

# CreditModel™ Corporates 2.6

## A Global Scoring Model Specializing in the Analysis of Unrated Firms and Low Default Sectors

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### Overview

Credit risk assessment of low default asset classes is traditionally performed with the aid of scorecard models internally developed at financial institutions/large firms or via expert opinions of creditworthiness offered by traditional credit rating agencies. The former approach usually is quite time-consuming, because it requires retrieval of company financials, deep analysis and assessment of many risk dimensions, while the latter is restricted to the limited number of companies that are rated by major credit rating agencies.

S&P Global Market Intelligence has developed CreditModel™ Corporates 2.6 (CM2.6) a statistical model trained on credit ratings from S&P Global Ratings, which offers an automated solution to assess the credit risk of numerous counterparties, globally. In order to achieve global coverage, a tailored approach is applied, to account for the inherent differences between companies operating in developed, emerging and frontier markets. This results in credit scores across a universe of companies well beyond what is normally covered by major credit rating agencies.

Risk managers at banks, insurance companies, corporations and asset management firms can use CM2.6 to:

- Assess the credit risk of unrated and rated counterparties;
- Benchmark internal credit ratings against a globally recognized metric;
- Support transfer pricing, trade credit, and supply chain risk management;
- Calculate capital for compliance purposes;
- Provide all relevant inputs for limit setting of exposures to industries, countries or regions;
- Incorporate fundamental credit risk in the investment idea generation process;
- Perform stress testing and sensitivity analysis.

CM2.6 embeds two key features to assess sovereign risk, transfer and convertibility risk, and country risk simultaneously. First is a sophisticated sovereign cap that goes beyond the industry-standard approach of using a sovereign's foreign currency rating as a cap if it exists at all. Second, are newly developed country risk scores (CRS) to encapsulate the risk of doing business in a given country. In addition, various early warning signals were added as additional explanatory factors as well as higher order terms and cross-terms of

explanatory factors whenever deemed appropriate. As a result, performance in CM2.6 has improved with respect to a number of measures.

This paper explains the difference between the risks stated above, why they are relevant in analyzing credit risk, in particular in emerging markets, and how they are incorporated into CM2.6 via the sovereign cap and CRS features.

## Entity Coverage and Model Features

CM2.6 is a widely used statistical tool that facilitates an easy, efficient, and cost-effective evaluation of a company's credit quality by generating credit scores for both public and private corporates globally (see Appendix A).

Since the majority of corporate entities rated by S&P Global Ratings are large (in revenues), we recommend using CM2.6 to assess the credit risk of non-financial corporates with total revenues greater than \$25M.

### Financial and Macroeconomic Factors

Our model utilizes both financial data from corporates and the most relevant macroeconomic data, to generate a quantitative credit score that statistically matches a credit rating issued by S&P Global Ratings.<sup>1</sup>

### Global Coverage

As the world has become more interconnected economically, financial institutions, investors, and multi-national corporations have shown more and more interest in the creditworthiness of corporates around the globe. Our model covers country, industry and transfer and convertibility risk for all 247 countries, reflecting their different operating environments and degrees of economic development. For country coverage, please refer to Appendix B.

### Public and Private

CM2.6 covers both privately held and publicly listed corporates.

### Primary Model Outputs

The model's primary output is a lower-case letter grade score. The score excludes any group or government support consideration, and is reported both on a standalone basis and subject to a transfer and convertibility risk capping.

In addition, each score is mapped to one-, three- and five year implied default rates using S&P Global Ratings observed historical default rates for the whole rated universe.

### Parental and Government Support Overlay

S&P Global Market Intelligence has developed a statistical overlay that uses quantifiable inputs to derive an assessment of the likelihood and extent of parental and governmental support (or burden) exerted on a company. A separate white paper describes more in detail the underlying methodology.<sup>2</sup>

<sup>1</sup> S&P Global Ratings does not contribute to or participate in the creation of credit scores generated by S&P Global Market Intelligence. Lowercase nomenclature is used to differentiate S&P Global Market Intelligence PD credit model scores from the credit ratings issued by S&P Global Ratings.

<sup>2</sup> Please, see S&P Global Market Intelligence's "Support Does Matter In Credit – Government related entities and parental support overlay" (2015) for more details.

## Pre-scored Database

We provide clients with access to estimates of creditworthiness for more than 48,000<sup>3</sup> non-financial corporations globally, spanning more than 10 years, based upon S&P Capital IQ's database of public and private company fundamentals.

## Sensitivity Analysis, Stress-Testing, Peer Comparison and Reporting

Consistent with all our scoring and PD models, clients can score any corporate company using their own financials, change financial data and other input factors for a 'what-if' analysis or even stress-test input factors.

Through its S&P Capital IQ platform, S&P Global Market Intelligence offers Desktop and Excel tools that cover both scoring and what-if analysis, as well as batch-scoring – where many corporate companies can be scored simultaneously for a single financial period, or one entity can be scored over multiple financial periods.

Surveillance dashboards allow the user to quickly compare creditworthiness and distribution of a portfolio of entities, covered by CM2.6 or any of our other models.

For every analysis, reports can be generated with a comprehensive summary analysis, directly from the S&P Capital IQ desktop or Excel templates, dynamically linking the analysis to PowerPoint via PresCenter™ to efficiently replicate credit memos or senior management presentations.

## Contribution Analysis

In addition to the sensitivity measures, clients can assess the “weight” or importance of contribution of a risk factor to the current credit score, through two contribution measures: the Absolute Contribution and the Relative Contribution.

The Absolute Contribution is obtained by first calculating the “Marginal Contribution”, i.e. the percentage change of the (numerical unrounded) credit score when among the actual inputs one variable at a time is set to its best possible value, thus effectively “removing” or “switching off” the effect due to that variable. Next, the Absolute Contribution of a variable can be simply expressed as marginal contribution of the variable divided by summation of all marginal contributions of all variables. Thus, Absolute Contributions of all input factors add to 100% and therefore provide a straightforward means to identify the main input(s) that drives a model output away from the best score (“aaa”). The higher the contribution value, the more the input “contributes” to the model output.

The Relative Contribution of a variable is obtained by first calculating the (numerical unrounded) score with all inputs set to their median values, and then the percentage change of the score when the corresponding variable is set to its actual value (all others remaining at their median values). As such, the Relative Contribution of a variable can be positive or negative, and gives an idea about the extent to which the corresponding input drives the model output away from the “median case” (when all inputs are set to their median values). The median values are based on the closest quarter for which financials are available, and include all pre-scored companies in the same industry and country, by default; users can alternatively opt to get country-level or industry-level medians.

## Imputation

It is desirable to have a model that can still provide an assessment when only partial information for a company is available. The imputation methodology for CM2.6 utilizes a Nearest Neighbor approach to identify companies with similar characteristics to the company

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<sup>3</sup> As of July 13<sup>th</sup>, 2016.

with missing inputs; then we run a regression to estimate the missing input from similar companies with complete financials. Once the missing inputs are estimated, along with non-missing variables, the CM2.6 output is calculated through the standard scoring framework. Please refer to the White Paper on Imputation for additional details.<sup>4</sup>

### **Integration with other S&P Global Market Intelligence Models**

CM2.6 can be used on a standalone basis to generate long-term credit scores, or in conjunction with other S&P Global Market Intelligence quantitative models, such as PD Model Market Signals, to establish a timely credit surveillance framework on publicly listed corporations. This allows for the detection of early warning signals when the market-driven view is diverging significantly from the fundamentally-driven view offered by CreditModel™ Corporates 2.6.

