 15 years. Investment-grade credits have a very similar

pattern, with a slight edge over nonfinancial corporate ratings of 0.01% in the first year, followed by an increasing margin in the default rates for nonfinancial corporates over infrastructure through 20 years. Speculative-grade nonfinancial corporate ratings start with a default rate that is 1.66% higher in the first year and grows to 15.16% higher by year 15.

Table 11

Cumulative Default Rates: Infrastructure And Nonfinancial Corporates (1981-2017)

(%)

Rating	--Time horizon (years)--			
	1	5	10	15
All infrastructure				
AAA	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.06
A	0.08	0.51	0.83	0.98
BBB	0.11	1.05	1.88	2.72
BB	0.38	3.97	6.16	6.85
B	2.08	8.20	11.23	11.54
CCC/C	16.79	32.67	35.69	35.69
Investment grade	0.09	0.71	1.21	1.64
Speculative grade	2.27	7.68	10.23	10.75
All rated	0.50	1.99	2.82	3.26
Nonfinancial corporates				
AAA	0.00	0.00	0.23	0.39
AA	0.00	0.10	0.33	0.60
A	0.03	0.32	1.17	2.00
BBB	0.14	1.53	3.44	4.83
BB	0.67	7.53	13.68	16.97
B	3.68	18.67	26.10	29.66
CCC/C	28.36	49.09	53.51	55.75
Investment grade	0.08	0.85	2.06	2.99
Speculative grade	3.94	15.90	22.57	25.91
All rated	1.92	7.88	11.42	13.28
Difference				
AAA	0.00	0.00	(0.23)	(0.39)
AA	0.00	(0.10)	(0.33)	(0.54)
A	0.05	0.19	(0.34)	(1.02)
BBB	(0.02)	(0.48)	(1.56)	(2.11)
BB	(0.29)	(3.56)	(7.52)	(10.12)
B	(1.60)	(10.47)	(14.87)	(18.12)
CCC/C	(11.57)	(16.42)	(17.82)	(20.06)
Investment grade	0.01	(0.14)	(0.85)	(1.35)

Table 11

**Cumulative Default Rates: Infrastructure And Nonfinancial Corporates
(1981-2017) (cont.)**

Speculative grade	(1.66)	(8.21)	(12.34)	(15.16)
All rated	(1.42)	(5.89)	(8.60)	(10.02)

Source: S&P Global Fixed Income Research.

Table 12

**Cumulative Default Rates: Corporate Infrastructure And Project Finance
Infrastructure (1981-2017)**

(%)

Rating	--Time horizon (years)--			
	1	5	10	15
Corporate infrastructure				
AAA	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.06
A	0.09	0.50	0.76	0.85
BBB	0.12	0.99	1.83	2.56
BB	0.39	2.66	3.65	3.89
B	1.44	6.72	8.60	9.01
CCC/C	16.72	30.74	34.96	34.96
Investment grade	0.09	0.64	1.10	1.44
Speculative grade	2.11	6.32	7.90	8.17
All rated	0.41	1.51	2.12	2.45
Project finance infrastructure				
AAA	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00
A	0.00	0.77	2.55	4.09
BBB	0.10	1.33	2.09	3.58
BB	0.34	6.99	12.14	14.35
B	3.60	11.73	17.83	17.83
CCC/C	16.96	37.37	37.37	37.37
Investment grade	0.07	1.20	2.09	3.55
Speculative grade	2.66	10.90	15.90	17.38
All rated	0.97	4.57	6.87	8.33
Difference				
AAA	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.06
A	0.09	(0.27)	(1.80)	(3.24)

Table 12

Cumulative Default Rates: Corporate Infrastructure And Project Finance Infrastructure (1981-2017) (cont.)

BBB	0.02	(0.34)	(0.26)	(1.03)
BB	0.05	(4.33)	(8.49)	(10.45)
B	(2.16)	(5.01)	(9.24)	(8.82)
CCC/C	(0.24)	(6.63)	(2.41)	(2.41)
Investment grade	0.02	(0.55)	(0.99)	(2.11)
Speculative grade	(0.55)	(4.58)	(8.01)	(9.21)
All rated	(0.56)	(3.06)	(4.75)	(5.88)

Source: S&P Global Fixed Income Research.

Project finance infrastructure has higher cumulative default rates than corporate infrastructure, with a larger discrepancy among speculative-grade credits. The speculative-grade cumulative default rate among project finance ratings is 17.38% at 15 years, compared with 8.17% for corporate infrastructure. Among the industries within infrastructure, power has the highest cumulative default rate for 15 years, at 13.4%. Social infrastructure sector is next but far behind, with 4.6%. Utilities have a rate of 2.2%, transportation is at 1.9%, and oil and gas is at 0.71%.

Table 13

Average Cumulative Default Rates (1981-2017)

(%)

	--Time horizon (years) --														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
All infrastructure															
Investment grade	0.09	0.28	0.42	0.57	0.71	0.82	0.93	1.04	1.11	1.21	1.33	1.43	1.52	1.58	1.64
Speculative grade	2.27	3.99	5.50	6.79	7.68	8.32	8.85	9.40	9.96	10.23	10.37	10.54	10.60	10.67	10.75
All rated	0.50	0.97	1.37	1.72	1.99	2.19	2.37	2.54	2.69	2.82	2.94	3.05	3.13	3.20	3.26
Project finance															
Investment grade	0.07	0.31	0.57	0.89	1.20	1.36	1.54	1.67	1.75	2.09	2.61	3.11	3.55	3.55	3.55
Speculative grade	2.66	4.97	7.30	9.29	10.90	12.03	13.04	14.20	15.39	15.90	16.10	16.33	16.61	16.95	17.38
All rated	0.97	1.93	2.91	3.82	4.57	5.07	5.54	6.02	6.47	6.87	7.27	7.68	8.06	8.18	8.33
Corporate infrastructure															
Investment grade	0.09	0.27	0.40	0.52	0.64	0.75	0.85	0.95	1.03	1.10	1.18	1.25	1.31	1.38	1.44
Speculative grade	2.11	3.57	4.73	5.72	6.32	6.75	7.08	7.38	7.72	7.90	8.03	8.17	8.17	8.17	8.17
All rated	0.41	0.79	1.08	1.32	1.51	1.66	1.80	1.92	2.03	2.12	2.20	2.28	2.34	2.40	2.45

Table 13

Average Cumulative Default Rates (1981-2017) (cont.)

Utilities

Investment grade	0.09	0.24	0.37	0.48	0.59	0.67	0.75	0.83	0.89	0.96	1.02	1.08	1.13	1.19	1.24
Speculative grade	2.67	4.46	5.90	7.16	7.81	8.30	8.59	8.82	9.06	9.15	9.24	9.33	9.33	9.33	9.33
All rated	0.39	0.72	1.00	1.24	1.41	1.53	1.64	1.74	1.82	1.88	1.95	2.01	2.06	2.11	2.16

Oil and gas

Investment grade	0.05	0.15	0.26	0.37	0.44	0.50	0.57	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Speculative grade	0.36	0.66	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
All rated	0.16	0.33	0.44	0.52	0.56	0.60	0.65	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71

Power

Investment grade	0.23	1.44	1.96	2.53	3.14	3.97	4.69	5.30	5.97	6.74	7.33	8.01	8.80	9.73	10.28
Speculative grade	2.85	5.03	6.71	8.45	9.99	11.23	12.10	13.12	14.34	15.34	15.96	16.76	16.76	16.76	16.76
All rated	1.46	3.11	4.14	5.20	6.18	7.17	7.95	8.71	9.57	10.41	11.01	11.71	12.28	12.97	13.40

Transportation

Investment grade	0.00	0.17	0.36	0.58	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Speculative grade	2.40	4.27	6.51	7.19	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06
All rated	0.40	0.83	1.32	1.60	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92

Social

Investment grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	2.42	2.42	2.42	2.42	2.42
Speculative grade	0.89	1.90	3.08	4.46	6.08	8.04	10.52	13.97	19.34	19.34	19.34	19.34	19.34	19.34	0.00
All rated	0.13	0.27	0.43	0.62	0.84	1.10	1.42	1.83	2.39	3.19	4.55	4.55	4.55	4.55	4.55

Other

Investment grade	0.12	0.30	0.49	0.75	1.03	1.25	1.47	1.64	1.72	2.01	2.44	2.94	3.36	3.36	3.36
Speculative grade	3.66	6.69	9.75	12.32	14.14	15.30	16.52	17.85	19.14	19.75	19.98	20.25	20.56	20.94	21.40
All rated	1.22	2.30	3.42	4.44	5.22	5.75	6.31	6.85	7.33	7.72	8.09	8.51	8.90	9.01	9.15

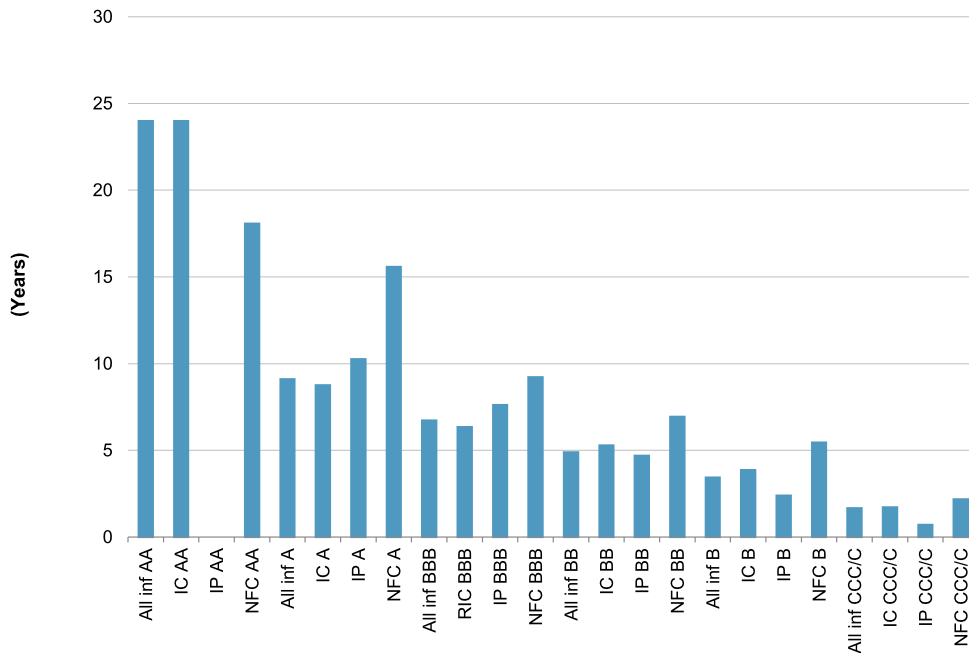
Source: S&P Global Fixed Income Research.

Generally, there is a positive correlation between initial ratings and time to default, if default occurs. This holds true within each asset class we examined, but some slight differences across sectors do exist. For example, across all ratings ranging from 'A' to 'CCC'/'C', nonfinancial corporates usually display longer times to default relative to infrastructure and its two subsectors, infrastructure corporates and project finance. On the other hand, in the 'AA' rating

category, infrastructure credits display an average time to default of just under 24.3 years, compared with 18.1 years for corporate nonfinancials.

Chart 28

Average Times To Default From Original Rating



All inf--All infrastructure, including corporates and project finance. IC--Infrastructure corporate.

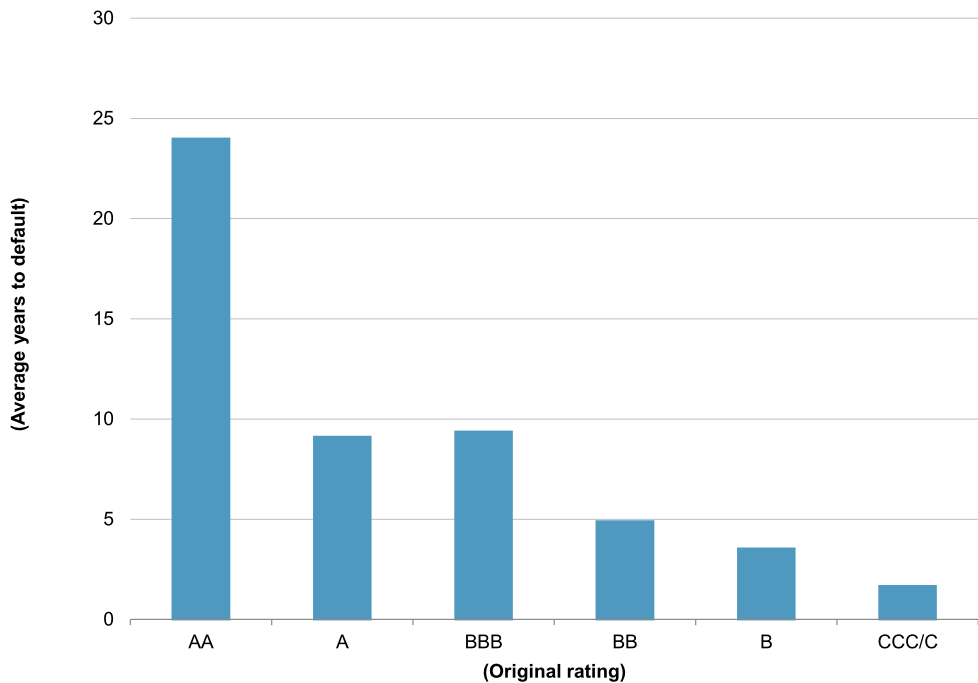
IP--Infrastructure project finance. NFC--Nonfinancial corporate. Source: S&P Global Fixed Income Research.

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The shortest time to default in our data set was for Vistra Energy Corp., which defaulted in April 2014, just 36 days after it initially was rated 'CC'. This was the second default for Vistra Energy, which previously defaulted in 3.5 years after receiving an initial rating of 'CCC'. Conversely, the longest time to default was for El Paso Electric Co., which defaulted in April 1992, 24 years after receiving an initial rating of 'AA'.

Chart 29

All Infrastructure Average Time To Default



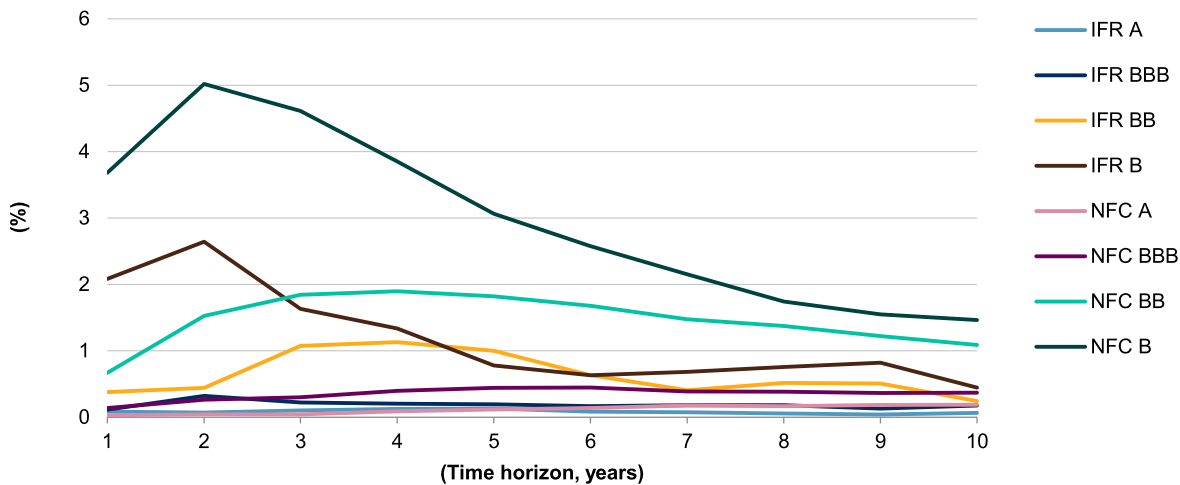
Note: Includes time to default after emergence from default, counted as a new entity. Source: S&P Global Fixed Income Research.
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Marginal Default Rates

Default may occur at any time during a project's life. We define the percentage of projects that default in a given year of being rated as the marginal default rate for that year. 'BBB' category marginal default rates hold steady over 10 years, and 'BB' and 'B' category rates increase early and then sharply decline. Speculative-grade credits tend to have higher marginal default rates in earlier years and then steadily declining rates. Investment-grade credits have low marginal default rates throughout all years.

Chart 30

Marginal Default Rates: All Infrastructure And Nonfinancial Corporate



IFR--Infrastructure. NFC--Nonfinancial corporate. Source: S&P Global Fixed Income Research.
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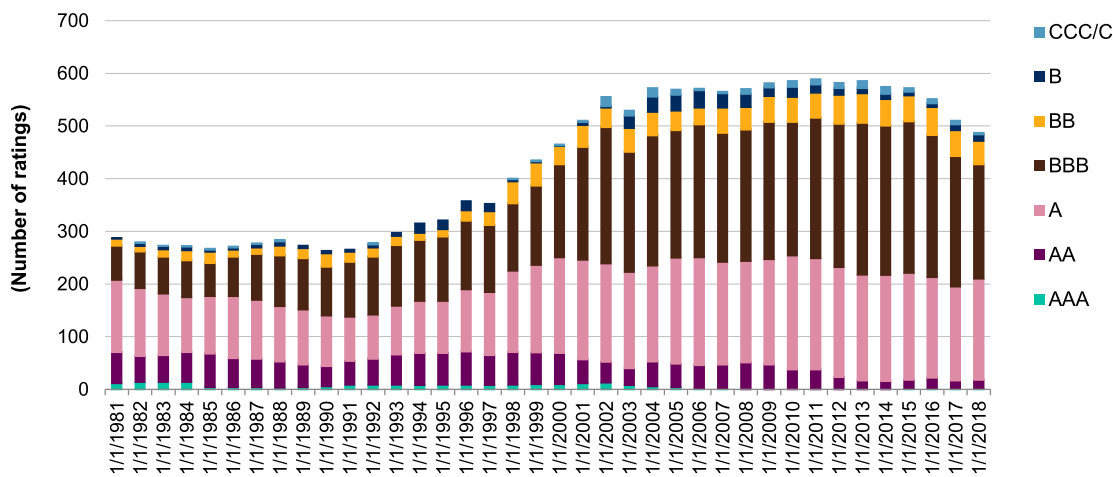
Marginal default trends for the entire infrastructure universe are similar to those for nonfinancial corporates, except that infrastructure default rates are usually lower. Marginal default rates for infrastructure ratings in the 'BBB' category peak at 0.32% in year two, while nonfinancial corporate rates reach 0.45% in years five and six. The highest 'BB' marginal default rates are in year four, at 1.13% for infrastructure and 1.90% for nonfinancial corporates. The highest 'B' category marginal default rates are in the second year, at 5.02% for nonfinancial corporates and 2.64% for infrastructure. For all ratings, the first year has the highest marginal default rate, at 1.92% for nonfinancial corporates and 0.50% for infrastructure.