### **Financial Institutions Coverage**

CreditModel includes also a separate module to cater to the generation of credit scores of other characteristically low-default industries, such as Banks and Insurance Companies. These financial institutions are typically more difficult to model under a probability of default framework and accordingly a credit scoring framework can add significant value for these entities. Please refer to the CreditModel Financial Institutions whitepaper for additional details.<sup>5</sup>

## **A Tailored Framework for Developed, Emerging and Frontier Countries**

There are a number of structural problems that may increase the risk of investing, especially in emerging markets and frontier markets. For example:

- Uncertainty of a sovereign's intervention in the private sector's exchange of hard currency;
- A lack of information transparency when/if reporting company financials;
- International standards, such as those for accounting, are not always in use;
- The laws relevant for conducting business are inadequate (eg do not provide enough protection, or do not exist at all);
- There is a risk of political interference (eg nationalization of companies, expropriation of company assets, etc);
- Corruption-related risk could affect day-to-day operations;
- Income inequality;
- Labor quality (e.g., low education and skill levels).

All these risks can have a tremendous impact on the creditworthiness of companies, and are captured by appropriate Sovereign and Country Risk considerations in the Corporates rating framework adopted by S&P Global Ratings.

<sup>4</sup> Please, see S&P Global Market Intelligence's "Imputation of Missing Company Financial Ratios – Bridging the Gap of missing Financials to Estimate Credit Risk" (2015) for more details.

<sup>5</sup> Please, see S&P Global Market Intelligence's "CreditModel™ Financial Institutions – A State of the art scoring model for banks and insurance companies" (2016) for more details.

At S&P Global Market Intelligence, we have quantified these considerations into specific risk indicators that are included into CM2.6, to distinguish between developed, emerging and frontier markets. In the next sections, we will present our approach more in detail.

### Trained on S&P Global Ratings credit ratings and S&P Capital IQ Platform's Financial Data

We trained CM2.6 using more than 10 years of S&P Global Ratings' historical ratings for corporate companies. We used standalone credit profiles (SACP) where available, or stripped any group or parental support from the final rating if the standalone credit profile was unavailable, in order to obtain the credit profile of a company prior to any extraordinary support considerations. In total, we used more than 52,000 observations globally for corporates, that we complemented with internal standalone assessments generated for companies operating in emerging markets to enrich our training dataset. We collected all relevant financial items for the same companies, from the S&P Capital IQ Platform standardized fundamentals.

Table 1: Model Development Sample Region Summary

Region	Number of Observations for Corporates
North America	37,545
Europe	8,505
Asia Mature	467
Emerging Markets	1,110
Japan	4,013
Pacific	476
Airlines	251
<b>Total</b>	<b>52,367</b>

Source: S&P Global Market Intelligence. Data as of January 2012. For illustrative purposes only.

### Systemic Risk Data

As mentioned above, it is crucial to consider the environment in which a corporate company operates when constructing a global model. This is captured in credit ratings by S&P Global Ratings via the Corporate Industry and Country Risk Assessment (CICRA). A CICRA is a combination of *country risk* and *industry risk*.

Country risk refers to the risk associated with investing in a country, either by selling goods or by manufacturing goods, possibly with the establishment of a foreign subsidiary. It is a broad and general term that represents risks that linked to changes in the business environment that may adversely affect operating profits or the value of assets in a specific country. This type of risk affects all companies operating within a particular country and is a blend of monetary factors (e.g., currency control), political factors (e.g., civil war), and operating factors (e.g., corruption).

Analyzing country risk is particularly important for emerging markets because legal and regulatory systems can be underdeveloped and unpredictable. Laws and regulations are often poorly defined or are untested, may be enforced arbitrarily, and may be imposed to the detriment of investors. Furthermore, some emerging market countries may not respect the decisions of international arbitration courts. The level of education, technological

sophistication and its diffusion, and other socioeconomic variables that underpin the overall business environment are also important aspects to emerging market risk analysis.

For Country Risk, S&P Global Market Intelligence has developed a quantitative model that generates Country Risk Scores that closely align with S&P Global Ratings' assessments, and expands the coverage to 247 countries worldwide by establishing a "proxy mechanism" based on geographic proximity considerations, regional influences, independence (or not) of the central banks, the degree and evolution of a country's economic development and financial regulatory environment and its type of political system.<sup>6</sup>

CM2.6 uses these factors to help depict the characteristics of a country's corporates sector, its macroeconomic environment, and its degree of microeconomic development.

Industry risk is usually determined by elements such as barrier to entry, ease of conversion, level of competition, market fragmentation, etc. This is implicitly captured in CM2.6 by training industry-specific sub-models or adding dummy variables to reflect differences in specific industry sectors.<sup>7</sup>

### **Vigorous Variable Selection Process**

We calculated more than 100 alternative financial and non-financial items, in order to investigate the most predictive variables for modelling purposes. We applied a vigorous, cutting-edge procedure for the variable selection process that helps to prescreen what could be included as an input for the model. In order to select the final set of inputs and variables we used both statistical analysis and business judgment to weight the following considerations:

**Availability of Factors** – All factors included in the model must be widely available on a consistent basis over time for companies in each sector. Some factors have a high predictive power but are seldom reported by companies (e.g. some cash flow items of private corporates); while these factors may help boost a model's performance, such a model would be irrelevant for firms that do not report similar information.

**Correlation** – Highly correlated factors do not provide additional insights and could distort model performance. We use correlation analysis to identify and remove correlated variables.

**Representation of All Relevant Risk Dimensions** – In order to capture the variety of factors that influence the creditworthiness of corporates, we referred to the list of "risk dimensions" that S&P Global Ratings uses for the analysis of corporate firms, and classified each candidate variable into its corresponding risk dimension, using expert judgement. Then, we selected the variables that would comprise these risk dimensions from a range of categories, including financial information, as well as economic and industry-based risk indicators to ensure a proper balance of microeconomic and macroeconomic factors, similar to how a credit analyst would analyze a corporate company.

<sup>6</sup> Please, see S&P Global Market Intelligence's "Country Risk Score – Technical Reference Guide" (2016) for more details.

<sup>7</sup> Please, see S&P Global Market Intelligence's "Corporate Industry Risk Scores – technical reference guide (2015)"

Table 2: Risk Dimensions Covered for CreditModel 2.6 Corporates (Emerging Markets case)

Dimension	Corporate Factor
<b>Size</b>	Total Assets
	Total Equity
	Sales Growth
<b>Profitability</b>	Return on Capital
<b>Efficiency</b>	Asset Turnover
<b>Gearing</b>	Debt / Capital
<b>Liquidity</b>	Cash / Total Debt
	Current Ratio
<b>Debt Service Capacity</b>	EBITDA Interest Coverage
	EBIT Interest Coverage
<b>Risk of Doing Business</b>	Country Risk Scores

Source: S&P Global Market Intelligence (2012). For illustrative purposes.

Dummy Variables – We add pure dummy variables and extra features to the model, which help us control for:

- Potential differences in the explanatory power of factors in different industries, where relevant.
- Early warning signals such as low values of Debt / Capital.

### Regional and Sector Segmentation

In order to achieve optimal model performance and stability of the results, CM2.6 was trained using a regional/sector segmentation based on similarities of available financials and rating distributions, as well as taking into account data availability and other macroeconomic considerations. For example, the North America (NA) model was further split into 19 separately trained industry-sector sub-models. Conversely, Europe was trained with 10 sub-regions based on the ratings distribution but 19 industry-sector dummy variables. Finally, the airlines industry was treated as a separate, global model due to the globalized nature of this industry. More details can be found in the technical reference guide.<sup>8</sup>

<sup>8</sup> Please, see "CreditModel™ Corporates 2.6 – Technical Reference Guide" (2016).



Table 4: Sub-models within CreditModel 2.6

Regional Models	Industries
North America	19 industry-sector sub-models
Asia Mature	19 industry-sector sub-models
Pacific	19 industry-sector sub-models
Airlines	Airlines (Global)
Europe (10 regional submodels)	19 industry dummy variables
Japan	7 industry dummy variables
Emerging Markets	19 industry dummy variables

Source: S&P Global Market Intelligence (2012). For illustrative purposes.

### Sophisticated Methodology

Most of the models available in the market only employ simple logistic regression techniques. Our model employs an advanced generalization of the logistic regressions, based on the family of Exponential Density Functions. It uses the prior distribution of all S&P Global Ratings credit ratings in the training dataset as an “anchor distribution”, and modifies it in proportion to how much the financials of a specific company deviate from those of companies used in the anchor distribution. The process of variable selection considers both linear terms and terms of higher order, and selects the final variables according to k-fold Greedy Forward Approach, a widely-used statistical method that ensures a good fit out-of-sample and out-of-time.

The model uses a number of techniques, including variable transformations, which minimize the impact of extreme values. It also uses various constraints, which avoid risk of model over-fitting without any loss of data as well as a more accurate estimation of the parameters and final output.

The model maximizes the maximum likelihood function within a Maximum Expected Utility, adapted to a multi-state case (the rating categories, on which the model is trained, are not binary, but 18 in total), and uses the Akaike Information Criterion (AIC) to limit the maximum number of variables that are included (model parsimony). This optimization process ensures the model exhibits greater stability and out-of-time performance. Moreover, monotonicity constraints are applied to ensure that the model produces outputs that follow economic intuition.

### Sovereign Cap

Sovereign risk is defined as the risk of sovereign default on foreign-currency obligations. A transfer and convertibility (T&C) risk assessment reflects the likelihood of the sovereign restricting non-sovereign access to foreign exchange needed for debt service. For most countries, this risk is less than the risk of sovereign default on foreign-currency obligations; thus, most T&C assessments exceed the sovereign foreign currency rating. One of the most extreme cases is where a country uses a hard currency such as the U.S. dollar or the euro as its domestic currency when its sovereign is in financial distress. In such cases, the sovereign foreign currency rating can be low but the T&C assessment will be at a substantially better level because access to hard currency is broadly available in the country. For example, in February 2012 Greece defaulted on some of its debt obligations and had a ‘SD’ (selected default) status before it returned to a ‘CCC’ category,



indicating substantial vulnerability to default. However, its T&C assessment remained at the 'AAA' level because its domestic currency is the euro.<sup>9</sup>

S&P Global Ratings' foreign currency ratings of non-sovereign entities or transactions generally can be as high as the T&C assessment if their stress-tested operating and financial characteristics support the higher rating. This may be less the case for banks or other financial institutions that are intrinsically linked to their (main) sovereigns. But for non-financial corporates, which CreditModel Corporates 2.6 is designed for, this rule holds. Thus, it seems reasonable to consider the more relaxed T&C assessment of a country as the best achievable credit score for a company rather than the sovereign rating. The T&C assessment becomes particularly relevant for emerging and frontier markets, where T&C risk is usually higher than in developed countries.

Thus, we assume that a corporate credit score should not be better than the transfer and convertibility assessment of the country where the company is headquartered. We apply this assumption to CreditModel 2.6 outputs by capping the estimated score by the T&C Score prevailing at that moment.

S&P Global Market Intelligence uses the S&P Global Ratings' T&C assessments, for the countries covered by S&P Global Ratings, and extends the coverage globally, also to countries not covered by S&P Global Ratings, with a "proxy" mechanism that takes into account geographic proximity and a range of macroeconomic factors/considerations.<sup>10</sup>

## Sovereign Cap vs Country Risk

At first glance, it might seem possible to assume that the sovereign cap and CRS overlap. This is not the case, however, as they measure different risks. In particular, in emerging markets country risk is often delinked from the corresponding T&C risk. This is because certain countries may have high sovereign ratings (due to their high GDP growth rates, huge foreign reserves, etc.) but unfriendly business environments. China is a good example. It has a CRS of 'bb+' and a sovereign rating of 'AA-'. The 'AA-' sovereign rating mainly reflects exceptional growth prospects, a strong external asset position, and modest government indebtedness. However, China ranks in the middle range in terms of perceived corruption, protection of intellectual property, income inequality, human development, and overall ease of doing business, all of which contribute to a middle-range CRS, which is substantially below the sovereign rating and T&C assessment. This confirms the importance of keeping the two assessments separate and include both in CM2.6.

## Model Performance

CM2.6 was trained on actual S&P Global Ratings (prior to group or government support considerations) and outputs a score that statistically matches the rating by S&P Global Ratings. Thus, the model's performance can be best measured by looking at the Ratings agreement, as shown in table 5. Additional performance measures are available in the technical reference guide.<sup>11</sup>

<sup>9</sup> Note that a T&C assessment does not assess the likelihood of a country to stay in a monetary union or not.

<sup>10</sup> Further details can be found in S&P Global Market Intelligence's "Sovereign Risk Score Proxies" document. (2015).

<sup>11</sup> See S&P Global Market Intelligence's "CreditModel™ Corporates 2.6 – technical reference guide" (2016).

Table 5: CM2.6 Ratings Agreement (Model Development)<sup>12</sup>

Sub-Model	Exact Match	+1 Notch	+2 Notches	+3 Notches
North America	25.3%	64.9%	84.9%	93.4%
Europe	25.6%	66.2%	85.8%	94.2%
Japan	35.3%	75.0%	93.1%	97.7%
Pacific	26.3%	62.5%	83.0%	91.3%
Asia Mature	22.1%	58.3%	76.9%	89.5%
Emerging Markets	22.5%	61.8%	84.9%	93.0%
Airlines	25.4%	50.5%	75.8%	88.4%

Source: S&P Global Market Intelligence (2012). For illustrative purposes.