Utilities

The 'BBB' category has been the largest for utility ratings since 2000 and now represents 45% of ratings. About 84% of ratings are in the 'A' and 'BBB' categories. Utility ratings have consistently remained above speculative grade, with 90% investment grade being the norm. The number of 'AAA' ratings has declined markedly, with one at the start of 2018, down from 13 in 2002. 'AA' category ratings have also fallen in that period, while 'A' category ratings have grown. The utility sector has the second-lowest proportion of speculative-grade ratings within infrastructure, at 12%.

Chart 31

Utility Rating Distribution



Source: S&P Global Fixed Income Research.

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Utility ratings are less prone to being lowered than other ratings within infrastructure. The downgrade-to-upgrade ratio is 1.24 to 1, higher than for social infrastructure and oil and gas but lower than for power, transportation, and uncategorized ratings. Ratings in the 'BBB' category tend to move up more than down over increments of up to five years, and this tendency is more pronounced over longer periods. After one year, 9% of 'AAA' and 11% of 'AA' category utility ratings move into lower categories. In three years, 5% of 'BBB' utility ratings move to lower categories, but 9% move into higher rating categories. In five years, 10% of 'BBB' category utility ratings move into higher categories--the second-highest percentage after social infrastructure.

The utility crisis associated with Enron Corp. had a marked effect on utility ratings and defaults. The rating composition shifted into the 'BBB' category during that time, and from 2000-2003, downgrades outnumbered upgrades by 372. The largest cluster of utility defaults occurred from 2001-2005, when there were 27 defaults--more than 40% of the 61 defaults since 1981. This turmoil was the result of Enron's manipulation of the power supply market in the western U.S. during the introduction of utility deregulation that caused unpredictability in energy markets. Enron squeezed energy resources to utility companies while falsifying its financial statements and later would declare bankruptcy and default. Utility companies in California, which contracted with Enron after the state deregulated its local electricity markets, were among the most affected and highest profile. Pacific Gas & Electric Co. in northern California and Southern California Edison Co. defaulted as well.

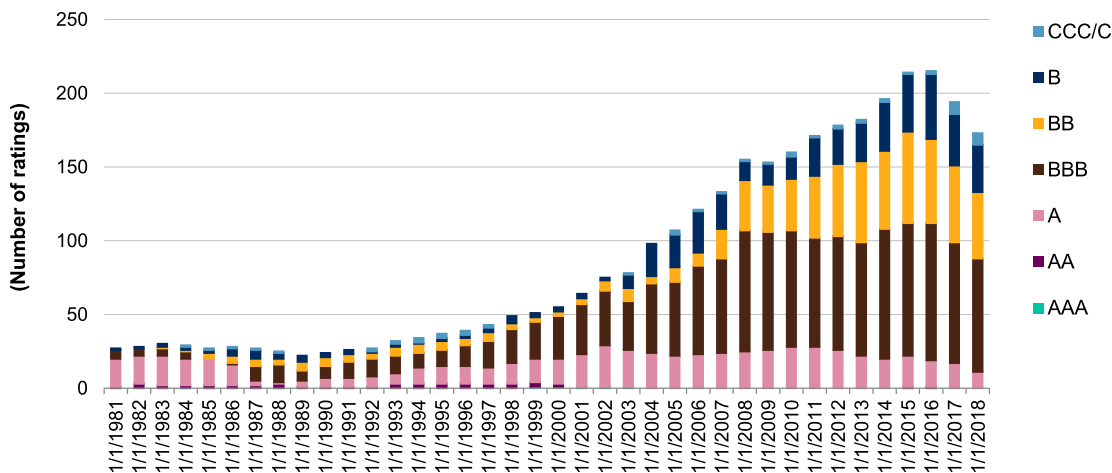
Utility defaults occur most frequently in the U.S., and 24 of the past 26 in the sector have been U.S. concerns. The three-year Gini coefficient for utilities is moderately high, at 69%, indicating a meaningful correlation between the rating three years prior to default and the percentage of issues that default.

Oil And Gas

The 'BBB' category is the most common for oil and gas ratings, and in 2006, the 'BB' category became the second most prevalent. In 2013, the 'B' category became the third largest, surpassing the 'A' category. The oil and gas sector has the most ratings in the 'CCC'/'C' category, at eight. About 49% of oil and gas ratings are speculative grade, the highest percentage among infrastructure sectors.

Chart 32

Oil And Gas Rating Distribution



Source: S&P Global Fixed Income Research.

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Oil and gas ratings are more likely to move into lower rating categories over most time horizons. Investment-grade ratings move into lower categories, while speculative-grade ratings are more likely to move higher. However, 'B' ratings generally move no further than 'BB'. The downgrade-to-upgrade ratio is 1.08 to 1, the second lowest of the infrastructure industries.

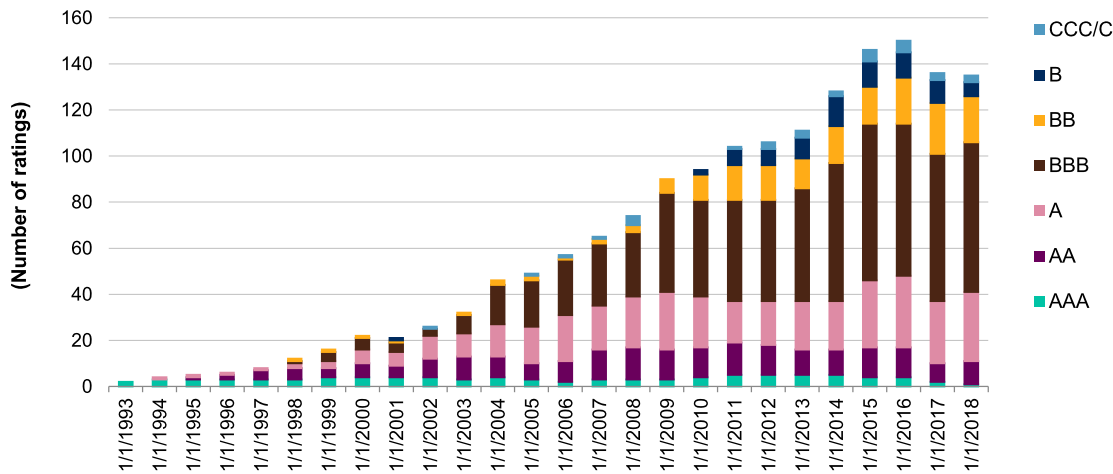
There have been just five defaults within the oil and gas industry, with no evident chronological pattern. Just 4% of all infrastructure defaults are in oil and gas. However, the three-year Gini coefficient for oil and gas ratings is exceptionally low, at less than 10%. This is the result of a low sample size that includes more investment-grade than speculative-grade defaults within the three-year horizon.

Transportation

The largest rating category for transportation ratings has been 'BBB' since 2004. The rating distribution has shifted lower following 119 downgrades and 59 upgrades from 2005-2014. Many of the downgrades were connected to sovereign downgrades, since several transportation enterprises are government-related entities, which receive partial support from a sovereign government.

Chart 33

Transportation Rating Distribution



Source: S&P Global Fixed Income Research.

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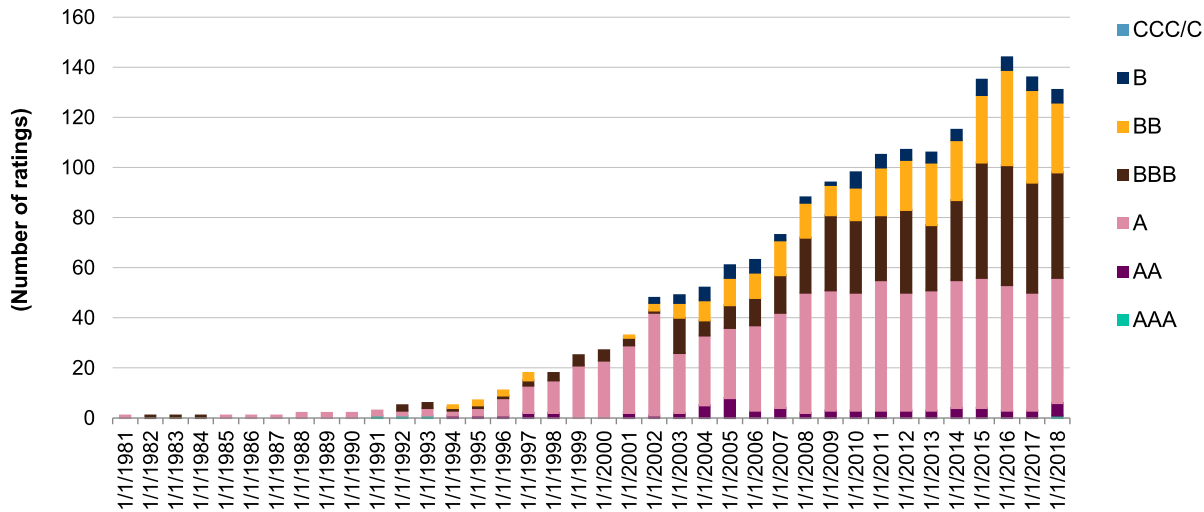
Rating movement is more likely to be negative for transportation issues than in most infrastructure sectors. Between 1981 and 2017, the ratio of downgrades to upgrades was 1.68 to 1, trailing only power ratings. Ratings in the 'BBB' category tend to move down more than up over increments of up to five years, and this tendency is more pronounced over longer periods. In five years, 17% of 'BBB' category transportation ratings move into lower categories, compared with 5% of 'BBB' category ratings that move into higher categories over five years. There have been six defaults of transportation ratings, the most recent in 2016. The three-year Gini coefficient for transportation is relatively high, at 84%, indicating a very strong correlation between the rating three years prior to default and the percentage of issues that default.

Power

The 'A' category has been the largest for power ratings since 2003. Since 2004, at least 20% of power ratings have been speculative grade, which was the percentage of speculative-grade ratings at the start of 2018.

Chart 34

Power Rating Distribution



Source: S&P Global Fixed Income Research.

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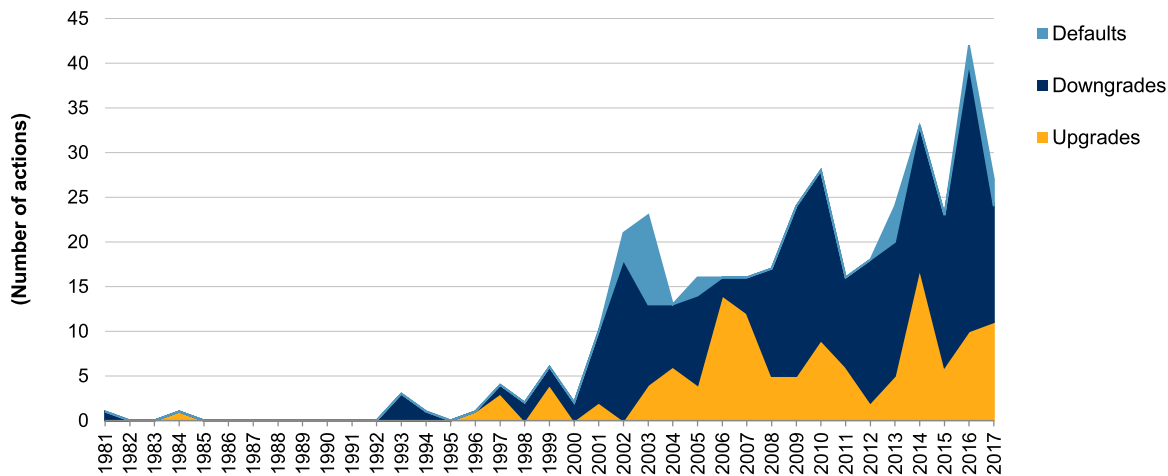
Gasoline prices are a significant contributor to power ratings, and lower prices typically result in lower ratings. As the price of gasoline has remained low for much of the time since 2008, downgrades have exceeded upgrades 167 to 76, with every year except 2014 having more downgrades than upgrades.

Another factor is the model under which the power is provided. In a contracted mode, power is purchased over a long term, usually 30 years. These transactions are more predictable, with less upside or downside. The other version of power generation and delivery is merchant, wherein prices are determined on a spot market or other market forum and can vary. This system is less stable and more likely to exhibit rating movement.

Power ratings are the most likely to be lowered within infrastructure. The downgrade-to-upgrade ratio is 1.87 to 1, the highest of the infrastructure industries. Power ratings also move down more quickly than those in other sectors. About 12% of 'A' power ratings move to lower categories within one year, including 6% that default. In three years, 31% of 'A' power ratings move into lower categories and 18% default. By five years, 46% of 'A' power ratings move to lower categories and 29% default. On the other hand, power ratings virtually never transition to higher rating categories. Over five years, an average of just 0.16% of power ratings move to a higher level from the 'A' category.

Chart 35

Power Rating Actions (1981-2017)



Source: S&P Global Fixed Income Research.

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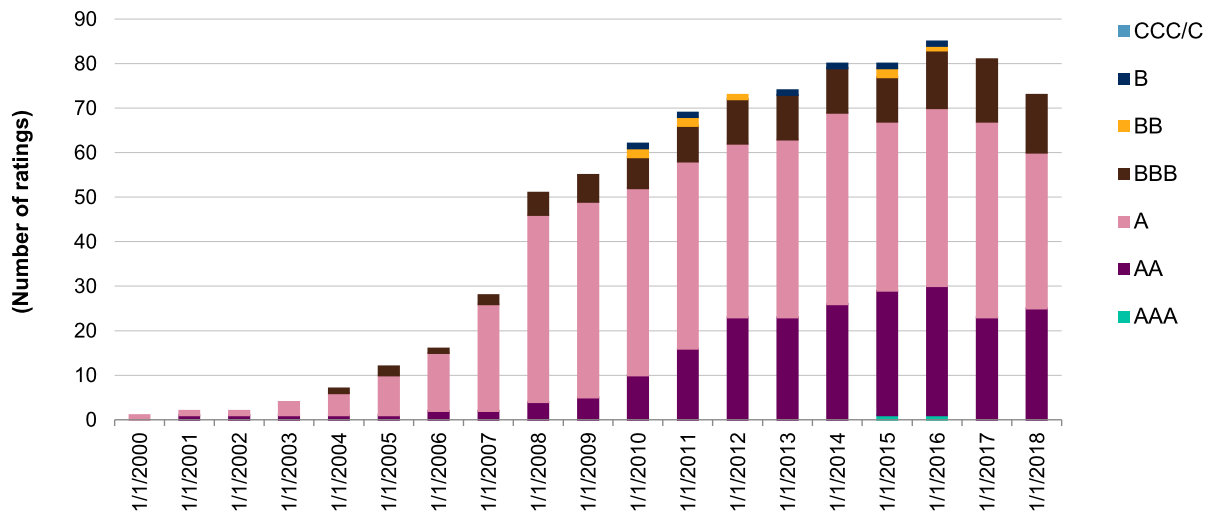
There have been 24 defaults within the power industry, clustered in two periods, between 2002 and 2005 and between 2013 and 2017. The second concentration, of nine defaults, was related to the lower gasoline prices of recent years. The three-year Gini coefficient for power ratings is exceptionally low, at 43%, suggesting that lower gasoline prices can result in unexpected defaults among higher-rated issues.

Social Infrastructure

The largest number of social infrastructure ratings is in the 'A' category, which has been the predominant category for nearly two decades. All ratings are investment grade, marking the highest proportion in infrastructure. The last year with a speculative-grade rating in social infrastructure was 2016, when there was one.

Chart 36

Social Infrastructure Rating Distribution



Source: S&P Global Fixed Income Research.

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There have been 59 upgrades and 51 downgrades in social infrastructure, making it the only infrastructure group with more upgrades than downgrades. Since 2012, there have been 40 upgrades and 23 downgrades.

As with all sectors other than utilities, ratings in social infrastructure are more likely to move into lower rating categories over various time horizons. However, after five years, social infrastructure ratings have significant upward movement. This may be the result of stabilization following construction. The movement is moderate, particularly at horizons of one and three years. After one year, half of 'AAA' social infrastructure ratings move into lower categories. All other rating categories have balanced movement after one year. In three years, all rating categories other than 'BBB' have negative rating movement.

There has been just one default within social infrastructure, which occurred in 1997. The three-year Gini coefficient for social infrastructure ratings is extremely high, at 99.5%, indicating a strong relationship between ratings and the propensity for default.