### Model Performance without and with capping

If we assume that a credit rating from S&P Global Ratings is generally understood and reflects an entity's creditworthiness, we can see how the sovereign cap via the T&C assessment helps to increase the accuracy of credit risk assessment in emerging markets. Table 6 shows that credit scores are most likely to be at the same level as a credit rating from S&P Global Ratings among low-rated companies (e.g., 'B' and below). With the sovereign cap, the performance of CM2.6, measured via a notch statistic, i.e. the difference in notches for each observation of the S&P Global Ratings public rating from the CM2.6 score, improves significantly for companies with lower credit grades, here shown for the 'BB' level, 'B' level and 'CCC' (or lower) level. The result shows the effectiveness of the sovereign cap on emerging markets because emerging market countries are more likely to have a lower T&C assessment than developed countries.

Table 6: CM2.6 Ratings Agreement: without and with sovereign cap

Rating Category	Without Sovereign Cap		With Sovereign Cap	
	Exact Match	+1 Notch	Exact Match	+1 Notch
<b>BB</b>	25%	67%	25%	69%
<b>B</b>	20%	59%	24%	66%
<b>CCC or below</b>	15%	47%	24%	51%

Source: S&P Global Market Intelligence (2012). For illustrative purposes.

## Case Study

Zoomlion Heavy Industry Science and Technology Co., Ltd., together with its subsidiaries, engages in the research, development, manufacture, and sale of equipment in the areas of agricultural, building, energy, environmental, and transport engineering in the People's Republic of China and internationally. The company was formerly known as Changsha Zoomlion Heavy Industry Science and Technology Development Co., Ltd. and changed its name to Zoomlion Heavy Industry Science and Technology Co., Ltd. in October 2011. Zoomlion Heavy Industry Science and Technology Co., Ltd. was founded in 1992 and is based in Changsha, the People's Republic of China.

<sup>12</sup> The time interval may be different for each region, depending on the data availability.

Figure 1 shows the evolution of the Stand-Alone Credit Profile (SACP) and the CM2.6 score in the period 2012-2016, i.e. since the company received an S&P Global Ratings credit rating and until now. The scores presented are derived from the credit factors corresponding to the fiscal year before each scoring period.

At first glance, CM2.6 scores on Zoomlion remain within 1 notch from the actual S&P Global Ratings credit rating, and this is expected due to the statistical nature of this quantitative model, that has a 60% ratings agreement within 1 notch over the whole universe of rated corporates.

According to the S&P Global Ratings, among the main company strengths until 2014 were the established market position and adequate liquidity, but its weaknesses laid in high revenue concentration in China (largely driven by the government's fixed-asset investments), declining profitability, worsening operating leverage and high exposure to political risks. Although the company maintained its strong domestic market position after 2014, the unfavorable economic environment linked to weak demand, intense competition, and Zoomlion's increased customer credit risks lead to a deterioration of the company's financial strength. As a result, its Issuer Credit Rating was downgraded several times since 2014, from BB+ to B+, with a further negative outlook.<sup>13</sup>

CM2.6 score closely aligns with S&P Global Ratings' assessment, showing a progressive deterioration linked to weakened financials. Specifically, EBIT Interest Coverage and EBITDA Interest Coverage constantly decreased from end of 2013 until end of 2015, while Sales Growth drastically falls into negative territory, reaching a minimum of -32% at the end of 2014, and remaining in negative territory at the end of 2015. Meanwhile, Return on Capital (negatively impacted by a deterioration of the working capital management) lowers from the peaks of 2012 (16%) to ca. 0% by the end of 2015. All these factors reflect Zoomlion's increased business and financial risks and are captured by the CM2.6 score, that closely reproduces or exactly matches S&P Global Ratings' issuer rating.

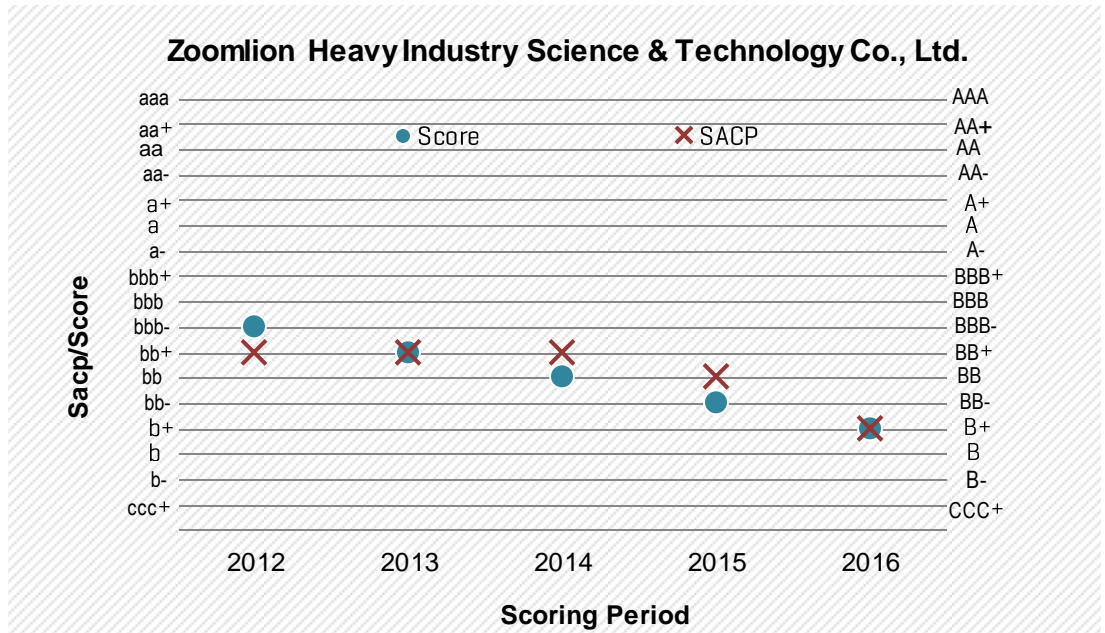
The attentive reader's eye may also notice that the behavior of the CM2.6 scores seems to anticipate the actual S&P Global Ratings credit rating. In principle, the "predictive" characteristics of CM2.6 may appear the result of mere statistical noise that usually accompanies any quantitative model. On the contrary, this allows us to highlight an additional and useful application of this scoring model.

A company rating is regularly reviewed, but changed only when an analyst assesses that financial risk, business risk, other qualitative elements and/or macroeconomic considerations have undergone a sustained and significant enough change to warrant an update of the company rating.<sup>14</sup> This process often entails the analysis of several years of company financials and translates in the well-known stability of ratings. CM2.6, on the contrary, uses only latest company financials and other quantifiable inputs for the generation of a credit score. Thus, CM2.6 usually presents similar, but higher volatility of outputs; in addition, whenever the company financials keep trending in a significant manner, CM2.6 score will show an anticipatory drift before a similar change is reflected in the credit rating by S&P Global Ratings, as in this case study.

<sup>13</sup> See S&P Global Ratings' "Research Update: Zoomlion and Notes Downgraded to 'B+' On Weak Recovery Prospects, Deteriorating Receivable Quality; Outlook Negative", available on [WWW.STANDARDANDPOORS.COM/RATINGSDIRECT](http://WWW.STANDARDANDPOORS.COM/RATINGSDIRECT) (April 2, 2015).

<sup>14</sup> The rating process includes also a Committee that ratifies the rating update.

Figure 1: Comparison Between S&P Global Ratings' Stand-Alone Credit Profile (SACP) and CM2.6 Score.