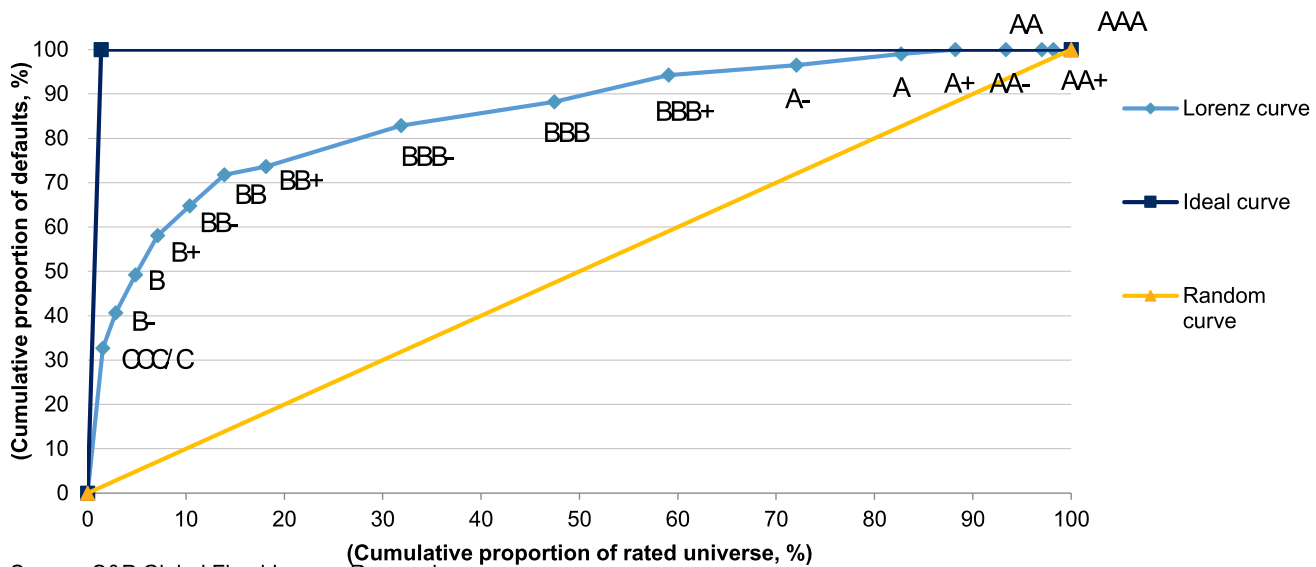
Relative Rating Performance

In addition to examining the absolute performance of ratings, we examine their relative performance. One technique we use to measure relative performance is the Gini coefficient. The Gini coefficient--a summary statistic of the Lorenz curve--is a measure of the relative ability of ratings to differentiate risk. We believe that comparing Lorenz curves and Gini coefficients is useful. Infrastructure Lorenz curves vary in their similarity to ideal curves, and Gini coefficients fall within a wide range. Over one year, three years, and five years, the coefficients for infrastructure as a whole--at 80%, 71%, and 65%, respectively--show a strong relationship between the ratings and the propensity to default.

The chart below shows the three-year Lorenz curve for infrastructure. The points along the Lorenz curve represent different ratings, starting with bonds in the 'CCC' and lower categories on the far left. The first point indicates that the one-year transition to default was 50% at 'CCC' and lower ratings. As the ratings rise, the number of defaults decreases, yielding points that continue to climb through the remainder of the speculative-grade scale before turning sharply to the right in the 'BBB' category. As investment-grade ratings continue to rise, the vertical distance representing defaults changes little, while the proportion of ratings in the universe increases dramatically.

Chart 37

All Infrastructure Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.

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The Lorenz curve for infrastructure shows an extremely strong relationship between ratings at the beginning of a year and the default experience of the group of ratings. The left side of the Lorenz curve travels vertically toward 100% before slightly turning at 'CCC'/'C' at 33%, meaning that 33% of defaults within a three-year time horizon were for bonds that began the period in the 'CCC' rating category or lower. Meanwhile, 74% of defaults occurred among bonds rated speculative grade (below 'BBB-') at the start of the three-year period.

The table below further illustrates the information in the Lorenz graph. The lowest value in the left column shows the cumulative proportion of defaults at the 'CCC'/'C' category, or 32.7%, and the number to the right is the cumulative proportion of the rated universe--much lower, at 1.54%. This means that 32.7% of the defaults came from just 1.5% of the ratings, all of which were in the 'CCC' or lower category. Moving up the table, one can observe that once ratings reach 'A', representing 82.72% of all ratings, 99.05% of defaults have occurred at 'A' or lower ratings.

Table 14

Infrastructure Three-Year Lorenz Curve Values

	Y-axis: cumulative proportion of defaults	X-axis: cumulative proportion of ratings
AAA	100.00	100.00
AA+	100.00	98.20
AA	100.00	97.01
AA-	100.00	93.37
A+	100.00	88.21
A	99.05	82.72
A-	96.51	72.06
BBB+	94.29	59.08
BBB	88.25	47.45
BBB-	82.86	31.88
BB+	73.65	18.13
BB	71.75	13.90
BB-	64.76	10.37
B+	58.10	7.13
B	49.21	4.85
B-	40.63	2.87
CCC/C	32.70	1.54

Source: S&P Global Fixed Income Research.

A closer examination, however, shows the relationship is not the same for all sectors within infrastructure. A three-year horizon is the longest period for a sizable number of issues to remain outstanding before redemption or other cause of rating withdrawal, and social infrastructure has a three-year Gini index of nearly 100%, an extremely high measure that indicates a close fit with the ideal curve. Transportation and utility ratings have high Gini indexes as well, at 83% and 69%. In contrast, power ratings and oil and gas ratings have low scores, indicating that defaults have occurred among higher-rated issues.

Power and oil and gas have Gini indexes under 50%, well below those of the other groups. Oil and gas in particular has an extremely low Gini coefficient, of less than 10%. The cause of the low coefficient is an unusually high number of defaults of credits that were rated investment grade three years earlier. Of the nine observations of defaults in oil and gas over three-year horizons, five were rated investment grade three years prior, including three that were rated 'A'.

Table 15

Infrastructure Gini Coefficients (1981-2017)

All infrastructure	
One-year	80.4
Three-year	71.1
Five-year	65.0

Table 15

Infrastructure Gini Coefficients (1981-2017) (cont.)

(%)

Three-year	
Social infrastructure	99.5
Transportation	83.5
Utilities	69.0
Power	42.9
Oil and gas	9.7
Other	75.8
Canada	99.6
Asia-Pacific	66.2
U.S. and tax havens	68.1
EMEA	67.5
Latin America	60.3

EMEA--Europe, Middle East, and Africa. Source: S&P Global Fixed Income Research.

Regional variance is not as extreme. Canada has an extremely high Gini coefficient over three years, at 99.7%, while Latin America is lowest, at 60.3%. The Asia-Pacific region and the U.S. have Gini indexes of 66.2% and 68.1%, respectively, indicating a strong relationship between ratings and the propensity for default over a three-year horizon.

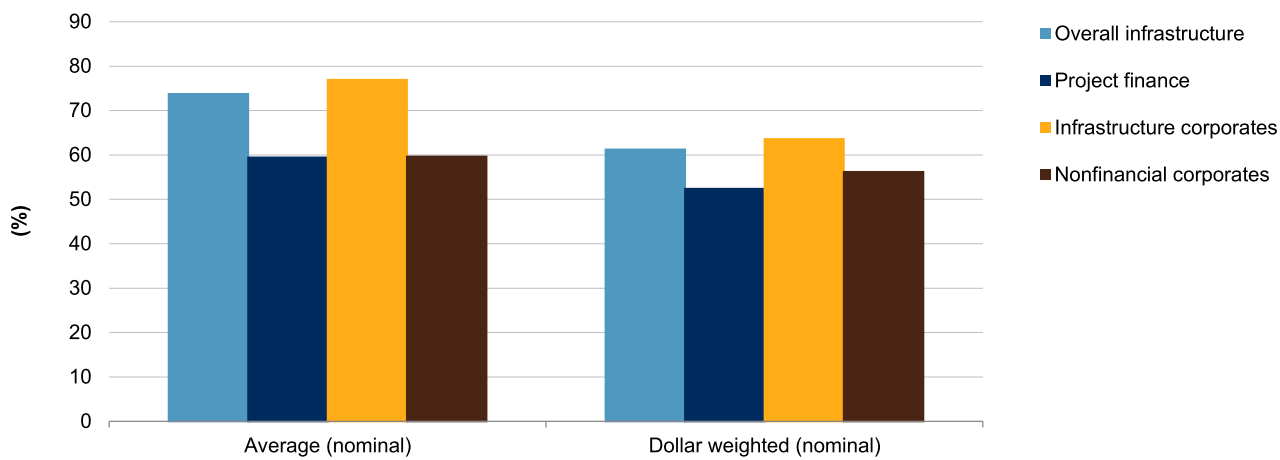
Recovery Rates

Ultimate recovery rates for infrastructure debt instruments have been broadly stronger than for nonfinancial corporates generally. Many of the infrastructure corporates and projects that achieved the highest recoveries exhibited high asset quality and low industry risk. Furthermore, regulated utilities specifically tend to show above-average recovery rates (in particular, for senior unsecured bonds), and this sector accounts for a notable share of the defaulted infrastructure debt instruments.

Recovery rates for infrastructure (including bank debt and bonds from corporate infrastructure and project finance) average 74%, which is higher than the 60% average for nonfinancial corporates.

Chart 38

Recovery Rates For Infrastructure Corporates And Project Finance



Note: Nominal recovery for defaulted debt instruments from infrastructure corporate, project finance, and nonfinancial corporate entities. Sources: S&P LossStats and S&P Global Fixed Income Research. Copyright © 2018 by Standard & Poor's Financial Services LLC. All rights reserved.

Within infrastructure, corporate infrastructure (excluding project finance) displays a higher average recovery of 77% (from 218 instruments), and more than half of the defaulted instruments recovered 80% or more. This average recovery from corporate infrastructure was notably higher than the average recovery from project finance and from nonfinancial corporates (which displays a historical average recovery of 60%).

Meanwhile, average recoveries from project finance instruments are considerably lower than for the corporate infrastructure subsector and are also modestly lower than those of nonfinancial corporates. Project finance exhibits an average recovery of 59% (from 49 instruments), and the distribution of these recoveries is more varied than it is within corporate infrastructure. Nearly as many project finance instruments recovered par or greater as recovered less than 20%. The projects with the lowest recoveries typically exhibited high market risk or encountered technology issues.

Our data set of recoveries for infrastructure corporate and project finance includes defaulted instruments that were resolved through a debt restructuring, a distressed exchange, or a liquidation and sale of assets. To calculate recovery rates on defaulted projects, we relied on public documents, court filings, and company reports. Because we used public information, we were unable to calculate recovery rates on all defaulted projects. Most of the recovery rates we were able to calculate were from legal jurisdictions, such as the U.S., that published an abundance of postdefault data.

This data set includes 62 defaulted obligors, affecting 267 debt instruments. While the data set includes obligors from the emerging and developed markets, nearly 86% of the instruments included in the recovery data set are from U.S.-based obligors. These include entities that defaulted from 1988-2017. The count of instruments includes senior debt, senior unsecured debt, and subordinated debt. Many obligors have defaulted on a variety of instruments, and some have defaulted more than once, causing the number of observations to far exceed the number of

defaulters.

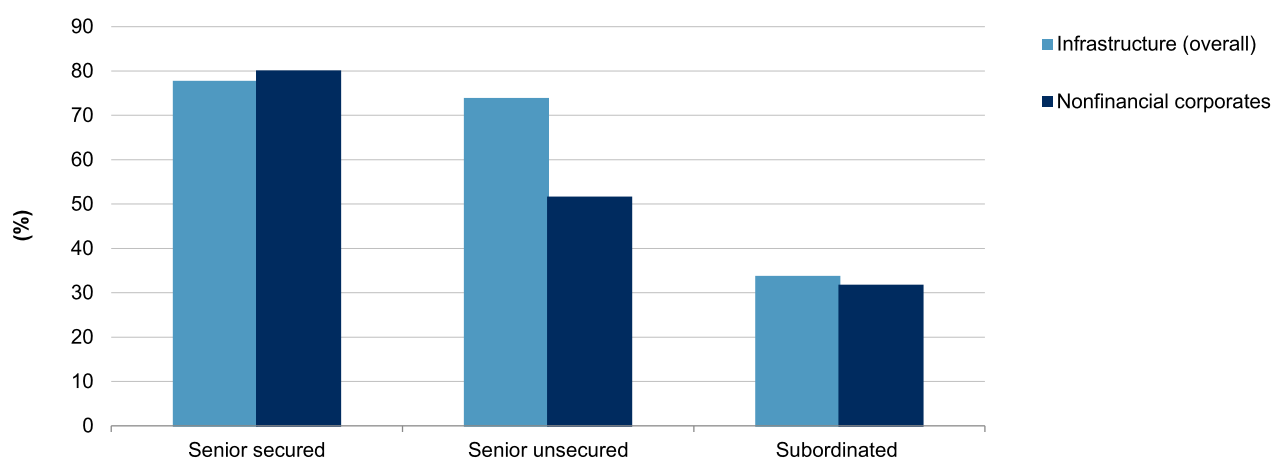
Recovery By Instrument Type

By debt type, the key difference between recoveries of infrastructure and nonfinancial corporate debt is in the recoveries of senior unsecured bonds. Senior unsecured bonds in the infrastructure sector have shown average recoveries of 74%, which is considerably higher than the 52% average recovery for senior unsecured bonds from the nonfinancial corporate sectors.

Aside from senior unsecured bonds, the recovery rates for infrastructure debt are much more closely aligned with those of nonfinancial corporates. Senior secured debt (which includes bank debt along with senior secured bonds) from the infrastructure sector shows an average recovery of 78%, which is modestly lower than that of nonfinancial corporates, at 80%. Meanwhile, subordinated debt from the infrastructure sector averages 34%, modestly higher than the 32% average recovery on subordinated debt from the nonfinancial sectors.

Chart 39

Recovery Rates By Instrument Type



Note: Senior secured includes all bank debt and senior secured bonds. Infrastructure (overall) includes infrastructure corporates and project finance. Sources: S&P LossStats and S&P Global Fixed Income Research.

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Within the infrastructure sector, average recovery rates for project finance are considerably lower than those of infrastructure corporates. The average recovery for a defaulted project finance instrument is 59%, while the average recovery from an infrastructure corporate is 77%.

Within the corporate infrastructure subsector, elevated recoveries for senior secured and unsecured debt largely reflect the contribution from the utility sector. Recoveries from the utilities sector's instruments account for close to 45% of the recoveries for the infrastructure corporate subsector, and among subsectors, utilities has the highest average recovery rate, at about 92%.

There are several reasons why utilities tend to have higher recoveries than the other infrastructure industries. With essential assets and as providers of essential services, such as power, water, and

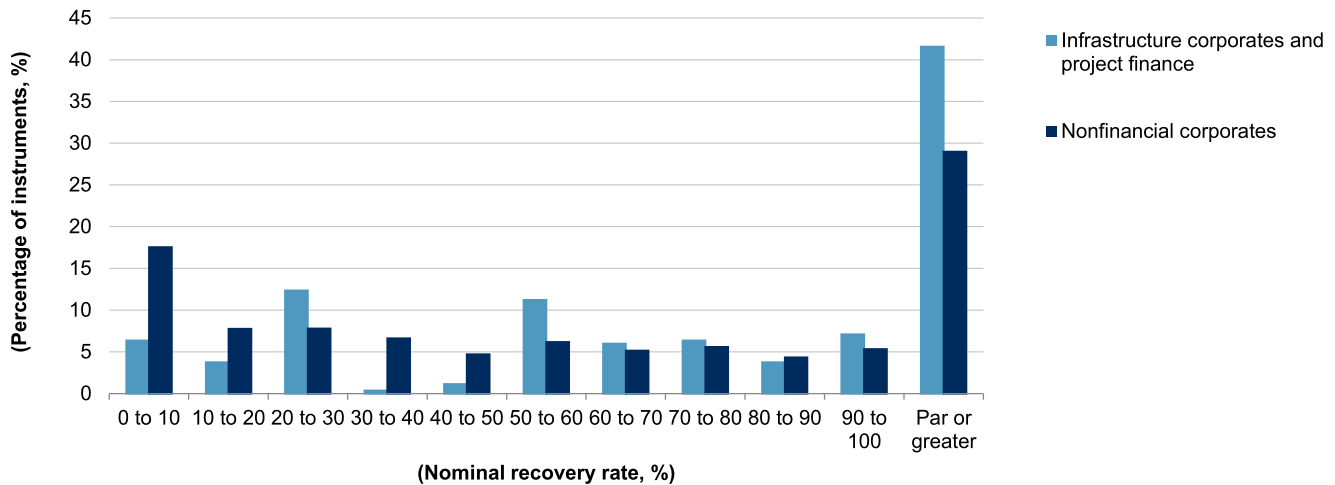
gas, utilities often have little or no practical substitute. This supports a business model shielded by regulation, and the ability of issuers to add debt is often limited by regulation or secured bond indenture. These characteristics support the very low industry risk for the regulated utilities sector, which is the only corporate sector to have this assessment.

In addition to calculating recovery rates as an average of instrument recoveries, weighted by the number of instruments, we also looked at recoveries on a dollar-weighted basis. For the dollar-weighted averages, we calculated the nominal sum of debt recovered from the pool of defaulted instruments, divided by the total of defaulted debt in the sample for that instrument type.

Dollar-weighted recoveries for the infrastructure sector tend to be lower, on average, than the instrument-weighted averages. However, the dollar-weighted average recovery of 61% for the infrastructure sector overall remains higher than the 56% dollar-weighted average for nonfinancial corporates.

Chart 40

Distribution Of Recoveries For Infrastructure And Nonfinancial Corporates



Note: Nominal recovery for defaulted debt instruments from infrastructure corporates and project finance.

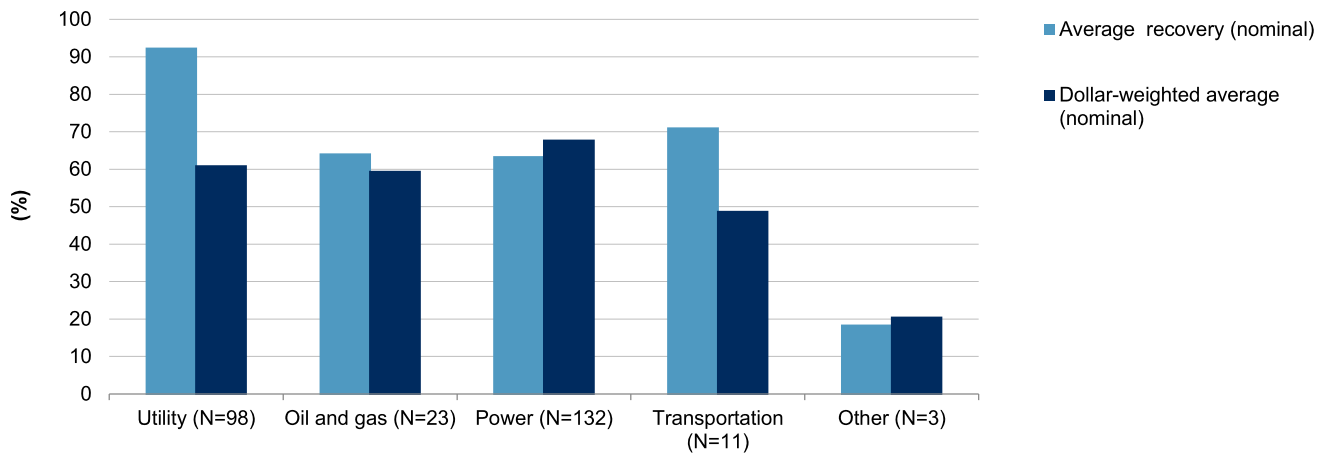
Corporates exclude financial services companies. Sources: S&P LossStats and S&P Global Fixed Income Research.

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Within the infrastructure sector, the power industry has the highest dollar-weighted average recovery rate, of 68%, which is modestly higher than the industry's simple average of 63%. The power sector accounts for the largest share of instruments, with 132, including both project finance and infrastructure corporates.

Chart 41

Average Recovery By Infrastructure Sector



Note: Nominal recovery for defaulted debt from infrastructure corporate, project finance, and nonfinancial corporate entities. Sources: S&P LossStats and S&P Global Fixed Income Research.
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Recovery Default Type

Recovery rates can also vary with the type of default that the infrastructure entity undergoes. In nonbankruptcy restructurings, which include distressed exchanges, along with defaults that are cured within, or outside of, the grace period, the recovery rates for unsecured and subordinated debt tend to be higher, on average, than they would be through a bankruptcy restructuring.

The average recovery across all instruments is higher, at 83%, following a nonbankruptcy restructuring than the 71% average following a bankruptcy. By debt type, the difference stems from senior unsecured and subordinated debt, which have an average recovery that is 20 percentage points higher following a nonbankruptcy restructuring. In contrast, senior secured debt experienced the same average recovery (of 78%) whether following a bankruptcy or nonbankruptcy restructuring.

Table 16

Average Recovery Rate For Bankruptcy Versus Nonbankruptcy Restructurings

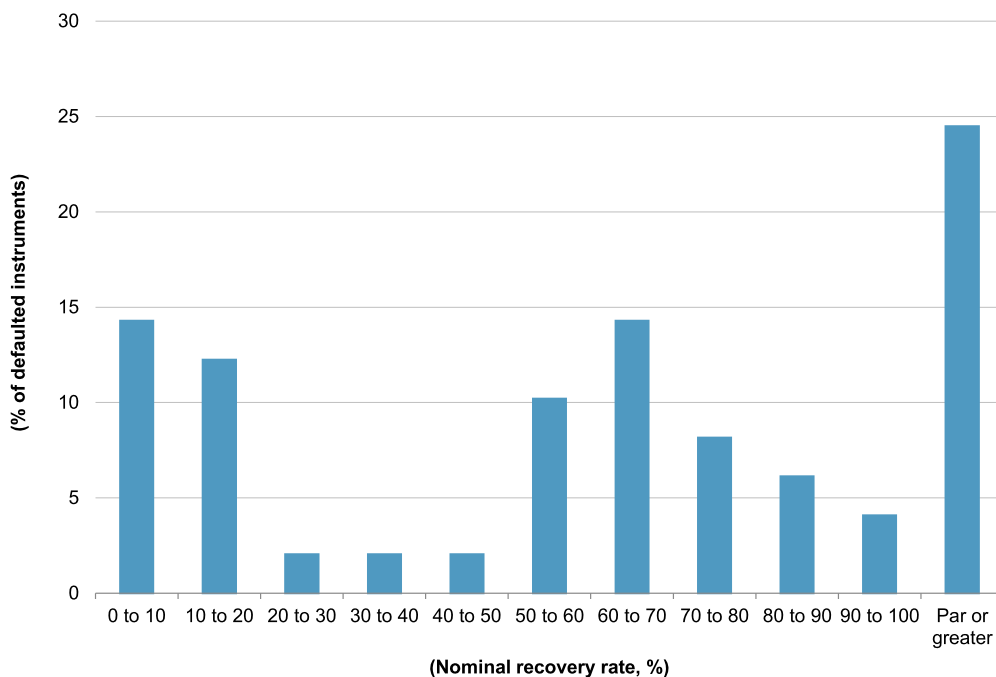
	--Average recovery (nominal, %)--		--Instrument count--	
	Bankruptcy	Nonbankruptcy	Bankruptcy	Nonbankruptcy
Senior secured	78	78	101	16
Senior unsecured and subordinated	65	85	109	41
Total	71	83	210	57

Note: Nominal recovery for defaulted debt instruments from infrastructure corporate and project finance entities. Senior secured debt includes all bank debt and senior secured bonds. Nonbankruptcy restructurings include distressed exchanges; defaults cured within, or without, the grace period; and other nonbankruptcy restructurings. Sources: S&P LossStats and S&P Global Fixed Income Research.

Within the distribution of recovery rates, we see that a higher share of instruments from infrastructure and project finance have experienced the highest recoveries, of par or greater, than have nonfinancial corporates. Overall, 41.6% of defaulted infrastructure debt instruments recovered par or greater, compared with 29.0% of nonfinancial corporate debt instruments that recovered par or greater. At the low end of the distribution, just 10.1% of defaulted infrastructure debt instruments recovered 20% or less, compared with about 25.3% of nonfinancial corporate debt instruments. However, the sample size of infrastructure recoveries remains considerably smaller than that of nonfinancial corporates.

Chart 42

Recovery Rates For Project Finance



Note: Nominal recovery for defaulted debt instruments from project finance. Sources: S&P LossStats and S&P Global Fixed Income Research.

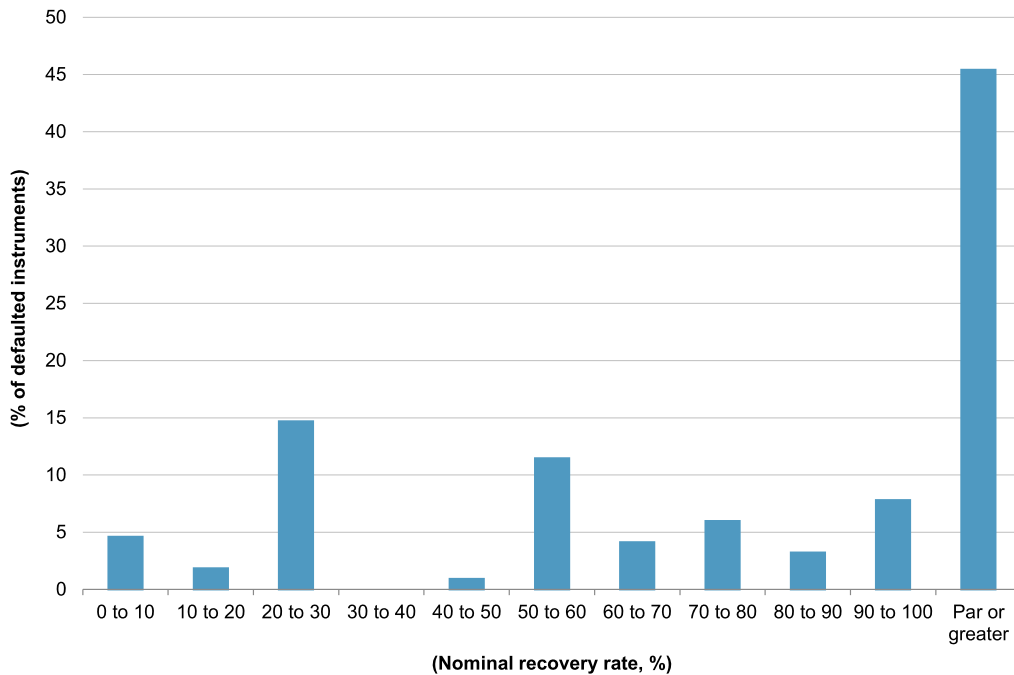
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Distribution of project finance recoveries tends to vary more widely than that of the corporate infrastructure sector. Nearly as many project finance instruments recovered par or greater as experienced negligible recoveries of 20% or less.

Among other projects with higher recoveries, many tend to benefit from characteristics similar to those of regulated utilities. For instance, infrastructure project financings hold essential assets, have stable cash flows, and exhibit low industry risk. In many cases, low industry risk may be supported by long-term offtake contracts, such as power purchase agreements or availability-based payments under a concession, operations and maintenance contracts, or fuel-supply contracts, among others.

Chart 43

Recovery Rates For Infrastructure Corporates



Note: Nominal recovery for defaulted debt instruments from infrastructure corporates. Sources: S&P LossStats and S&P Global Fixed Income Research.
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In contrast, the distribution of recoveries within the corporate infrastructure subsector tends to be more highly concentrated at the high end of the recovery range. The majority of defaulted debt instruments from the infrastructure corporate subsector experienced recoveries of 80% or more, and about 45% of the instruments recovered par or greater.

Appendix I: Definitions And Methodology

Our long-term infrastructure default and rating transition study uses long-term ratings on individual project finance debt issues. For projects with multiple tranches of debt, we used a single rating for all pari passu tranches to try to mitigate the risk of overweighting such projects in the sample set. For projects with senior and subordinated debt with different ratings, we counted each class separately and collapsed multiple tranches of pari passu debt into a single rating.

An infrastructure rating reflects S&P Global Ratings' opinion of the obligor's ability and willingness to meet its financial commitments on time, and it generally indicates our opinion of the likelihood of default regarding the specific rated issuance. Unlike issuer credit ratings, project finance ratings consider the value of collateral and recovery in determining the rating.

We analyzed the rating histories of corporate infrastructure and project finance credits that S&P Global Ratings first rated between Dec. 31, 1981, and Dec. 31, 2017. We categorized these ratings into one of five subsectors: utilities, power, oil and gas, social infrastructure, and transportation,

with other obligors grouped in a separate category. The analysis excludes ratings based on the guarantee of another entity and obligations wrapped by a monoline insurer, unless the obligations bear an S&P Underlying Rating (SPUR), in which case we included the SPUR. Corporate issuers, structured finance vehicles, public-sector issuers, and sovereign issues are the subjects of separate default and transition studies, so we have excluded them from this study. The infrastructure data is a sufficiently large set, although individual sectors are small, so that a few defaults or rating transitions can have a sizable effect on portfolio performance within those groups.

Withdrawn ratings

When a rating is withdrawn, it is changed to not rated ("NR"). Issue ratings are withdrawn when an obligation is repaid or at the request of the issuer. S&P Global Ratings also withdraws ratings when sufficient information to maintain a rating is unavailable. If we withdrew a rating after the issue defaulted, we counted it as a default.

Definition of default

A default is assumed to take place on the date S&P Global Ratings revised the rating to 'D', which could occur when a payment on the issue is missed, a distressed exchange offer is completed, or the issuer filed for or was forced into bankruptcy. When an issue defaults, it is not uncommon for S&P Global Ratings to subsequently withdraw the 'D' rating.

For the purposes of this study, if an issue defaults, we end its rating history at 'D'. For those instances when an issue defaulted and was subsequently upgraded, we entered the rating history after the default into the calculations as a new rating.

Many practitioners use statistics from this default study to estimate "probability of default" and "probability of rating transition." It is important to note that S&P Global Ratings' credit ratings do not imply a specific probability of default.

Static pool methodology

S&P Global Fixed Income Research conducts its default studies on the basis of groupings called static pools. For the purposes of this study, we form static pools by grouping issues by rating category at the beginning of each year, quarter, or month that the database covers. Each static pool is followed from that point forward. All issues included in the study are assigned to one or more static pools. When an issue defaults, we assign that default back to all of the static pools to which the issue belonged.

We use the static pool methodology to avoid certain pitfalls in estimating default rates. This is to ensure that default rates account for rating migration and to allow for default rates to be calculated across multiperiod time horizons.

The pools are static in the sense that their membership remains constant over time. Each static pool can be interpreted as a buy-and-hold portfolio. Because errors, if any, are corrected by every new update and because the criteria for inclusion or exclusion of issues in the default study are subject to minor revisions as time goes by, it is not possible to compare static pools across different studies. Therefore, every new update revises results back to the same starting date of Jan. 1, 1981, so as to avoid continuity problems.

Because static pools only include issues with active ratings as of the beginning date of a given

pool, we exclude those with withdrawn ratings, as well as those that have defaulted, from subsequent static pools. If the rating on an issue is withdrawn after the start date of a particular static pool and subsequently defaults, we will include it in that static pool as a default and categorize it in the rating category of which it was a member at that time.

For instance, the 1983 static pool consists of all companies rated as of 12:01 a.m. on Jan. 1, 1983. Adding those issues first rated in 1983 to the surviving members of the 1983 static pool forms the 1984 static pool. All rating changes that took place are reflected in the newly formed 1984 static pool through the ratings on these issues as of 12:01 a.m. on Jan. 1, 1984. We used the same method to form static pools for 1985-2016. From Jan. 1, 1981, to Dec. 31, 2017, a total of 669 first-time-rated project finance issues were added to form new static pools, while we excluded 39 defaults and 370 issues with last ratings of "NR" (after they were included in the initial 669 in prior static pools).

Consider the following example: An issue is originally rated 'BB' in mid-1996 and is downgraded to 'B' in 1998. This is followed by a rating withdrawal in 2000 and a default in 2003. We would include this hypothetical company in the 1997 and 1998 pools with the 'BB' rating, which was the rating at the beginning of those years. Likewise, it would be included in the 1999 and 2000 pools with the 'B' rating. It would not be part of the 1996 pool because it was not rated as of the first day of that year, and it would not be included in any pool after the last day of 2000 because the rating had been withdrawn by then. Yet each of the four pools in which this company was included (1997-2000) would record its 2003 default at the appropriate time horizon.

Transition matrices

Transition rates compare issue ratings at the beginning of a period with ratings at the end of the period. To compute one-year rating transition rates by rating category, we compared the rating on each entity at the end of a particular year with the rating at the beginning of the same year. An issue that remained rated for more than one year was counted as many times as the number of years it was rated. For instance, an issue continually rated from the middle of 1984 to the middle of 1991 would appear in the seven consecutive one-year transition matrices from 1986-1991. If the rating on the issue was withdrawn in the middle of 1991, it would be included in the column representing transitions to "NR" in the 1991 transition matrix. Similarly, if it defaulted in the middle of 1991, it would be included in the column representing transitions to 'D' in the 1991 one-year transition matrix.

All 1982 static pool members still rated on Jan. 1, 2017, had 33 one-year transitions, while companies first rated on Jan. 1, 2015, had only one. Each one-year transition matrix displays all rating movements between letter categories from the beginning of the year through year-end. For each rating listed in the matrix's leftmost column, there are nine ratios listed in the rows, corresponding to the ratings from 'AAA' to not rated.

The only ratings considered in these calculations are those on entities at the beginning of each static pool and those at the end. All rating changes that occur in between are ignored. For example, if an issue was rated 'A' on Jan. 1, 2014, and was downgraded to 'BBB' in the middle of the year and then upgraded to 'A' later in the year (with no other subsequent rating changes), this instrument would be included only in the percentage of issues that began the year as 'A' that ended the year as 'A'. This also applies to transition matrices that span longer time horizons. If an issue defaults or if the rating is withdrawn in the middle of the year, then it would be considered rated 'D' or not rated as of Dec. 31 of that particular year.

Multiyear transitions

Multiyear transitions were also calculated for periods of two up to five years. In this case, we compared the rating at the beginning of the multiyear period with the rating at the end. For example, three-year transition matrices were the result of comparing ratings at the beginning of the years 1981-2015 with the ratings at the end of the years 1983-2017.

Otherwise, the methodology was identical to that used for single-year transitions. We calculated average transition matrices on the basis of the multiyear matrices just described. These average matrices are a true summary, the ratios of which represent the historical incidence of the ratings listed in the first column changing to the ones listed in the top row over the course of the multiyear period. Transition matrices that present averages over multiple time horizons are also calculated as issue-weighted averages.

Rating modifiers

We use rating modifiers (plus and minus signs) to calculate upgrade and downgrade percentages, as well as the magnitude of rating changes, throughout this study. However, some transition tables may use full rating categories for practical reasons: The use of a rating category suggests that transitions to 'AA-' from 'AA', for example, or to 'BBB-' from 'BBB+' are not considered to be rating transitions because the rating remained within the rating category.

Issue-weighted statistics

Averages that appear in this study are calculated based on the number of issues, rather than the dollar amounts, affected by defaults or rating changes. Although dollar amounts provide information about the portion of the market affected by defaults or rating changes, we believe issue-weighted averages are more useful measures of the performance of ratings.

Average cumulative default rate calculation

The cumulative default rates in this study average the experience of all static pools by first calculating marginal default rates for each possible time horizon and for each static pool, weight-averaging the marginal default rates conditional on survival (survivors being nondefaulters), and accumulating the average conditional marginal default rates. We calculated conditional default rates by dividing the number of issues in a static pool that default at a specific time horizon by the number of issues that survived (did not default) to that point in time. Weights are based on the number of issues in each static pool. Cumulative default rates are one minus the product of the proportion of survivors (nondefaulters).