Source: S&P Global Market Intelligence. Data as of June 6, 2016. For illustrative purposes only.

### Annual Model Validation

Since the release of CM2.6 in 2013, S&P Global Market Intelligence has conducted a detailed performance evaluation annually, based on the actual performance data and provided the results of the validation to users. If a significant deterioration in model performance is observed, S&P Global Market Intelligence will consider a recalibration of the parameters or a review of the risk drivers.

Below we report the notch statistics, neutrality, and correlation coefficient of CM2.6 for previous validations, specifically for the universe of companies rated by S&P Global Ratings.

Table 7a: Model Performance of CM2.6 (2014 Validation)

2014 Validation	Exact Match	+1 Notch	+2 Notches	+3 Notches	Neutrality (Rating - Score)	Neutrality (Absolute Discrepancy)	Sample Size	Correlation Coefficient
North America (NA)	26%	67%	88%	95%	0.31	1.29	5,631	84.80%
Europe (EU)	20%	53%	78%	89%	0.58	1.68	1,564	75.36%
Japan (JP)	27%	69%	85%	95%	0.63	1.24	143	80.02%
Global Airlines (GA)	31%	55%	75%	94%	0.5	1.48	80	71.14%
Asia Mature (AM)	17%	53%	69%	80%	-1.19	2.17	295	47.55%
Pacific Area (PAC)	17%	54%	73%	83%	-0.06	1.86	181	68.93%
Emerging Markets (EM)	23%	61%	81%	92%	-0.8	1.49	995	81.55%
<b>Overall</b>	<b>24%</b>	<b>63%</b>	<b>84%</b>	<b>93%</b>	<b>0.18</b>	<b>1.42</b>	<b>8,889</b>	<b>81.94%</b>

Source: S&P Global Market Intelligence as of June 01, 2014

Table 7b: Model Performance of CM2.6 (2015 Validation)

2015 Validation	Exact Match	+1 Notch	+2 Notches	+3 Notches	Neutrality (Rating - Score)	Neutrality (Absolute Discrepancy)	Sample Size	Correlation Coefficient
North America (NA)	26%	65%	86%	95%	0.32	1.33	5,910	83.88%
Europe (EU)	18%	53%	79%	90%	0.62	1.67	1,964	77.69%
Japan (JP)	22%	64%	83%	92%	0.99	1.45	183	74.61%
Global Airlines (GA)	25%	52%	67%	83%	0.49	1.85	84	69.65%
Asia Mature (AM)	17%	54%	73%	82%	-0.94	2.02	308	62.03%
Pacific Area (PAC)	18%	51%	68%	80%	-0.35	1.95	252	61.33%
Emerging Markets (EM)	23%	58%	77%	86%	-1.18	1.7	1,055	77.01%
<b>Overall</b>	<b>23%</b>	<b>61%</b>	<b>83%</b>	<b>92%</b>	<b>0.17</b>	<b>1.48</b>	<b>9,756</b>	<b>80.47%</b>

Source: S&P Global Market Intelligence as of June 01, 2015

Table 7c: Model Performance of CM2.6 (2016 Validation)

2015 Validation	Exact Match	+1 Notch	+2 Notches	+3 Notches	Neutrality (Rating - Score)	Neutrality (Absolute Discrepancy)	Sample Size	Correlation Coefficient
North America (NA)	26%	65%	85%	94%	0.22	1.35	5685	84%
Europe (EU)	22%	56%	78%	88%	0.51	1.63	2237	78%
Japan (JP)	21%	63%	84%	93%	0.99	1.46	174	75%
Global Airlines (GA)	12%	40%	58%	76%	1.34	2.38	50	66%
Asia Mature (AM)	25%	59%	74%	80%	-0.90	1.85	303	64%
Pacific Area (PAC)	17%	52%	67%	82%	-0.38	2.00	263	64%
Emerging Markets (EM)	24%	56%	78%	87%	-1.12	1.68	1175	78%
<b>Overall</b>	<b>24%</b>	<b>61%</b>	<b>82%</b>	<b>91%</b>	<b>0.10</b>	<b>1.49</b>	<b>9887</b>	<b>81%</b>

Source: S&P Global Market Intelligence as of July 01, 2016.

More details can be found in the validation documents, available to users upon request.

## Conclusion

Credit risk assessment of large corporates is particularly challenging due to the inherent low default character of this asset class. This renders the development of a statistical model specializing in large corporates and based on default flags quite challenging, and forces risk managers to refer to the limited universe of ratings by main agencies or to leverage time-consuming scorecard approaches.

The need for reliable, quick and dependable risk analysis, however, is significant and growing in step with the fast pace of globalization: companies that originally operated in developed markets are now increasingly moving into emerging markets because they see the benefits of relatively cheap labor, growing population, loose regulation and rich resources. Conversely, more and more companies in emerging markets have started similar explorations into the developed world, yet the emerging market companies have far less knowledge about the characteristics of the markets they have started to integrate into.

CreditModel Corporates 2.6 is a unique statistical automated tool, trained on S&P Global Ratings, for assessing credit risk of corporate counterparties, globally; the model is calibrated to generate a quantitative output to broadly align with credit ratings from S&P Global Ratings, for the rated universe. In addition, the model achieves global coverage (200+ countries globally), via inclusion of tailored indicators/features, for developed, emerging and frontier markets. These features were designed to specifically address sovereign risk, Transfer and Convertibility risk, and country risk, making CM2.6 an easy, automated and cost-efficient scoring solution for global use by risk managers.

## APPENDIX A

CreditModel CORPORATES 2.6: Supported Industries except Japan (as of July 2016).

Industry Classification Code	Industry Classification Name	PICs <sup>15</sup> Classification Code	PICs Description
1	Aerospace & Defense	20101010	Aerospace & Defense
2	Airlines	20302010	Airlines
3	Automotive	25101010	Auto Parts & Equipment
		25101020	Tires & Rubber
		25102010	Automobile Manufacturers
		25102020	Motorcycle Manufacturers
4	Energy	10101010	Oil & Gas Drilling
		10101020	Oil & Gas Equipment & Services
		10102010	Integrated Oil & Gas
		10102020	Oil & Gas Exploration & Production
		10102030	Oil & Gas Refining & Marketing
		10102040	Oil & Gas Storage & Transportation
		10102050	Coal & Consumable Fuels
5	Information Technology	45101010	Internet Software & Services
		45102010	IT Consulting & Other Services
		45102020	Data Processing & Outsourced Services
		45103010	Application Software
		45103020	Systems Software
		45103030	Home Entertainment Software
		45201010	Networking Equipment
		45201020	Communications Equipment
		45202010	Computer Hardware
		45202020	Computer Storage & Peripherals
		45202030	Technology Hardware, Storage & Peripherals
		45203010	Electronic Equipment & Instruments
		45203015	Electronic Components
		45203020	Electronic Manufacturing Services

<sup>15</sup> PICs stand for Primary Industry Classifications, and is produced within the S&P Capital IQ platform.