Appendix II: Additional Exhibits

Table 17

Average Transition Rates For All Infrastructure (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	83.45	6.90	0.00	0.00	0.00	0.00	0.23	0.00	9.43
AA	0.33	82.23	8.72	0.50	0.17	0.08	0.00	0.00	7.97
A	0.04	1.27	83.39	5.90	0.14	0.06	0.06	0.08	9.07
BBB	0.00	0.01	2.91	84.19	2.75	0.28	0.27	0.11	9.48
BB	0.00	0.00	0.17	7.25	71.48	7.35	1.10	0.38	12.27
B	0.00	0.07	0.27	0.94	10.34	66.55	6.45	2.08	13.30
CCC/C	0.75	0.00	0.75	0.00	1.75	11.53	55.89	16.79	12.53
Three years									
AAA	54.70	12.29	2.17	1.93	0.00	0.00	0.72	0.00	28.19
AA	0.78	57.98	16.49	1.87	0.57	0.00	0.00	0.00	22.31
A	0.07	2.56	58.28	12.26	0.72	0.28	0.12	0.27	25.44
BBB	0.01	0.02	6.66	60.39	4.37	1.44	0.70	0.69	25.71
BB	0.04	0.00	0.36	14.45	38.67	9.52	2.33	1.94	32.70
B	0.16	0.00	0.70	4.35	18.03	30.07	6.68	6.22	33.80
CCC/C	0.56	0.00	0.00	1.13	3.94	11.27	18.31	29.01	35.77
Five years									
AAA	33.16	11.39	2.28	6.08	0.00	0.00	0.76	0.00	46.33
AA	1.05	39.72	18.28	3.11	0.87	0.00	0.00	0.00	36.97
A	0.11	2.60	41.67	13.77	0.85	0.41	0.18	0.56	39.85
BBB	0.04	0.02	7.41	43.58	4.47	1.82	0.80	1.16	40.69
BB	0.09	0.00	0.83	15.19	22.07	6.69	1.85	4.20	49.08
B	0.00	0.00	0.81	6.38	15.74	12.59	4.41	8.45	51.62
CCC/C	0.00	0.00	0.00	1.93	2.25	7.72	5.79	32.15	50.16

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 18

Average Transition Rates For Corporate Infrastructure (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	86.60	5.47	0.19	0.00	0.00	0.00	0.00	0.00	7.74
AA	0.26	83.72	7.87	0.37	0.15	0.07	0.04	0.00	7.54
A	0.00	1.54	83.89	5.78	0.15	0.10	0.04	0.07	8.43
BBB	0.00	0.00	3.09	84.49	2.43	0.25	0.20	0.16	9.38
BB	0.00	0.00	0.33	8.94	71.75	5.31	0.81	0.24	12.62
B	0.00	0.00	0.18	1.35	11.03	68.52	5.11	1.52	12.29

Table 18

Average Transition Rates For Corporate Infrastructure (1981-2017) (cont.)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
CCC/C	0.00	0.00	0.00	0.00	1.47	10.66	61.40	15.07	11.40
Three years									
AAA	61.07	10.87	1.78	1.19	0.00	0.00	0.00	0.00	25.10
AA	0.65	59.19	16.27	1.50	0.54	0.00	0.12	0.00	21.73
A	0.00	3.28	57.20	12.34	0.85	0.27	0.06	0.24	25.77
BBB	0.00	0.00	7.50	58.96	3.86	1.08	0.44	0.67	27.49
BB	0.00	0.00	0.56	17.63	34.65	7.03	1.40	1.17	37.56
B	0.00	0.00	0.62	5.89	18.49	28.93	6.82	4.44	34.81
CCC/C	0.00	0.00	0.00	1.71	3.85	10.68	20.94	29.06	33.76
Five years									
AAA	41.91	10.58	1.87	3.73	0.00	0.00	0.00	0.00	41.91
AA	0.65	40.86	18.36	2.63	0.77	0.00	0.08	0.00	36.64
A	0.03	3.37	39.91	14.09	1.03	0.36	0.06	0.48	40.66
BBB	0.00	0.00	8.48	41.65	3.50	1.42	0.62	1.06	43.28
BB	0.00	0.00	1.24	17.17	16.71	4.70	0.85	2.68	56.66
B	0.00	0.00	1.30	8.03	13.93	9.68	4.60	6.02	56.43
CCC/C	0.00	0.00	0.00	3.48	1.49	6.47	7.46	34.83	46.27

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 19

Average Transition Rates For Project Finance (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	44.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.56
AA	0.00	70.97	9.68	3.23	0.00	0.00	0.00	0.00	16.13
A	0.00	0.00	89.15	4.41	0.37	0.00	0.00	0.00	6.07
BBB	0.00	0.05	1.24	87.34	3.81	0.38	0.33	0.10	6.76
BB	0.00	0.00	0.00	2.75	74.91	10.31	1.49	0.34	10.19
B	0.00	0.00	0.00	0.00	7.87	67.64	7.42	3.60	13.48
CCC/C	2.68	0.00	0.00	0.00	3.57	6.25	54.46	16.96	16.07
Three years									
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
AA	0.00	40.00	0.00	6.67	0.00	0.00	0.00	0.00	53.33
A	0.00	0.00	72.65	6.28	1.35	0.67	0.00	0.22	18.83
BBB	0.05	0.11	2.97	66.49	6.70	2.54	1.35	0.70	19.08

Table 19

**Average Transition Rates For Project Finance
(1981-2017) (cont.)**

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
BB	0.13	0.00	0.00	6.79	44.26	14.75	3.79	3.26	27.02
B	0.53	0.00	0.00	0.00	15.08	33.07	6.35	9.26	35.71
CCC/C	1.94	0.00	0.00	0.00	6.80	9.71	16.50	31.07	33.98
Five years									
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
AA	0.00	27.59	0.00	3.45	0.00	0.00	0.00	0.00	68.97
A	0.29	0.00	60.58	6.38	1.16	1.45	0.29	0.87	28.99
BBB	0.19	0.12	3.68	49.81	8.48	3.18	1.31	1.37	31.86
BB	0.31	0.00	0.00	8.33	30.09	10.34	3.70	7.10	40.12
B	0.00	0.00	0.00	0.00	12.84	18.35	3.06	13.46	52.29
CCC/C	0.00	0.00	0.00	0.00	4.26	7.45	2.13	37.23	48.94

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 20

Average Transition Rates For Utilities (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	81.65	8.72	0.00	0.00	0.00	0.00	0.46	0.00	9.17
AA	0.06	81.07	9.79	0.66	0.24	0.12	0.00	0.00	8.06
A	0.04	1.37	82.77	5.99	0.09	0.04	0.07	0.09	9.55
BBB	0.00	0.00	3.87	83.04	2.24	0.14	0.26	0.12	10.32
BB	0.00	0.00	0.42	10.87	68.31	6.27	1.34	0.08	12.71
B	0.00	0.00	0.47	2.34	14.72	60.28	5.84	2.34	14.02
CCC/C	0.00	0.00	1.71	0.00	0.00	12.00	53.14	21.14	12.00
Three years									
AAA	47.22	13.43	4.17	3.70	0.00	0.00	1.39	0.00	30.09
AA	0.06	55.07	19.17	2.50	0.79	0.00	0.00	0.00	22.41
A	0.08	2.69	57.02	12.32	0.57	0.17	0.15	0.26	26.74
BBB	0.00	0.00	8.88	57.80	3.28	0.79	0.47	0.61	28.17
BB	0.00	0.00	0.82	19.84	34.55	7.31	1.65	1.28	34.55
B	0.00	0.00	0.73	10.24	19.27	21.95	5.85	7.07	34.88
CCC/C	0.00	0.00	0.00	2.50	3.13	6.25	16.88	36.25	35.00
Five years									
AAA	24.19	8.84	4.19	11.16	0.00	0.00	1.40	0.00	50.23
AA	0.06	36.07	21.31	3.74	1.18	0.00	0.00	0.00	37.63

Table 20

**Average Transition Rates For Utilities
(1981-2017) (cont.)**

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
A	0.10	2.67	40.32	13.64	0.63	0.31	0.14	0.53	41.65
BBB	0.00	0.00	9.66	40.80	2.99	0.84	0.58	0.95	44.17
BB	0.00	0.00	1.71	19.40	17.39	5.83	0.80	2.81	52.06
B	0.00	0.00	0.76	13.23	14.76	5.60	4.33	9.67	51.65
CCC/C	0.00	0.00	0.00	4.29	0.71	5.00	5.00	40.00	45.00

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 21

Average Transition Rates For Oil And Gas (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	80.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	20.00
AA	0.00	80.43	15.22	0.00	0.00	0.00	0.00	0.00	4.35
A	0.16	0.16	85.17	6.47	0.63	0.16	0.00	0.16	7.10
BBB	0.00	0.00	1.60	86.21	3.21	0.36	0.00	0.00	8.61
BB	0.00	0.00	0.00	8.13	71.06	6.02	0.16	0.16	14.47
B	0.00	0.23	0.46	0.92	9.91	70.97	5.53	0.46	11.52
CCC/C	0.00	0.00	0.00	0.00	4.08	22.45	63.27	2.04	8.16
Three years									
AAA	40.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	60.00
AA	0.00	53.33	31.11	0.00	0.00	0.00	0.00	0.00	15.56
A	0.17	0.00	62.44	14.52	2.00	0.33	0.00	0.50	20.03
BBB	0.00	0.00	2.84	67.81	6.02	2.26	0.17	0.17	20.74
BB	0.00	0.00	0.00	16.80	37.15	6.52	0.79	0.59	38.14
B	0.00	0.00	1.69	3.94	20.85	36.06	7.04	0.28	30.14
CCC/C	0.00	0.00	0.00	0.00	5.13	20.51	30.77	0.00	43.59
Five years									
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
AA	0.00	27.27	34.09	6.82	0.00	0.00	0.00	0.00	31.82
A	0.18	0.00	46.24	18.10	2.69	0.00	0.00	0.90	31.90
BBB	0.00	0.00	3.54	53.93	6.19	4.13	0.49	0.10	31.63
BB	0.00	0.00	0.26	18.16	21.23	2.05	0.00	0.00	58.31
B	0.00	0.00	2.12	6.01	19.79	14.13	5.30	0.00	52.65
CCC/C	0.00	0.00	0.00	0.00	2.78	16.67	16.67	0.00	63.89

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 22

Average Transition Rates For Power (1981-2017)

(%)	AA	A	BBB	BB	B	CCC/C	D	NR
One year								
AA	66.67	33.33	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	79.37	17.46	0.00	0.00	0.00	0.00	3.17
BBB	0.00	0.37	87.86	4.34	0.74	0.50	0.25	5.95
BB	0.00	0.00	1.67	74.40	10.77	0.96	1.67	10.53
B	0.00	0.00	0.00	6.90	72.41	5.52	2.41	12.76
CCC/C	0.00	0.00	0.00	4.69	10.94	62.50	12.50	9.38
Three years								
AA	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	52.63	40.35	0.00	0.00	0.00	0.00	7.02
BBB	0.00	0.42	68.73	6.20	4.08	0.70	2.25	17.61
BB	0.00	0.00	3.99	46.32	16.56	5.83	2.76	24.54
B	0.00	0.00	0.00	18.14	36.28	6.51	8.37	30.70
CCC/C	0.00	0.00	0.00	3.70	24.07	18.52	22.22	31.48
Five years								
AA	0.00	100.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	34.69	42.86	2.04	4.08	0.00	0.00	16.33
BBB	0.00	0.16	53.87	7.58	4.28	1.65	3.95	28.50
BB	0.00	0.00	4.44	31.45	15.32	6.45	6.85	35.48
B	0.00	0.00	1.22	20.12	20.73	4.27	10.37	43.29
CCC/C	0.00	0.00	0.00	2.27	9.09	4.55	27.27	56.82

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 23

Average Transition Rates For Transportation (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	81.82	6.82	0.00	0.00	0.00	0.00	0.00	0.00	11.36
AA	1.94	84.47	3.88	0.00	0.00	0.00	0.00	0.00	9.71
A	0.00	0.87	84.35	5.51	0.00	0.00	0.00	0.00	9.28
BBB	0.00	0.00	1.77	86.15	2.58	0.48	0.81	0.00	8.21
BB	0.00	0.00	0.00	4.70	78.52	7.38	0.67	0.00	8.72
B	0.00	0.00	0.00	0.00	9.86	69.01	11.27	0.00	9.86
CCC/C	0.00	0.00	0.00	0.00	0.00	13.33	56.67	20.00	10.00
Three years									
AAA	58.54	13.41	0.00	0.00	0.00	0.00	0.00	0.00	28.05

Table 23

Average Transition Rates For Transportation (1981-2017) (cont.)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
AA	5.41	61.62	7.03	0.00	0.00	0.00	0.00	0.00	25.95
A	0.00	2.09	60.63	12.20	1.05	0.70	0.00	0.00	23.34
BBB	0.00	0.00	4.48	62.73	6.31	1.22	2.24	0.81	22.20
BB	0.00	0.00	0.00	13.08	42.99	15.89	2.80	1.87	23.36
B	0.00	0.00	0.00	0.00	14.00	48.00	12.00	4.00	22.00
CCC/C	0.00	0.00	0.00	0.00	0.00	27.27	18.18	36.36	18.18
Five years									
AAA	34.25	19.18	0.00	0.00	0.00	0.00	0.00	0.00	46.58
AA	8.70	41.61	7.45	1.24	0.00	0.00	0.00	0.00	40.99
A	0.00	2.11	44.73	15.19	1.27	0.42	1.27	0.00	35.02
BBB	0.00	0.00	4.68	43.80	8.26	4.96	1.10	2.20	34.99
BB	0.00	0.00	0.00	18.67	20.00	18.67	1.33	5.33	36.00
B	0.00	0.00	0.00	0.00	11.54	42.31	11.54	0.00	34.62
CCC/C	0.00	0.00	0.00	0.00	0.00	13.33	13.33	40.00	33.33

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 24

Average Transition Rates For Social Infrastructure (1981-2017)

(%)	AA	A	BBB	BB	B	CCC/C	D	NR
One year								
AA	50.00	0.00	50.00	0.00	0.00	0.00	0.00	0.00
A	0.00	90.82	3.06	0.51	0.00	0.00	0.00	5.61
BBB	0.21	2.76	90.45	2.76	0.21	0.00	0.00	3.61
BB	0.00	0.00	6.06	86.87	3.03	1.01	0.00	3.03
B	0.00	0.00	0.00	25.00	50.00	12.50	0.00	12.50
CCC/C	0.00	0.00	0.00	16.67	0.00	66.67	16.67	0.00
Three years								
AA	0.00	0.00	100.00	0.00	0.00	0.00	0.00	0.00
A	0.00	75.00	5.56	0.69	0.69	0.00	0.00	18.06
BBB	0.52	7.24	76.74	8.01	0.78	0.00	0.00	6.72
BB	0.00	0.00	16.67	68.06	4.17	2.78	0.00	8.33
B	0.00	0.00	0.00	28.57	0.00	42.86	0.00	28.57
CCC/C	0.00	0.00	0.00	40.00	0.00	20.00	40.00	0.00
Five years								
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 24

Average Transition Rates For Social Infrastructure (1981-2017) (cont.)

(%)	AA	A	BBB	BB	B	CCC/C	D	NR
A	0.00	65.56	6.67	0.00	2.22	0.00	0.00	25.56
BBB	0.65	10.13	66.34	11.76	0.98	0.00	0.00	10.13
BB	0.00	0.00	21.15	57.69	0.00	7.69	0.00	13.46
B	0.00	0.00	0.00	0.00	0.00	40.00	20.00	40.00
CCC/C	0.00	0.00	0.00	66.67	0.00	0.00	33.33	0.00

NR--Not rated. Source: S&P Global Fixed Income Research.

Table 25

Average One-Year Transition Rates For Other Infrastructure Ratings (1981-2017)

(%)	AAA	AA	A	BBB	BB	B	CCC/C	D	NR
One year									
AAA	87.90	4.03	0.00	0.00	0.00	0.00	0.00	0.00	8.06
AA	0.63	85.74	6.29	0.00	0.00	0.00	0.00	0.00	7.34
A	0.00	2.83	85.84	3.40	0.00	0.28	0.00	0.00	7.65
BBB	0.00	0.00	0.80	80.88	4.68	0.67	0.27	0.27	12.43
BB	0.00	0.00	0.00	2.54	72.06	9.93	2.08	0.46	12.93
B	0.00	0.00	0.00	0.00	7.36	62.79	8.53	4.65	16.67
CCC/C	4.00	0.00	0.00	0.00	1.33	4.00	50.67	18.67	21.33
Three years									
AAA	66.96	9.82	0.00	0.00	0.00	0.00	0.00	0.00	23.21
AA	1.64	68.62	8.20	0.23	0.00	0.00	0.00	0.00	21.31
A	0.00	7.37	62.82	4.81	0.64	1.60	0.00	0.32	22.44
BBB	0.14	0.00	2.20	50.82	5.49	3.30	2.75	0.96	34.34
BB	0.23	0.00	0.00	5.85	39.11	12.65	3.04	4.92	34.19
B	0.80	0.00	0.00	0.00	12.40	26.80	5.60	12.00	42.40
CCC/C	2.67	0.00	0.00	0.00	4.00	4.00	14.67	30.67	44.00
Five years									
AAA	52.94	11.76	0.00	0.00	0.00	0.00	0.00	0.00	35.29
AA	2.16	56.49	7.30	0.81	0.00	0.00	0.00	0.00	33.24
A	0.35	8.13	47.00	3.53	0.71	1.77	0.35	1.06	37.10
BBB	0.43	0.00	2.43	30.71	5.43	2.57	2.43	1.86	54.14
BB	0.49	0.00	0.00	7.16	24.44	6.67	2.72	10.37	48.15
B	0.00	0.00	0.00	0.00	10.37	13.69	2.07	15.77	58.09
CCC/C	0.00	0.00	0.00	0.00	2.74	6.85	1.37	34.25	54.79

NR--Not rated. Source: S&P Global Fixed Income Research.

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 26

Infrastructure Rating Actions Per Year

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Utilities																								
Upgrades	5	33	29	66	16	53	23	52	23	8	48	61	37	96	78	40	34	45	26	64	27	61	67	57
Downgrades	40	18	18	31	32	59	75	107	158	138	41	46	32	55	37	63	61	62	64	35	27	51	47	34
Defaults	0	0	0	0	0	0	0	6	12	4	1	4	0	0	0	4	3	5	3	2	7	0	0	1
Power																								
Upgrades	0	0	1	3	0	4	0	2	0	4	6	4	14	12	5	5	9	6	2	5	17	6	10	11
Downgrades	1	0	0	1	2	2	2	8	18	9	7	10	2	4	12	19	19	10	16	15	16	17	30	13
Defaults	0	0	0	0	0	0	0	0	3	10	0	2	0	0	0	0	0	0	0	4	0	0	2	3
Oil and gas																								
Upgrades	4	3	4	6	1	5	1	10	5	5	4	11	28	23	11	5	10	15	29	21	28	15	19	24
Downgrades	3	5	4	0	2	4	4	4	21	14	20	18	3	11	9	9	8	8	20	18	22	24	38	21
Defaults	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1
Transportation																								
Upgrades	0	0	0	1	0	0	2	0	0	1	1	5	2	3	5	0	7	4	8	7	18	14	12	9
Downgrades	0	0	0	0	3	1	1	1	1	3	0	8	9	7	10	16	15	13	17	9	15	13	15	9
Defaults	0	0	0	0	0	0	0	0	1	0	0	0	0	1	2	0	0	0	0	0	0	0	2	0
Social infrastructure																								
Upgrades	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	1	1	0	2	4	5	6	5	6	12	6	3	8
Downgrades	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	0	1	1	3	11	6	6	2	4	7	4	3	3
Defaults	N/A	N/A	N/A	N/A	N/A	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other																								
Upgrades	0	0	0	4	0	8	9	4	7	2	5	17	20	24	15	9	8	1	8	2	2	3	5	5
Downgrades	0	2	1	4	11	9	5	8	27	30	10	17	8	7	18	23	23	15	7	6	5	2	21	7
Defaults	0	0	0	0	0	1	0	1	1	0	1	5	1	1	2	2	4	1	8	1	1	0	0	0

Source: S&P Global Fixed Income Research.