Industry Classification Code	Industry Classification Name	PICs <sup>15</sup> Classification Code	PICs Description
		45203030	Technology Distributors
		45204010	Office Electronics
		45301010	Semiconductor Equipment
		45301020	Semiconductors
6	Hotel & Gaming	25301010	Casinos & Gaming
		25301020	Hotels, Resorts & Cruise Lines
		25301030	Leisure Facilities
		25301040	Restaurants
7	Capital Goods	20102010	Building Products
		20103010	Construction & Engineering
		20104010	Electrical Components & Equipment
		20104020	Heavy Electrical Equipment
		20105010	Industrial Conglomerates
		20106010	Construction Machinery & Heavy Trucks
		20106015	Agricultural & Farm Machinery
		20106020	Industrial Machinery
		20107010	Trading Companies & Distributors
8	Media	25401010	Advertising
		25401020	Broadcasting
		25401025	Cable & Satellite
		25401030	Movies & Entertainment
		25401040	Publishing
9	Healthcare	35101010	Health Care Equipment
		35101020	Health Care Supplies
		35102010	Health Care Distributors
		35102015	Health Care Services
		35102020	Health Care Facilities
		35102030	Managed Health Care
		35103010	Health Care Technology
10	Chemicals and Industrial Products	15101010	Commodity Chemicals
		15101020	Diversified Chemicals
		15101030	Fertilizers & Agricultural Chemicals
		15101040	Industrial Gases
		15101050	Specialty Chemicals

Industry Classification Code	Industry Classification Name	PICs <sup>15</sup> Classification Code	PICs Description
		15103010	Metal & Glass Containers
		15103020	Paper Packaging
11	Pharmaceuticals	35201010	Biotechnology
		35202010	Pharmaceuticals
		35203010	Life Sciences Tools & Services
12	Consumer Products (Non-Durable)	25203010	Apparel, Accessories & Luxury Goods
		25203020	Footwear
		25203030	Textiles
		30201010	Brewers
		30201020	Distillers & Vintners
		30201030	Soft Drinks
		30202010	Agricultural Products
		30202020	Meat Poultry & Fish
		30202030	Packaged Foods & Meats
		30203010	Tobacco
		30301010	Household Products
		30302010	Personal Products
13	Consumer Products (Other)	25201010	Consumer Electronics
		25201020	Home Furnishings
		25201030	Homebuilding
		25201040	Household Appliances
		25201050	Housewares & Specialties
		25202010	Leisure Products
		25202020	Photographic Products
14	Wholesale and Retail	25501010	Distributors
		25502010	Catalog Retail
		25502020	Internet & Direct Marketing Retail
		25503010	Department Stores
		25503020	General Merchandise Stores
		25504010	Apparel Retail
		25504020	Computer & Electronics Retail
		25504030	Home Improvement Retail
		25504040	Specialty Stores
		25504050	Automotive Retail
		25504060	Home furnishing Retail

Industry Classification Code	Industry Classification Name	PICs <sup>15</sup> Classification Code	PICs Description
		30101010	Drug Retail
		30101020	Food Distributors
		30101030	Food Retail
		30101040	Hypermarkets & Super Centers
15	Construction Materials + Forest Products	15102010	Construction Materials
		15105010	Forest Products
		15105020	Paper Products
16	Metals & Mining	15104010	Aluminum
		15104020	Diversified Metals & Mining
		15104025	Copper
		15104030	Gold
		15104040	Precious Metals & Minerals
		15104045	Silver
		15104050	Steel
17	Utilities	55101010	Electric Utilities
		55102010	Gas Utilities
		55103010	Multi-Utilities
		55104010	Water Utilities
		55105010	Independent Power Producers & Energy Traders
		55105020	Renewable Electricity
18	Telecoms	50101010	Alternative Carriers
		50101020	Integrated Telecommunication Services
		50102010	Wireless Telecommunication Services
19	Services for Businesses and Industries	20201010	Commercial Printing
		20201040	Human Resource & Employment Services
		20201050	Environmental & Facilities Services
		20201060	Office Services & Supplies
		20201070	Diversified Support Services
		20201080	Security & Alarm Services
		20202010	Human Resource & Employment Services

Industry Classification Code	Industry Classification Name	PICs <sup>15</sup> Classification Code	PICs Description
		20202020	Research & Consulting Services
		25302010	Education Services
		25302020	Specialized Consumer Services
20	Transport (ex Airlines)	20301010	Air Freight & Logistics
		20303010	Marine
		20304010	Railroads
		20304020	Trucking
		20305010	Airport Services
		20305020	Highways & Rail tracks
		20305030	Marine Ports & Services

CreditModel CORPORATES 2.6: Supported Industries – Japan (as of July 2016).

Industry Classification Code	Industry Classification Name	PICs Classification Code	PICs Description
25	Capital Intensive Manufacturing	10102010	Integrated Oil and Gas
		10102020	Oil and Gas Exploration and Production
		10102030	Oil and Gas Refining and Marketing
		15101010	Commodity Chemicals
		15101020	Diversified Chemicals
		15101030	Fertilizers and Agricultural Chemicals
		15101040	Industrial Gases
		15101050	Specialty Chemicals
		15102010	Construction Materials
		15103010	Metal & Glass Containers
		15104010	Aluminum
		15104020	Diversified Metals and Mining
		15104030	Gold
		15104040	Precious Metals and Mining
		15104045	Silver
		15104025	Copper
		15104050	Steel
		15105010	Forest Products

Industry Classification Code	Industry Classification Name	PICs Classification Code	PICs Description
		15105020	Paper Products
		20102010	Building Products
		20106010	Construction & Farm Machinery & Heavy Trucks
		25101010	Auto parts and Equipment
		25101020	Tires and Rubber
		25102010	Automobile Manufacturers
		25201050	Housewares and Specialties
26	Construction, Real Estate, and Warehousing	20103010	Construction and Engineering
		20303010	Marine
		20305030	Marine Ports and Services
		25201030	Homebuilding
		60102010	Diversified Real Estate Activities
		60102020	Real Estate Operating Companies
		60102030	Real Estate Development
		60102040	Real Estate Services
27	Consumer Products	20201010	Commercial Printing
		20201060	Office Services & Supplies
		25203010	Apparel, Accessories & Luxury Goods
		25203030	Textiles
		30201010	Brewers
		30201020	Distillers & Vintners
		30201030	Soft Drinks
		30202010	Agricultural Products
		30202030	Packaged Foods & Meats
		30203010	Tobacco
		30301010	Household Products
		30302010	Personal Products
		35202010	Pharmaceuticals
28	High Tech Manufacturing	25201010	Consumer Electronics
		25202010	Leisure Products
		25202020	Photographic Products
		35101010	Health Care Equipment
		45103020	Systems Software
		45103030	Home Entertainment

Industry Classification Code	Industry Classification Name	PICs Classification Code	PICs Description
			Software
		45201020	Communications Equipment
		45202010	Computer Hardware
		45202020	Computer Storage & Peripherals
		45202030	Technology Hardware, Storage & Peripherals
		45203010	Electronic Equipment & Instruments
		45203015	Electronic Components
		45203020	Electronic Manufacturing Services
		45204010	Office Electronics
		45301010	Semiconductor Equipment
		45301020	Semiconductors
		50102010	Wireless Telecommunication Services
29	Industrial Products	20104010	Electrical Components & Equipment
		20104020	Heavy Electrical Equipment
		20106015	Agricultural & Farm Machinery
		20106020	Industrial Machinery
		25201040	Household Appliances
30	Retail	25301030	Leisure Facilities
		25301040	Restaurants
		25501010	Distributors
		25503010	Department Stores
		25503020	General Merchandise Stores
		25504010	Apparel Retail
		25504020	Computer & Electronics Retail
		25504030	Home Improvement Retail
		25504040	Specialty Stores
		25504050	Automotive Retail
		30101010	Drug Retail
		30101030	Food Retail
		30101040	Hypermarkets & Super Centers
31	Distributors & Railroad	20107010	Trading Companies &

Industry Classification Code	Industry Classification Name	PICs Classification Code	PICs Description
	Companies		Distributors
		20304010	Railroads
		30101020	Food Distributors

## APPENDIX B

CreditModel CORPORATES 2.6: Global Coverage (as of July 2016).

Country	Country ISO Code	Currency ISO Code	Model Region
Afghanistan	AFG	AFN	EM
Åland Islands	ALA	EUR	EU
Albania	ALB	ALL	EU
Algeria	DZA	DZD	EM
American Samoa	ASM	USD	NA
Andorra	AND	EUR	EU
Angola	AGO	AOA	EM
Anguilla	AIA	XCD	EU
Antarctica (British Antarctic Territory)	ATA	GBP	EU
Antigua and Barbuda	ATG	XCD	EM
Argentina	ARG	ARS	EM
Armenia	ARM	AMD	EU
Aruba	ABW	AWG	EU
Australia	AUS	AUD	PAC
Austria	AUT	EUR	EU
Azerbaijan	AZE	AZN	EU
Bahamas	BHS	BSD	EM
Bahrain	BHR	BHD	EM
Bangladesh	BGD	BDT	EM
Barbados	BRB	BBD	EM
Belarus	BLR	BYR	EU
Belgium	BEL	EUR	EU
Belize	BLZ	BZD	EM
Benin	BEN	XOF	EM
Bermuda	BMU	BMD	EU
Bhutan	BTN	BTN	EM
Bolivia	BOL	BOB	EM
Bonaire, Sint Eustatius & Saba	BES	USD	EU
Bosnia & Herzegovina	BIH	BAM	EU
Botswana	BWA	BWP	EM



Brazil	BRA	BRL	EM
British Indian Ocean Territory	IOT	GBP	EU
British Virgin Islands	VGB	USD	EU
Brunei Darussalam	BRN	BND	EM
Bulgaria	BGR	BGN	EU
Burkina Faso	BFA	XOF	EM
Burundi	BDI	BIF	EM
Cambodia	KHM	KHR	EM
Cameroon	CMR	XAF	EM
Canada	CAN	CAD	NA
Cape Verde	CPV	CVE	EM
Cayman Islands	CYM	KYD	EM
Central African Republic	CAF	XAF	EM
Chad	TCD	XAF	EM
Chile	CHL	CLP	EM
China	CHN	CNY	EU
Christmas Island	CXR	AUD	PAC
Cocos (Keeling) Islands	CCK	AUD	PAC
Colombia	COL	COP	EM
Comoros	COM	KMF	EM
Congo Brazzaville	COG	XAF	EM
Cook Islands	COK	NDZ	EM
Costa Rica	CRI	CRC	EM
Côte d'Ivoire	CIV	XOF	EM
Croatia	HRV	HRK	EU
Cuba	CUB	CUC	EM
Curaçao	CUW	ANG	EM
Cyprus	CYP	EUR	EU
Czech Republic	CZE	CZK	EU
Democratic Republic of Congo	COD	CDF	EM
Denmark	DNK	DKK	EU
Djibouti	DJI	DJF	EM
Dominica	DMA	XCD	EM
Dominican Republic	DOM	DOP	EM
Ecuador	ECU	USD	EM
Egypt	EGY	EGP	EM
El Salvador	SLV	SVC	EM
Equatorial Guinea	GNQ	XAF	EM
Eritrea	ERI	ERN	EM
Estonia	EST	EUR	EU
Ethiopia	ETH	ETB	EM
Falkland Islands (Malvinas)	FLK	FKP	EU

Faroe Islands	FRO	DKK	EU
Fiji	FJI	FJD	EM
Finland	FIN	EUR	EU
France	FRA	EUR	EU
French Guiana	GUF	EUR	EU
French Polynesia	PYF	XPF	EU
Gabon	GAB	XAF	EM
Gambia	GMB	GMD	EM
Georgia	GEO	GEL	EU
Germany	DEU	EUR	EU
Ghana	GHA	GHS	EM
Gibraltar	GIB	GIP	EU
Greece	GRC	EUR	EU
Greenland	GRL	DKK	EU
Grenada	GRD	XCD	EM
Guadeloupe	GLP	EUR	EU
Guam	GUM	USD	NA
Guatemala	GTM	GTQ	EM
Guernsey	GGY	GGP	EU
Guinea	GIN	GNF	EM
Guinea-Bissau	GNB	XOF	EM
Guyana	GUY	GYD	EM
Haiti	HTI	HTG	EM
Heard Island & Mc Donald Islands	HMD	AUD	PAC
Honduras	HND	HNL	EM
Hong Kong	HKG	HKD	AM
Hungary	HUN	HUF	EU
Iceland	ISL	ISK	EU
India	IND	INR	EM
Indonesia	IDN	IDR	EM
Iran	IRN	IRR	EM
Iraq	IRQ	IQD	EM
Ireland	IRL	EUR	EU
Isle of Man	IMN	GBP	EU
Israel	ISR	ILS	EM
Italy	ITA	EUR	EU
Jamaica	JAM	JMD	EM
Japan	JPN	JPY	JPN
Jersey	JEY	JEP	EU
Jordan	JOR	JOD	EM
Kazakhstan	KAZ	KZT	EU
Kenya	KEN	KES	EM

Kiribati	KIR	AUD	EM
Kuwait	KWT	KWD	EM
Kyrgyzstan	KGZ	KGS	EU
Laos	LAO	LAK	EM
Latvia	LVA	LVL	EU
Lebanon	LBN	LBP	EM
Lesotho	LSO	LSL	EM
Liberia	LBR	LRD	EM
Libya	LYB	LYD	EM
Liechtenstein	LIE	CHF	EU
Lithuania	LTU	LTL	EU
Luxembourg	LUX	EUR	EU
Macau	MAC	MOP	EM
Macedonia	MKD	MKD	EU
Madagascar	MDG	MGA	EM
Malawi	MWI	MWK	EM
Malaysia	MYS	MYR	EM
Maldives	MDV	MVR	EM
Mali	MLI	XOF	EM
Malta	MLT	EUR	EU
Marshall Islands	MHL	USD	EM
Martinique	MTQ	EUR	EU
Mauritania	MRT	MRO	EM
Mauritius	MUS	MUR	EM
Mayotte	MYT	EUR	EU
Mexico	MEX	MXN	EM
Moldova	MDA	MDL	EU
Monaco	MCO	EUR	EU
Mongolia	MNG	MNT	EM
Montenegro	MNE	EUR	EU
Montserrat	MSR	XCD	EU
Morocco	MAR	MAD	EM
Mozambique	MOZ	MZN	EM
Myanmar	MMR	MMK	EM
Namibia	NAM	NAD	EM
Nauru	NRU	AUD	EM
Navassa Island	UMI	USD	NA
Nepal	NPL	NPR	EM
Netherlands	NLD	ANG	EU
New Caledonia	NCL	XPF	EU
New Zealand	NZL	NZD	PAC
Nicaragua	NIC	NIO	EM