Table 27

Infrastructure Defaults

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Public Service Co. of New Hampshire	Infrastructure - utilities	Senior secured	U.S.	U.S.	1/28/1988	CCC	A	6/14/1962
Public Service Co. of New Hampshire	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/28/1988	CCC-	BB+	9/12/1979
Geothermal Resources International Inc.	Infrastructure - utilities	Subordinated	U.S.	U.S.	8/11/1988	CC	B-	2/13/1986

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Columbia Energy Group	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	7/31/1991	BB	A	9/22/1966
Bonneville Pacific Corp.	Infrastructure - utilities	Subordinated	U.S.	U.S.	12/6/1991	CCC-	B-	8/16/1989
Del Norte Funding Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/8/1992	CCC-	BB+	1/20/1988
El Paso Funding Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/8/1992	CCC-	BBB-	12/12/1986
El Paso Funding Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/8/1992	CCC-	BBB-	1/1/1986
El Paso Electric Co.	Infrastructure - utilities	Senior secured	U.S.	U.S.	4/27/1992	CCC	AA	5/1/1968
Mobile Energy Services Co. LLC	Project - other	Senior secured	U.S.	U.S.	1/15/1999	CCC	BBB-	7/25/1995
Southern California Edison Co.	Infrastructure - utilities	Senior secured	U.S.	U.S.	1/18/2001	CC	A+	7/9/1993
Southern California Edison Co.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/18/2001	CC	A	1/18/1996
Southern California Edison Co.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	1/18/2001	CC	A	1/19/2000
Pacific Gas and Electric Co.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	4/9/2001	CC	A	5/28/1997
York Power Funding (Cayman) Ltd.	Project - other	Senior secured	Cayman Islands	Latin America	10/31/2001	BB-	BB-	7/22/1998
Enron Corp.	Infrastructure - utilities	Subordinated	U.S.	U.S.	12/3/2001	C	BBB-	9/18/1992
Enron Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	12/3/2001	CC	BBB	3/12/1986
Northern Natural Gas Co.	Infrastructure - oil and gas	Senior unsecured	U.S.	U.S.	12/3/2001	CC	BBB	4/28/1993
European Power Ltd. Co.	Project - other	Senior secured	U.K.	Europe, Middle East, Africa	12/5/2001	B-	BB-	8/17/2001
Autopistas del Sol S.A.	Infrastructure - transportation	Senior unsecured	Argentina	Latin America	2/1/2002	CC	BB-	7/18/1997
Teesside Power Financing Ltd.	Project - other	Senior secured	Cayman Islands	Latin America	2/18/2002	BB	BB	8/9/1999
Aguas Argentinas S.A.	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	2/19/2002	CC	BBB-	11/3/2000
Covanta Energy LLC	Infrastructure - power	Senior unsecured	U.S.	U.S.	3/1/2002	B	BBB+	3/5/1992

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Covanta Energy LLC	Infrastructure - power	Subordinated	U.S.	U.S.	3/1/2002	B-	BBB	6/4/1987
Inversora Electrica de Buenos Aires S.A.	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	3/15/2002	CC	BB+	9/3/1997
Metrogas S.A.	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	4/2/2002	CC	BBB-	3/24/2000
Compania de Transporte de Energia Electrica en Alta Tension TRANSENER S.A.	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	4/22/2002	CC	BBB-	4/27/1998
Transportadora de Gas del Norte S.A. (TGN)	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	5/7/2002	CC	BBB-	6/13/2000
Aguas Argentinas S.A.	Infrastructure - utilities	Senior secured	Argentina	Latin America	5/16/2002	CC	BBB-	8/10/1999
Azurix Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	6/18/2002	CC	BB	1/28/2000
Transportadora de Gas del Norte S.A. (TGN)	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	6/26/2002	CC	BBB-	6/13/2000
Engie Energia Chile S.A.	Infrastructure - power	Senior unsecured	Chile	Latin America	9/17/2002	CC	BBB	3/6/1996
Energy Group Ltd. (The)	Infrastructure - utilities	Senior unsecured	U.K.	Europe, Middle East, Africa	10/21/2002	CC	A-	10/16/1997
National Energy & Gas Transmission Inc.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/14/2002	B-	BBB	5/10/2001
TXU Europe Ltd.	Infrastructure - utilities	Senior unsecured	U.K.	Europe, Middle East, Africa	11/20/2002	CC	BBB+	3/30/1999
TXU Eastern Funding Co.	Infrastructure - utilities	Senior unsecured	U.K.	Europe, Middle East, Africa	11/20/2002	CC	BBB+	5/7/1999
EDF Energy Nuclear Generation Group Ltd.	Infrastructure - utilities	Senior unsecured	U.K.	Europe, Middle East, Africa	2/18/2003	C	A-	5/12/1999
CESP-Companhia Energetica de Sao Paulo	Infrastructure - power	Senior unsecured	Brazil	Latin America	4/23/2003	CC	B+	3/15/2001
CESP-Companhia Energetica de Sao Paulo*	Infrastructure - power	Senior unsecured	Brazil	Latin America	4/23/2003	CC	B+	3/15/2001

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
CESP-Companhia Energetica de Sao Paulo*	Infrastructure - power	Senior unsecured	Brazil	Latin America	4/23/2003	CC	B+	3/15/2001
NRG Energy Inc.	Infrastructure - power	Senior unsecured	U.S.	U.S.	5/15/2003	CC	BBB-	1/17/1996
USGen New England, Inc.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	7/8/2003	C	BBB+	9/4/1998
GenOn Energy Holdings Inc.	Infrastructure - power	Senior unsecured	U.S.	U.S.	7/15/2003	CC	BBB	7/9/1999
GenOn Mid-Atlantic LLC	Infrastructure - power	Senior secured	U.S.	U.S.	7/15/2003	CC	BBB-	10/31/2000
GenOn Mid-Atlantic LLC	Infrastructure - power	Senior secured	U.S.	U.S.	7/15/2003	CC	BBB-	10/31/2000
GenOn Mid-Atlantic LLC	Infrastructure - power	Senior secured	U.S.	U.S.	7/15/2003	CC	BBB-	6/22/2001
GenOn Americas LLC	Infrastructure - power	Senior unsecured	U.S.	U.S.	7/15/2003	CC	BBB-	5/1/2001
GenOn Mid-Atlantic LLC	Infrastructure - power	Senior secured	U.S.	U.S.	7/15/2003	CC	BBB-	10/31/2000
GenOn Americas LLC	Infrastructure - power	Senior unsecured	U.S.	U.S.	7/15/2003	CC	BBB-	5/1/2001
NorthWestern Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	9/15/2003	CCC	BBB+	11/20/1991
NorthWestern Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	9/15/2003	CC	A	11/6/1998
NorthWestern Corp.*	Infrastructure - utilities	Senior secured	U.S.	U.S.	9/15/2003	CCC	BBB+	4/25/2003
Avon Energy Partners Holdings	Infrastructure - utilities	Senior unsecured	U.K.	Europe, Middle East, Africa	1/16/2004	CC	A-	12/5/1997
TermoEmcali Funding Corp	Project - other	Senior secured	Colombia	Latin America	9/15/2004	CC	BBB-	3/31/1997
Entergy New Orleans Inc.	Infrastructure - utilities	Senior secured	U.S.	U.S.	10/18/2005	CC	BBB	10/18/2002
Calpine Corp.	Infrastructure - power	Senior unsecured	U.S.	U.S.	12/21/2005	CC	B	5/9/1996
Rumford Power Assoc L.P.	Project - other	Senior secured	U.S.	U.S.	12/21/2005	CCC-	BB+	12/12/2000
Calpine Canada Energy Finance ULC	Infrastructure - utilities	Senior unsecured	Canada	Canada	12/21/2005	CC	BB+	4/20/2001
Calpine Canada Energy Finance II ULC	Infrastructure - utilities	Senior unsecured	Canada	Canada	12/21/2005	CC	BB+	10/2/2001

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
RockGen Energy LLC	Project - other	Senior secured	U.S.	U.S.	12/21/2005	CCC-	BB+	10/2/2001
Broad River Energy LLC	Project - other	Senior secured	U.S.	U.S.	12/21/2005	CCC-	BB+	10/2/2001
Broad River Energy LLC	Project - other	Senior secured	U.S.	U.S.	12/21/2005	CCC-	BB+	10/2/2001
Calpine Corp.	Infrastructure - power	Senior secured	U.S.	U.S.	12/21/2005	CCC	B	7/17/2003
Calpine Generating Co. LLC	Infrastructure - utilities	Senior secured	U.S.	U.S.	12/21/2005	CCC	B+	3/22/2004
Tiverton Power Assoc L.P	Project - other	Senior secured	U.S.	U.S.	12/21/2005	CCC-	BB+	12/12/2000
Eurotunnel S.A.	Project - other	Senior secured	U.K.	Europe, Middle East, Africa	8/16/2006	C	A	12/14/1998
Fixed-Link Finance 2 B.V.	Project - other	Senior secured	Netherlands	Europe, Middle East, Africa	3/16/2007	C	BBB-	7/11/2002
Autopistas del Sol S.A.	Infrastructure - transportation	Senior unsecured	Argentina	Latin America	5/30/2007	B-	CCC-	10/14/2004
Metronet Rail SSL Finance PLC	Project - transportation	Senior secured	U.K.	Europe, Middle East, Africa	2/29/2008	CC	BBB+	11/5/2003
Metronet Rail BCV Finance PLC	Project - transportation	Senior secured	U.K.	Europe, Middle East, Africa	2/29/2008	CC	BBB+	11/5/2003
Lane Cove Tunnel Finance Co. Pty Ltd.	Project - other	Senior secured	Australia	Pacific	12/8/2008	CC	BBB-	12/22/2003
OOO Mostransavto-Finance	Infrastructure - international public finance	Senior unsecured	Russia	Europe, Middle East, Africa	12/24/2008	CC	CCC+	12/24/2007
Northeast Biofuels L.P.	Project - other	Senior secured	U.S.	U.S.	1/14/2009	C	B+	6/8/2006
Fixed-Link Finance B.V.	Project - other	Junior Subordinated	Netherlands	Europe, Middle East, Africa	3/4/2009	C	BB-	11/27/2001
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/16/2009	CC	BBB-	11/23/2004
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/16/2009	CC	B-	3/21/2008

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Vistra Energy Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/16/2009	CC	CCC	10/9/2007
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/16/2009	CC	BBB-	11/23/2004
Autopistas del Sol S.A.*	Infrastructure - transportation	Senior unsecured	Argentina	Latin America	12/17/2009	CC	CCC+	5/21/2009
Bosque Power Co. LLC	Project - other	Senior secured	U.S.	U.S.	3/26/2010	B	B	3/31/2009
Bosque Power Company LLC	Project - other	Senior secured	U.S.	U.S.	3/26/2010	B	B	3/31/2009
Metrogas S.A.	Infrastructure - utilities	Senior unsecured	Argentina	Latin America	6/18/2010	CC	CCC+	6/22/2006
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	8/17/2010	CC	B-	11/17/2009
Boston Generating LLC	Project - other	Senior secured	U.S.	U.S.	8/18/2010	CC	B+	12/21/2006
Boston Generating LLC	Project - other	Senior secured	U.S.	U.S.	8/18/2010	C	B-	12/21/2006
Vistra Energy Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	12/21/2010	CCC	CCC	11/17/2009
Vistra Energy Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	4/20/2011	CC	B+	10/9/2007
Vistra Energy Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	4/20/2011	CC	B+	10/9/2007
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	5/2/2011	CC	CCC	12/3/2010
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	5/2/2011	CC	CCC	11/17/2009
Dynegy Holdings LLC	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	11/8/2011	CC	BBB+	10/11/1996
Dynegy Danskammer LLC	Project - other	Senior secured	U.S.	U.S.	11/8/2011	CC	BBB	5/13/2002
AES Eastern Energy L.P.	Project - other	Senior secured	U.S.	U.S.	1/3/2012	CC	BB+	9/24/2003
LSP Energy L.P.	Project - other	Senior secured	U.S.	U.S.	1/19/2012	CC	BBB-	5/12/1999
Bicent Power LLC	Project - other	Senior secured	U.S.	U.S.	4/20/2012	CC	BB-	7/10/2007
Bicent Power LLC	Project - other	Senior secured	U.S.	U.S.	4/20/2012	CC	B-	7/10/2007
Homer City Funding LLC	Project - other	Senior secured	U.S.	U.S.	10/10/2012	CC	BBB-	5/13/1999

Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Homer City Funding LLC	Project - other	Senior secured	U.S.	U.S.	10/10/2012	CC	BBB-	3/17/1999
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	12/6/2012	CC	CCC	11/17/2009
Energy Future Holdings Corp.	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	12/6/2012	CC	CCC	11/17/2009
Choctaw Generation L.P.	Project - other	Senior secured	U.S.	U.S.	12/14/2012	CC	BBB-	12/3/2002
Midwest Generation LLC	Project - other	Senior secured	U.S.	U.S.	12/17/2012	CCC+	A-	8/14/2000
Edison Mission Energy	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	12/17/2012	CCC-	B+	5/19/2006
Vistra Energy Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	1/31/2013	CC	CC	12/26/2012
Energy Future Intermediate Holding Co. LLC	Infrastructure - utilities	Senior secured	U.S.	U.S.	1/31/2013	CC	B+	11/17/2009
Northland Resources A.B.	Project - other	Senior secured	Sweden	Europe, Middle East, Africa	3/7/2013	C	B-	5/28/2012
Longview Power LLC	Project - power (new)	Senior secured	U.S.	U.S.	9/3/2013	CCC-	BB-	5/4/2007
Longview Power LLC	Project - power (new)	Senior secured	U.S.	U.S.	9/3/2013	CCC-	B+	12/21/2011
CRC Breeze Finance S.A.	Project - power (new)	Secured subordinated debt	Luxembourg	Europe, Middle East, Africa	10/31/2013	C	BB+	7/18/2007
Breeze Finance S.A.	Project - power (new)	Subordinated	Luxembourg	Europe, Middle East, Africa	10/31/2013	C	BB-	6/17/2008
Vistra Energy Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	4/4/2014	CC	CCC	10/22/2010
Energy Future Holdings Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	5/1/2014	C	BBB-	6/23/1993
Energy Future Competitive Holdings Co.	Infrastructure - utilities	Subordinated	U.S.	U.S.	5/1/2014	C	BBB	1/24/1997
Vistra Energy Corp.	Infrastructure - utilities	Senior secured	U.S.	U.S.	5/1/2014	CC	CCC-	10/9/2013
Energy Future Intermediate Holding Co. LLC	Infrastructure - utilities	Senior secured	U.S.	U.S.	5/1/2014	C	CC	2/1/2013

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Table 27

Infrastructure Defaults (cont.)

Issuer	Industry	Debt type	Country	Region	Default date	Rating prior to default	Original rating	Original date
Energy Future Intermediate Holding Company LLC	Infrastructure - utilities	Senior secured	U.S.	U.S.	5/1/2014	CCC-	CC	5/2/2011
Energy Future Intermediate Holding Company LLC	Infrastructure - utilities	Senior unsecured	U.S.	U.S.	5/1/2014	C	CC	12/6/2012
Windsor Petroleum Transport Corp.	Project - other	Senior secured	U.S.	U.S.	7/16/2014	CCC-	BBB	10/24/1997
Schahin II Finance Company (SPV) Ltd.	Project - oil and gas	Senior secured	Cayman Islands	Latin America	10/1/2015	CC	BBB-	3/28/2012
Southcross Holdings Borrower L.P.	Infrastructure - oil and gas	Senior secured	U.S.	U.S.	3/28/2016	CC	B-	7/10/2014
Ukrainian Railway PJSC	Infrastructure - transportation	Senior secured	Ukraine	Europe, Middle East, Africa	3/31/2016	CC	B	5/2/2013
Public Joint Stock Company Ukrainian Railway	Infrastructure - transportation	Senior secured	Ukraine	Europe, Middle East, Africa	3/31/2016	CC	B	5/2/2013
Odebrecht Oil & Gas Finance Ltd.	Project - oil and gas	Senior secured	Cayman Islands	Latin America	4/20/2016	CC	BBB-	6/3/2014
Lombard Pub Facs Corp.	Project - social infrastructure	Senior secured	U.S.	U.S.	6/30/2016	CC	A	9/19/2005
Homer City Generation L.P.	Infrastructure - power	Senior secured	U.S.	U.S.	10/25/2016	CC	B+	12/6/2012
Illinois Power Generating Co.	Infrastructure - power	Senior unsecured	U.S.	U.S.	12/19/2016	CC	BBB+	5/30/2002
Odebrecht Offshore Drilling Finance Ltd	Project - oil and gas	Senior secured	Cayman Islands	Latin America	4/3/2017	CCC-	BBB	8/30/2013
GenOn Americas LLC	Infrastructure - power	Senior unsecured	U.S.	U.S.	6/14/2017	CC	B-	12/6/2005
GenOn Energy Inc.	Infrastructure - power	Senior unsecured	U.S.	U.S.	6/14/2017	CCC-	B-	5/30/2007
GenOn Energy Inc.*	Infrastructure - power	Senior secured	U.S.	U.S.	6/14/2017	CCC	CCC+	5/19/2017
Corporacion Electrica Nacional S.A.	Infrastructure - utilities	Senior unsecured	Venezuela	Latin America	11/10/2017	CC	BB-	4/30/2008
ExGen Texas Power LLC	Project - power (new)	Senior secured	U.S.	U.S.	11/13/2017	CCC-	BB-	9/16/2014
Odebrecht Offshore Drilling Finance Ltd.*	Project - oil and gas	Senior secured	Cayman Islands	Latin America	12/22/2017	CC	CC	4/11/2017

*Indicates defaults that are not included in default rate or rating transition calculations because they occurred in the year in which the original rating was assigned. Of the 133 ratings listed, 127 are included in default and rating transition statistics. Source: S&P Global Fixed Income Research.

Table 28

All Infrastructure Cumulative Default Rates With Modifier (1981-2017)

(%)

Rating	--Time horizon (years)--			
	1	5	10	15
AAA	0.00	0.00	0.00	0.00
AA+	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00
AA-	0.00	0.00	0.00	0.12
A+	0.07	0.40	0.66	0.76
A	0.11	0.58	1.10	1.23
A-	0.06	0.52	0.68	0.87
BBB+	0.17	1.16	1.88	2.55
BBB	0.10	0.70	1.36	2.08
BBB-	0.09	1.37	2.46	3.64
BB+	0.00	3.80	5.80	7.39
BB	1.06	3.93	6.02	6.02
BB-	0.12	4.22	6.76	6.76
B+	1.14	6.56	9.17	9.17
B	2.15	7.88	11.17	11.17
B-	3.60	11.46	14.85	16.09
CCC/C	16.79	32.67	35.69	35.69
Investment grade	0.09	0.71	1.21	1.64
Speculative grade	2.27	7.68	10.23	10.75
All rated	0.50	1.99	2.82	3.26

Source: S&P Global Fixed Income Research.

Table 29

Investment-Grade Cumulative Default Rates

(%)

Year	'A' infrastructure corporates and project finance	'BBB' infrastructure corporates and project finance	'A' nonfinancial corporates	'BBB' nonfinancial corporates
0	0.00	0.00	0.00	0.00
1	0.08	0.11	0.03	0.14
2	0.15	0.44	0.07	0.40
3	0.26	0.66	0.12	0.70
4	0.38	0.86	0.21	1.09
5	0.51	1.05	0.32	1.53
6	0.60	1.22	0.46	1.97
7	0.67	1.40	0.63	2.36

Table 29

Investment-Grade Cumulative Default Rates (cont.)

(%)

Year	'A' infrastructure corporates and project finance	'BBB' infrastructure corporates and project finance	'A' nonfinancial corporates	'BBB' nonfinancial corporates
8	0.73	1.58	0.80	2.73
9	0.77	1.70	0.99	3.09
10	0.83	1.88	1.17	3.44

Source: S&P Global Fixed Income Research.

Table 30

Speculative-Grade Cumulative Default Rates

(%)

Year	'BB' infrastructure corporates and project finance	'B' infrastructure corporates and project finance	'CCC'/'C' infrastructure	'BB' nonfinancial corporates	'B' nonfinancial corporates	'CCC'/'C' nonfinancial corporates
0	0.00	0.00	0.00	0.00	0.00	0.00
1	0.38	2.08	16.79	0.67	3.68	28.36
2	0.82	4.67	24.50	2.19	8.52	38.28
3	1.89	6.22	29.01	3.99	12.74	43.64
4	3.00	7.48	31.72	5.81	16.10	46.72
5	3.97	8.20	32.67	7.53	18.67	49.09
6	4.57	8.78	33.70	9.08	20.77	50.05
7	4.96	9.41	34.83	10.42	22.47	51.27
8	5.45	10.09	35.24	11.65	23.82	52.04
9	5.94	10.83	35.69	12.73	25.00	52.91
10	6.16	11.23	35.69	13.68	26.10	53.51

Source: S&P Global Fixed Income Research.

Table 31

Average Cumulative Default Rates (1981-2017)

(%)

	--Time horizon (years) --														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
All infrastructure															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06
A	0.08	0.15	0.26	0.38	0.51	0.60	0.67	0.73	0.77	0.83	0.90	0.95	0.98	0.98	0.98
BBB	0.11	0.44	0.66	0.86	1.05	1.22	1.40	1.58	1.70	1.88	2.07	2.24	2.43	2.58	2.72
BB	0.38	0.82	1.89	3.00	3.97	4.57	4.96	5.45	5.94	6.16	6.33	6.52	6.62	6.73	6.85

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 31

Average Cumulative Default Rates (1981-2017) (cont.)

B	2.08	4.67	6.22	7.48	8.20	8.78	9.41	10.09	10.83	11.23	11.37	11.54	11.54	11.54	11.54
CCC/C	16.79	24.50	29.01	31.72	32.67	33.70	34.83	35.24	35.69	35.69	35.69	35.69	35.69	35.69	35.69
Investment grade	0.09	0.28	0.42	0.57	0.71	0.82	0.93	1.04	1.11	1.21	1.33	1.43	1.52	1.58	1.64
Speculative grade	2.27	3.99	5.50	6.79	7.68	8.32	8.85	9.40	9.96	10.23	10.37	10.54	10.60	10.67	10.75
All rated	0.50	0.97	1.37	1.72	1.99	2.19	2.37	2.54	2.69	2.82	2.94	3.05	3.13	3.20	3.26
Project finance															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	0.00	0.22	0.48	0.77	1.10	1.49	1.95	1.95	2.55	3.27	4.09	4.09	4.09	4.09
BBB	0.10	0.40	0.67	1.02	1.33	1.46	1.61	1.69	1.78	2.09	2.59	3.04	3.58	3.58	3.58
BB	0.34	0.95	3.30	5.14	6.99	8.17	9.10	10.35	11.58	12.14	12.46	12.82	13.24	13.74	14.35
B	3.60	7.71	9.04	10.48	11.73	13.08	14.57	15.85	17.28	17.83	17.83	17.83	17.83	17.83	17.83
CCC/C	16.96	25.36	31.18	36.31	37.37	37.37	37.37	37.37	37.37	37.37	37.37	37.37	37.37	37.37	37.37
Investment grade	0.07	0.31	0.57	0.89	1.20	1.36	1.54	1.67	1.75	2.09	2.61	3.11	3.55	3.55	3.55
Speculative grade	2.66	4.97	7.30	9.29	10.90	12.03	13.04	14.20	15.39	15.90	16.10	16.33	16.61	16.95	17.38
All rated	0.97	1.93	2.91	3.82	4.57	5.07	5.54	6.02	6.47	6.87	7.27	7.68	8.06	8.18	8.33
Corporate															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06
A	0.09	0.17	0.26	0.38	0.50	0.57	0.63	0.67	0.71	0.76	0.80	0.83	0.85	0.85	0.85
BBB	0.12	0.45	0.66	0.82	0.99	1.16	1.35	1.55	1.68	1.83	1.97	2.09	2.22	2.40	2.56
BB	0.39	0.76	1.27	2.07	2.66	3.02	3.18	3.36	3.55	3.65	3.77	3.89	3.89	3.89	3.89
B	1.44	3.38	5.03	6.21	6.72	6.99	7.28	7.75	8.24	8.60	8.79	9.01	9.01	9.01	9.01
CCC/C	16.72	24.16	28.13	29.83	30.74	32.22	33.81	34.36	34.96	34.96	34.96	34.96	34.96	34.96	34.96
Investment grade	0.09	0.27	0.40	0.52	0.64	0.75	0.85	0.95	1.03	1.10	1.18	1.25	1.31	1.38	1.44
Speculative grade	2.11	3.57	4.73	5.72	6.32	6.75	7.08	7.38	7.72	7.90	8.03	8.17	8.17	8.17	8.17
All rated	0.41	0.79	1.08	1.32	1.51	1.66	1.80	1.92	2.03	2.12	2.20	2.28	2.34	2.40	2.45
Utilities															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.07	0.07	0.07
A	0.09	0.16	0.26	0.37	0.50	0.56	0.63	0.67	0.72	0.77	0.83	0.83	0.83	0.83	0.83
BBB	0.12	0.38	0.59	0.73	0.86	0.98	1.10	1.26	1.35	1.45	1.56	1.68	1.80	1.93	2.08
BB	0.08	0.61	1.25	2.11	2.61	2.93	2.93	3.05	3.31	3.45	3.59	3.75	3.75	3.75	3.75

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 31

Average Cumulative Default Rates (1981-2017) (cont.)

B	2.34	4.74	6.93	8.68	9.44	9.70	9.97	10.25	10.25	10.25	10.25	10.25	10.25	10.25	10.25
CCC/C	21.14	30.10	35.19	37.89	39.33	41.67	44.13	44.99	45.91	45.91	45.91	45.91	45.91	45.91	45.91
Investment grade	0.09	0.24	0.37	0.48	0.59	0.67	0.75	0.83	0.89	0.96	1.02	1.08	1.13	1.19	1.24
Speculative grade	2.67	4.46	5.90	7.16	7.81	8.30	8.59	8.82	9.06	9.15	9.24	9.33	9.33	9.33	9.33
All rated	0.39	0.72	1.00	1.24	1.41	1.53	1.64	1.74	1.82	1.88	1.95	2.01	2.06	2.11	2.16
Oil and gas															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.16	0.32	0.49	0.66	0.84	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03	1.03
BBB	0.00	0.08	0.16	0.25	0.25	0.25	0.37	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
BB	0.16	0.34	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
B	0.46	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96	0.96
CCC/C	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04	2.04
Investment grade	0.05	0.15	0.26	0.37	0.44	0.50	0.57	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Speculative grade	0.36	0.66	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
All rated	0.16	0.33	0.44	0.52	0.56	0.60	0.65	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
Power															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.57	7.59	7.59	7.59
A	0.25	1.56	2.13	2.74	3.40	4.30	5.09	5.76	6.50	7.35	8.01	8.40	8.84	9.86	10.47
BBB	1.67	1.94	2.56	3.99	6.42	8.24	9.32	9.95	9.95	9.95	9.95	9.95	9.95	9.95	9.95
BB	2.41	6.36	8.68	10.27	10.87	11.57	12.39	14.31	17.61	20.14	21.71	23.82	23.82	23.82	23.82
B	12.50	19.10	24.50	28.58	28.58	28.58	28.58	28.58	28.58	28.58	28.58	28.58	28.58	28.58	28.58
CCC/C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment grade	0.23	1.44	1.96	2.53	3.14	3.97	4.69	5.30	5.97	6.74	7.33	8.01	8.80	9.73	10.28
Speculative grade	2.85	5.03	6.71	8.45	9.99	11.23	12.10	13.12	14.34	15.34	15.96	16.76	16.76	16.76	16.76
All rated	1.46	3.11	4.14	5.20	6.18	7.17	7.95	8.71	9.57	10.41	11.01	11.71	12.28	12.97	13.40
Transportation															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BBB	0.00	0.36	0.77	1.24	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79	1.79
BB	0.00	0.79	1.72	2.83	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18	4.18

Default, Transition, and Recovery: 2017 Inaugural Infrastructure Default Study And Rating Transitions

Table 31

Average Cumulative Default Rates (1981-2017) (cont.)

B	0.00	0.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00	4.00
CCC/C	20.00	31.43	36.00	36.00	36.00	36.00	36.00	36.00	36.00	36.00	0.00	0.00	0.00	0.00	0.00
Investment grade	0.00	0.17	0.36	0.58	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82	0.82
Speculative grade	2.40	4.27	6.51	7.19	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06	8.06
All rated	0.40	0.83	1.32	1.60	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92	1.92
Social															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.69	19.23	19.23	19.23	19.23	19.23
A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BBB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.17	10.16	10.16	10.16	10.16	10.16	10.16	0.00
BB	0.00	0.00	0.00	0.00	20.00	40.00	60.00	60.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
B	16.67	33.33	50.00	66.67	66.67	66.67	66.67	66.67	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CCC/C	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investment grade	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89	2.42	2.42	2.42	2.42	2.42
Speculative grade	0.89	1.90	3.08	4.46	6.08	8.04	10.52	13.97	19.34	19.34	19.34	19.34	19.34	19.34	0.00
All rated	0.13	0.27	0.43	0.62	0.84	1.10	1.42	1.83	2.39	3.19	4.55	4.55	4.55	4.55	4.55
Other															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
A	0.00	0.00	0.32	0.66	1.01	1.38	1.78	2.21	2.21	2.21	2.21	2.89	2.89	2.89	2.89
BBB	0.27	0.67	0.95	1.37	1.80	2.09	2.40	2.56	2.73	3.30	4.18	4.93	5.82	5.82	5.82
BB	0.46	1.16	4.91	7.76	9.99	11.28	12.63	14.09	15.40	16.11	16.50	16.93	17.41	17.96	18.63
B	4.65	10.17	11.77	13.81	15.07	16.36	17.71	19.19	20.81	21.42	21.42	21.42	21.42	21.42	21.42
CCC/C	18.67	26.67	30.67	33.39	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75	34.75
Investment grade	0.12	0.30	0.49	0.75	1.03	1.25	1.47	1.64	1.72	2.01	2.44	2.94	3.36	3.36	3.36
Speculative grade	3.66	6.69	9.75	12.32	14.14	15.30	16.52	17.85	19.14	19.75	19.98	20.25	20.56	20.94	21.40
All rated	1.22	2.30	3.42	4.44	5.22	5.75	6.31	6.85	7.33	7.72	8.09	8.51	8.90	9.01	9.15

Source: S&P Global Fixed Income Research.

Table 32

All Infrastructure And Nonfinancial Corporate Cumulative Default Rates (1981-2017)

(%)

Rating	--Time horizon (years)--														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
All infrastructure															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.06	0.06	0.06
A	0.08	0.15	0.26	0.38	0.51	0.60	0.67	0.73	0.77	0.83	0.90	0.95	0.98	0.98	0.98
BBB	0.11	0.44	0.66	0.86	1.05	1.22	1.40	1.58	1.70	1.88	2.07	2.24	2.43	2.58	2.72
BB	0.38	0.82	1.89	3.00	3.97	4.57	4.96	5.45	5.94	6.16	6.33	6.52	6.62	6.73	6.85
B	2.08	4.67	6.22	7.48	8.20	8.78	9.41	10.09	10.83	11.23	11.37	11.54	11.54	11.54	11.54
CCC/C	16.79	24.50	29.01	31.72	32.67	33.70	34.83	35.24	35.69	35.69	35.69	35.69	35.69	35.69	35.69
Investment grade	0.09	0.28	0.42	0.57	0.71	0.82	0.93	1.04	1.11	1.21	1.33	1.43	1.52	1.58	1.64
Speculative grade	2.27	3.99	5.50	6.79	7.68	8.32	8.85	9.40	9.96	10.23	10.37	10.54	10.60	10.67	10.75
All rated	0.50	0.97	1.37	1.72	1.99	2.19	2.37	2.54	2.69	2.82	2.94	3.05	3.13	3.20	3.26
Nonfinancial corporate															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.15	0.23	0.23	0.23	0.23	0.31	0.39
AA	0.00	0.00	0.03	0.06	0.10	0.14	0.21	0.25	0.28	0.33	0.39	0.44	0.50	0.54	0.60
A	0.03	0.07	0.12	0.21	0.32	0.46	0.63	0.80	0.99	1.17	1.34	1.51	1.68	1.83	2.00
BBB	0.14	0.40	0.70	1.09	1.53	1.97	2.36	2.73	3.09	3.44	3.81	4.09	4.33	4.57	4.83
BB	0.67	2.19	3.99	5.81	7.53	9.08	10.42	11.65	12.73	13.68	14.44	15.13	15.77	16.35	16.97
B	3.68	8.52	12.74	16.10	18.67	20.77	22.47	23.82	25.00	26.10	27.02	27.74	28.40	29.03	29.66
CCC/C	28.36	38.28	43.64	46.72	49.09	50.05	51.27	52.04	52.91	53.51	54.07	54.66	55.30	55.75	55.75
Investment grade	0.08	0.22	0.38	0.60	0.85	1.11	1.36	1.59	1.83	2.06	2.29	2.48	2.65	2.81	2.99
Speculative grade	3.94	7.71	11.00	13.70	15.90	17.69	19.20	20.46	21.57	22.57	23.39	24.08	24.73	25.32	25.91
All rated	1.92	3.78	5.40	6.76	7.88	8.81	9.61	10.28	10.88	11.42	11.89	12.28	12.63	12.95	13.28
Difference															
AAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	(0.07)	(0.15)	(0.23)	(0.23)	(0.23)	(0.23)	(0.31)	(0.39)
AA	0.00	0.00	(0.03)	(0.06)	(0.10)	(0.14)	(0.21)	(0.25)	(0.28)	(0.33)	(0.39)	(0.38)	(0.44)	(0.48)	(0.54)
A	0.05	0.08	0.14	0.18	0.19	0.14	0.04	(0.07)	(0.22)	(0.34)	(0.44)	(0.56)	(0.70)	(0.85)	(1.02)
BBB	(0.02)	0.04	(0.04)	(0.23)	(0.48)	(0.75)	(0.96)	(1.15)	(1.38)	(1.56)	(1.74)	(1.85)	(1.90)	(1.99)	(2.11)
BB	(0.29)	(1.37)	(2.11)	(2.82)	(3.56)	(4.51)	(5.46)	(6.20)	(6.80)	(7.52)	(8.11)	(8.61)	(9.15)	(9.62)	(10.12)
B	(1.60)	(3.85)	(6.51)	(8.62)	(10.47)	(11.98)	(13.06)	(13.73)	(14.17)	(14.87)	(15.65)	(16.20)	(16.85)	(17.49)	(18.12)
CCC/C	(11.57)	(13.77)	(14.64)	(15.00)	(16.42)	(16.35)	(16.44)	(16.80)	(17.22)	(17.82)	(18.38)	(18.97)	(19.61)	(20.06)	(20.06)
Investment grade	0.01	0.05	0.04	(0.04)	(0.14)	(0.29)	(0.43)	(0.56)	(0.71)	(0.85)	(0.96)	(1.05)	(1.13)	(1.23)	(1.35)

Table 32

All Infrastructure And Nonfinancial Corporate Cumulative Default Rates (1981-2017) (cont.)