Niger	NER	XOF	EM
Nigeria	NGA	NGN	EM
Niue	NIU	NZD	EM
Norfolk Island	NFK	AUD	PAC
North Korea	PRK	KPW	EM
Northern Mariana Islands	MNP	USD	NA
Norway	NOR	NOK	EU
Occupied Palestinian Territory	PSE	ILS	EM
Oman	OMN	OMR	EM
Pakistan	PAK	PKR	EM
Palau	PLW	USD	EM
Panama	PAN	PAB	EM
Papua New Guinea	PNG	PKG	EM
Paraguay	PRY	PYG	EM
Peru	PER	PEN	EM
Philippines	PHL	PHP	EM
Pitcairn Islands	PCN	NZD	EU
Poland	POL	PLN	EU
Portugal	PRT	EUR	EU
Puerto Rico	PRI	USD	NA
Qatar	QAT	QAR	EM
Réunion	REU	EUR	EU
Romania	ROU	RON	EU
Russia	RUS	RUB	EU
Rwanda	RWA	RWF	EM
Saint Barthélemy	BLM	EUR	EU
Saint Helena, Ascension & Tristan da Cunha	SHN	SHP	EU
Saint Kitts and Nevis	KNA	XCD	EM
Saint Lucia	LCA	XCD	EM
Saint Martin	MAF	EUR	EU
Saint Pierre & Miquelon	SPM	EUR	EU
Saint Vincent and the Grenadines	VCT	XCD	EM
Samoa	WSM	WST	EM
San Marino	SMR	EUR	EU
Sao Tome and Principe	STP	STD	EM
Saudi Arabia	SAU	SAR	EM
Senegal	SEN	XOF	EM
Serbia	SRB	RSD	EU
Seychelles	SYC	SCR	EM
Sierra Leone	SLE	SLL	EM
Singapore	SGP	SGD	AM

Sint Maarten	SXM	ANG	EU
Slovakia	SVK	EUR	EU
Slovenia	SVN	EUR	EU
Solomon Islands	SLB	SBD	EM
Somalia	SOM	SOS	EM
South Africa	ZAF	ZAR	EM
South Georgia & the South Sandwich Islands	SGS	GBP	EU
South Korea	KOR	KRW	AM
South Sudan	SSD	SSP	EM
Spain	ESP	EUR	EU
Sri Lanka	LKA	LKR	EM
Sudan	SDN	SDG	EM
Suriname	SUR	SRD	EM
Svalbard & Jan Mayen	SJM	NOK	EU
Swaziland	SWZ	SZL	EM
Sweden	SWE	SEK	EU
Switzerland	CHE	CHF	EU
Syria	SYR	SYP	EM
Taiwan	TWN	TWD	AM
Tajikistan	TJK	TJS	EU
Tanzania	TZA	TZS	EM
Thailand	THA	THB	EM
Timor-Leste	TLS	USD	EM
Togo	TGO	XOF	EM
Tokelau	TKL	NZD	PAC
Tonga	TON	TOP	EM
Trinidad and Tobago	TTO	TTD	EM
Tunisia	TUN	TND	EM
Turkey	TUR	TRY	EM
Turkmenistan	TKM	TMT	EU
Turks & Caicos Islands	TCA	USD	EU
Tuvalu	TUV	TVD	EM
Uganda	UGA	UGX	EM
Ukraine	UKR	UAH	EU
United Arab Emirates	ARE	AED	EM
United Kingdom	GBR	GBP	EU
United States	USA	USD	NA
United States Virgin Islands	VIR	USD	NA
Uruguay	URY	UYU	EM
Uzbekistan	UZB	UZS	EU
Vanuatu	VUT	VUV	EM

Vatican City	VAT	EUR	EU
Venezuela	VEN	VEF	EM
Vietnam	VNM	VND	EM
Wallis & Futuna	WLF	XPF	EU
Western Sahara	ESH	MAD	EM
Yemen	YEM	YER	EM
Zambia	ZMB	ZMW	EM
Zimbabwe	ZWE	ZWD	EM

## APPENDIX C

As a best practice, S&P Global Market Intelligence validates its models at a minimum annually, to ensure that they perform appropriately. We report below the aggregate results of the 2016 validation report of CM2.6, that show the model is satisfactory from a statistical point of view.<sup>16</sup>

CreditModel 2.6	Exact Match	Within 1 notch	Within 2 notches	Within 3 notches	Neutrality (Rating - Score)	Neutrality (Abs Discrepancy)	Sample Size	Correlation Coefficient	Neutrality (2 notches difference)	Sample Size (2-notch difference)
North America (NA)	26%	65%	85%	94%	0.22	1.35	5685	84%	-0.10	4829
Europe (EU)	22%	56%	78%	88%	0.51	1.63	2237	78%	-0.32	1750
Japan (JP)	21%	63%	84%	93%	0.99	1.46	174	75%	-0.63	147
Global Airlines (GA)	12%	40%	58%	76%	1.34	2.38	50	66%	0.69	29
Asia Mature (AM)	25%	59%	74%	80%	-0.90	1.85	303	64%	0.04	224
Pacific Area (PAC)	17%	52%	67%	82%	-0.38	2.00	263	64%	-0.07	175
Emerging Markets (EM)	24%	56%	78%	87%	-1.12	1.68	1175	78%	0.38	914
Overall	24%	61%	82%	91%	0.10	1.49	9887	81%	-0.10	8068

Source: S&P Global Market Intelligence CreditModel 2.6. Data as of 30 June 2016. For illustrative purposes only

For all submodels, except Global Airlines where the dataset is significantly smaller, we note that the 2016 performance is still similar to that of the previous year, or even better in some cases. This is in line with the statistical nature of the model, but also confirms the robustness of the out-of-time performance, because there is not a clear trend in deterioration. More detailed information can be found in the corresponding validation document.<sup>17</sup>

## About S&P Global Market Intelligence

At S&P Global Market Intelligence, we know that not all information is important—some of it is vital. Accurate, deep and insightful. We integrate financial and industry data, research and news into tools that help track performance, generate alpha, identify investment ideas, understand competitive and industry dynamics, perform valuation and assess credit risk. Investment professionals, government agencies, corporations and universities globally can gain the intelligence essential to making business and financial decisions with conviction.

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<sup>16</sup> Performance is considered satisfactory, if it meets at least one of the following criteria, for a dataset with at least 100 observations: Exact Match greater than 15%; Within 1 Notch greater than 55%; and Within 2 Notches greater than 75%. In general, higher notch statistics and lower neutralities are indicators of a better performance.

<sup>17</sup> See S&P Global Market Intelligence's "CreditModel™ Corporates 2.6 – Performance Validation Study (2016)" document.

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