Speculative grade	(1.66)	(3.73)	(5.51)	(6.91)	(8.21)	(9.37)	(10.35)	(11.06)	(11.61)	(12.34)	(13.02)	(13.55)	(14.13)	(14.65)	(15.16)
All rated	(1.42)	(2.81)	(4.04)	(5.04)	(5.89)	(6.63)	(7.24)	(7.73)	(8.18)	(8.60)	(8.95)	(9.23)	(9.50)	(9.75)	(10.02)

Source: S&P Global Fixed Income Research.

Table 33

Marginal Default Rates (1981-2017)

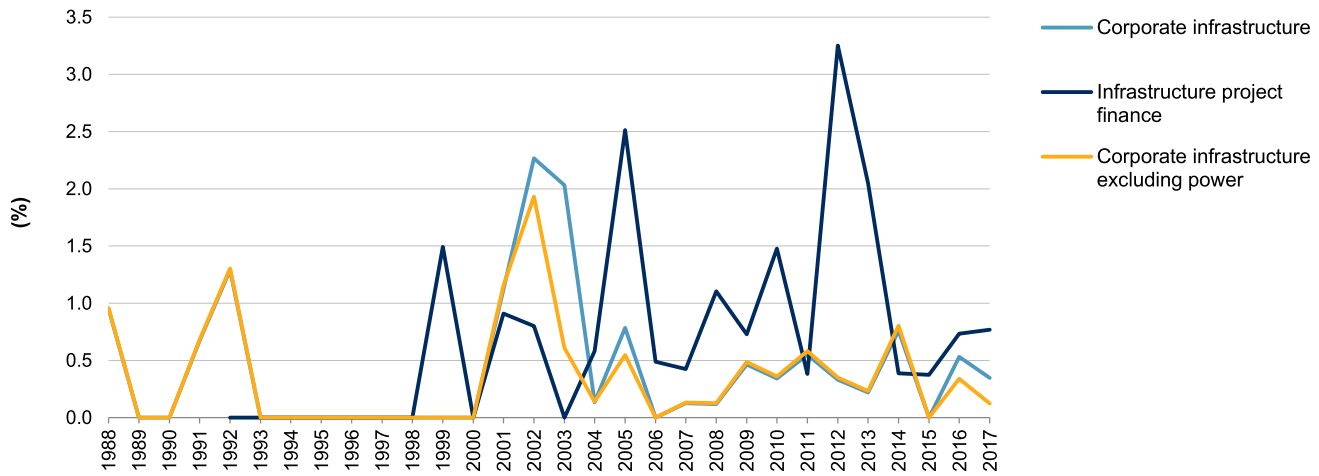
(%)

	--Time horizon (years)--									
	1	2	3	4	5	6	7	8	9	10
All infrastructure										
A	0.08	0.07	0.10	0.13	0.13	0.09	0.07	0.06	0.04	0.06
BBB	0.11	0.32	0.22	0.20	0.19	0.17	0.18	0.18	0.13	0.18
BB	0.38	0.44	1.08	1.13	1.00	0.63	0.41	0.52	0.51	0.24
B	2.08	2.64	1.63	1.34	0.78	0.63	0.68	0.76	0.82	0.45
All rated	0.50	0.47	0.40	0.35	0.28	0.20	0.18	0.18	0.15	0.13
Nonfinancial corporates										
A	0.03	0.04	0.04	0.09	0.12	0.14	0.17	0.17	0.19	0.19
BBB	0.14	0.26	0.30	0.40	0.45	0.45	0.39	0.38	0.36	0.37
BB	0.67	1.53	1.85	1.90	1.82	1.68	1.48	1.37	1.22	1.09
B	3.68	5.02	4.61	3.85	3.07	2.58	2.15	1.74	1.55	1.46
All rated	1.92	1.90	1.68	1.43	1.20	1.01	0.87	0.74	0.67	0.61

Source: S&P Global Fixed Income Research.

Chart 44

Default Rates, Including For Corporate Infrastructure Excluding Power (1981-2017)

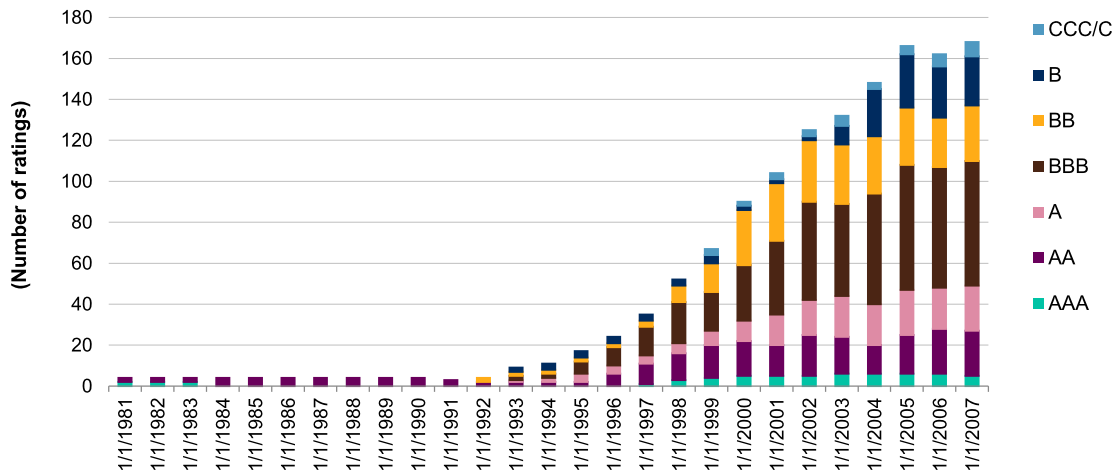


Source: S&P Global Fixed Income Research.

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Chart 45

Other Infrastructure Rating Distribution

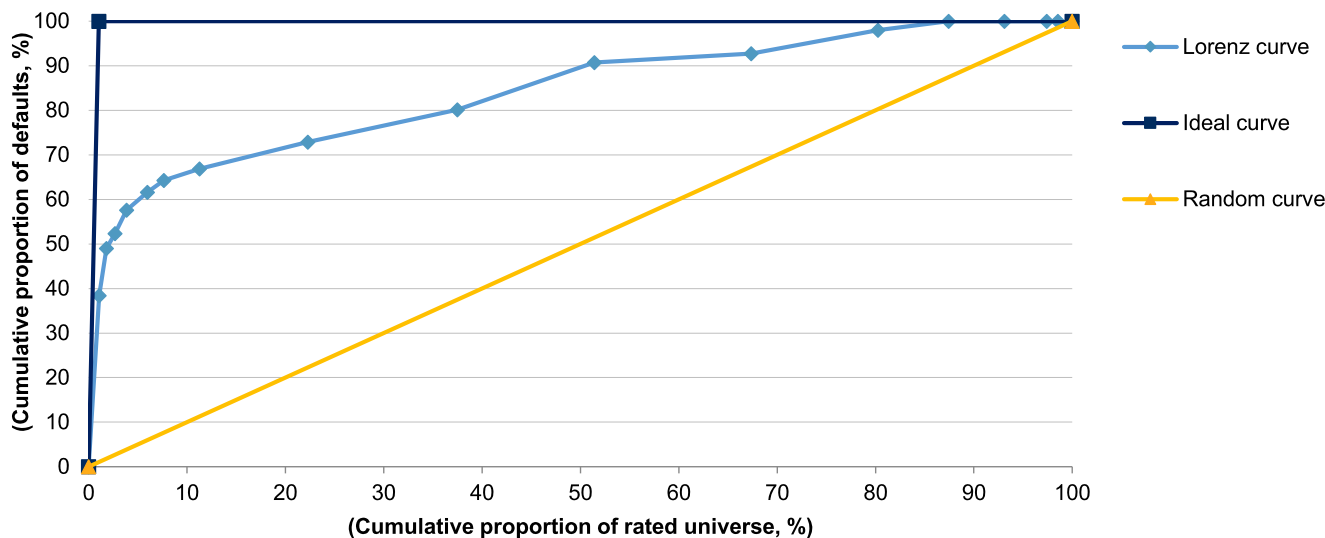


Source: S&P Global Fixed Income Research.

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Chart 46

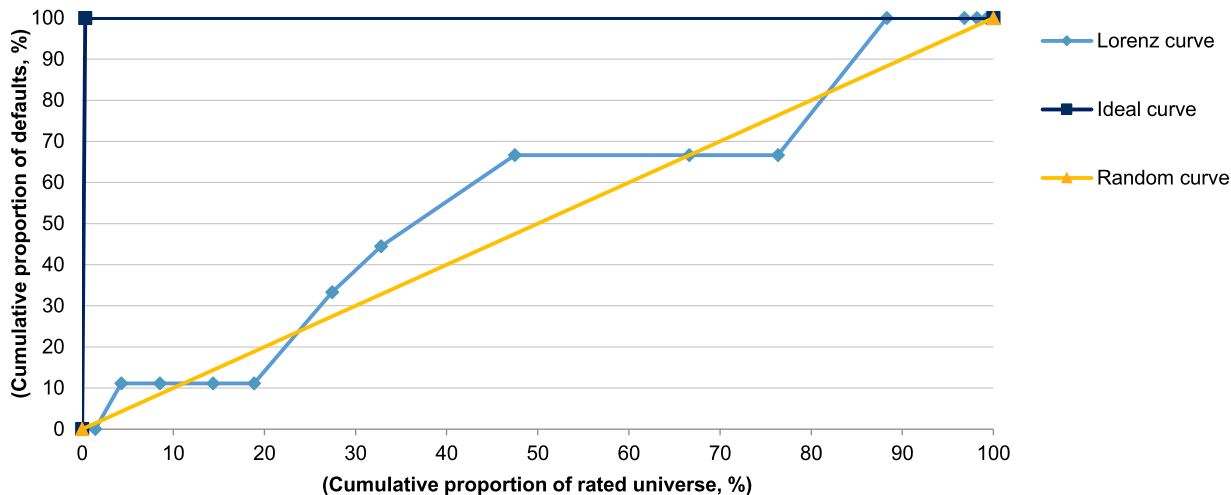
Utilities Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.
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Chart 47

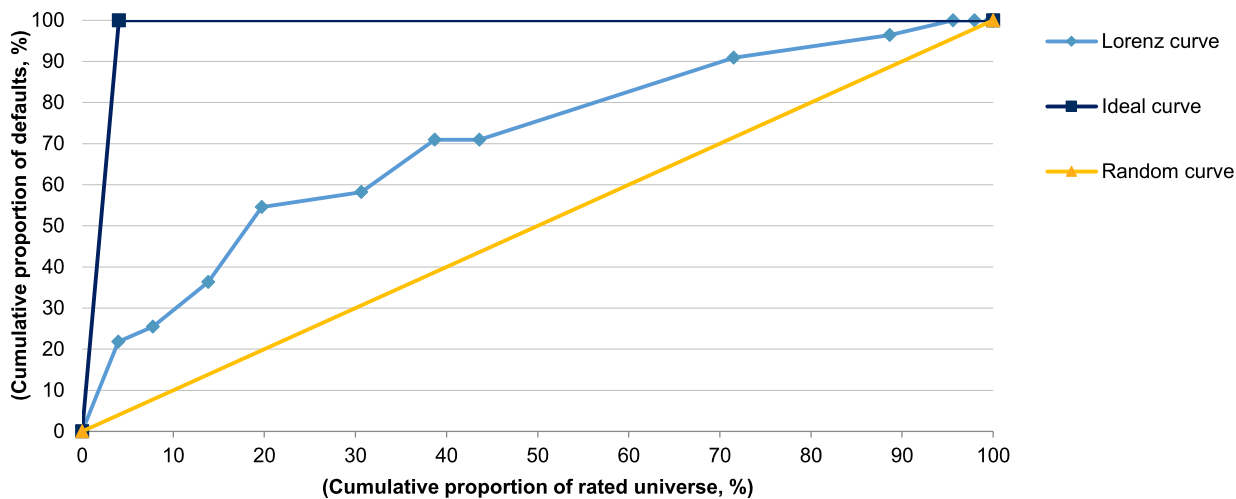
Oil And Gas Three-Year Lorenz Curve



Sources: S&P Global Fixed Income Research.
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Chart 48

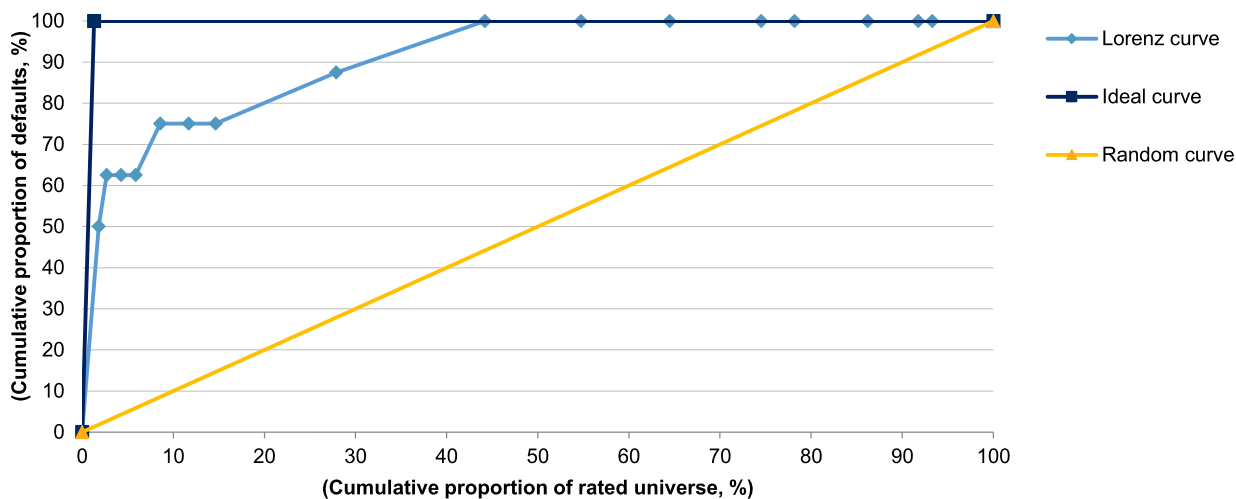
Power Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.
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Chart 49

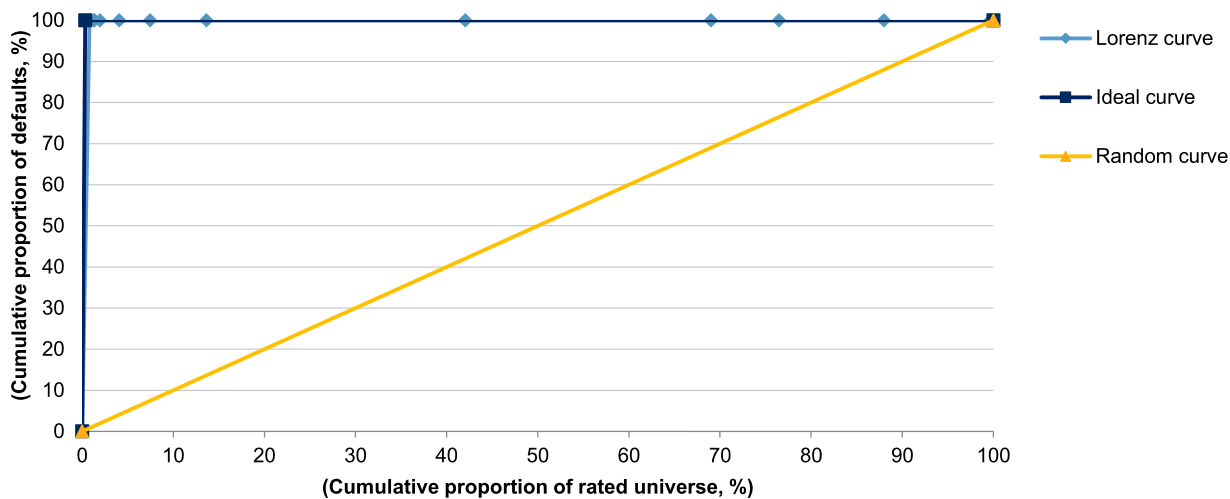
Transportation Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.
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Chart 50

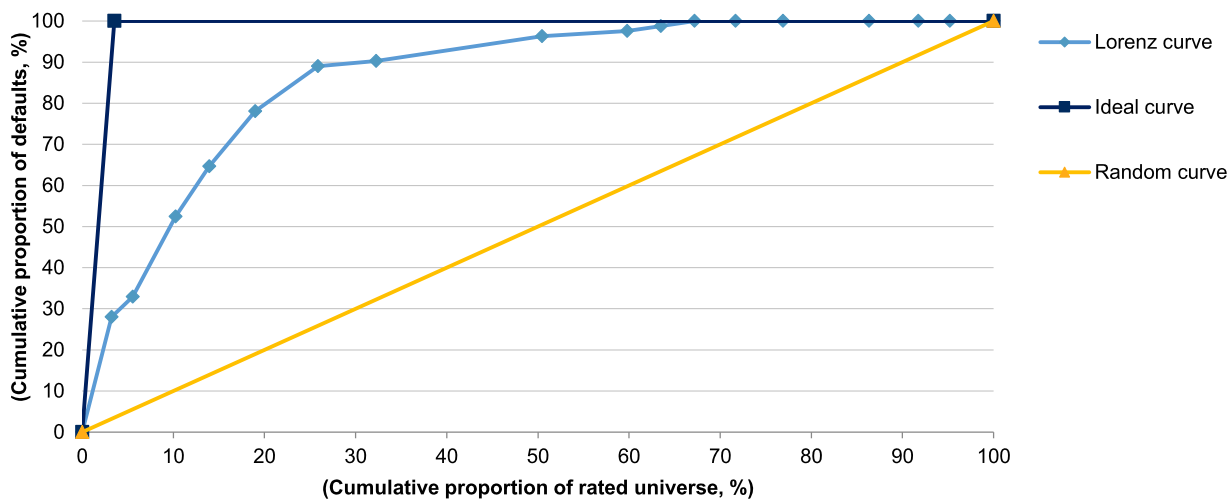
Social Infrastructure Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.
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Chart 51

Other Infrastructure Three-Year Lorenz Curve



Source: S&P Global Fixed Income Research.
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Related Research

- 1995-2016 Global Bank Loan Unrated Project Finance Default And Recovery Report, Nov. 20, 2018

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