S&P Global
Market Intelligence

CreditModel™ Financial Institutions

A State-of-the-Art Scoring Model for Banks and Insurance Companies

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Overview

Developing a statistical model to assess the credit risk of financial institutions is a formidable challenge mainly because:

- Financial institutions tend to be highly heterogeneous from a credit risk point of view
- The sector exhibits low default frequency
- The sector's default frequency is volatile over time

Therefore it is common belief that the assessment of credit risk for such companies can only be conducted using an expert-judgement framework, such as that employed by rating agencies, or a scorecard methodology that is usually inspired by and/or benchmarked with credit ratings.

Expert-judgement approaches are usually very successful in quantifying counterparty credit risk, but suffer from inherent operational limitations. Ratings tend to cover only a limited number of financial institutions; scorecards require a significant amount of time and resources for the generation of a single assessment and each counterparty needs to be assessed individually.

A statistical model, that combines the advantages of an expert-judgement approach driven by ratings with an automated engine, was not available up to now, but is highly desirable in order to:

- Assess the credit risk of financial institutions, expanding the universe of scored companies beyond what is normally covered by rating agencies and
- Accelerate and scale the credit assessment process

At S&P Global Market Intelligence, we have managed to bridge this gap by developing a cutting-edge statistical model that is trained on S&P Global Ratings and uses company financials, macroeconomic and industry-specific factors to generate a letter-grade credit score, for public and private banks and insurance companies, globally, representing a purely statistical view of the credit strength of a financial institution.[1]

Entity Coverage and Model Features

The model applies to "Banks" and "Insurers", (see Appendix A) as defined by S&P Global Market Intelligence's Primary Industry Classifications (PICs), including Diversified and Regional Banks, Thrift and Mortgage Finance, Life and Health Insurance companies, Multi-line Insurance companies, Property and Casualty Insurance companies, and Reinsurance companies. The model has been trained on S&P Global Ratings credit ratings, prior to group and government support considerations.

Since the majority of entities rated by S&P Global Ratings are large financial institutions, we recommend using CreditModel Financial Institutions to assess the credit risk of entities with total assets greater than $100M.

[1] S&P Global Ratings does not contribute to or participate in the creation of credit scores generated by S&P Global Market Intelligence.

Financial and Macroeconomic Factors

Our model utilizes both financial data from banks and insurance companies and the most relevant macroeconomic data for the banking and the insurance sectors, to generate a quantitative credit score that aims to statistically match S&P Global Ratings credit ratings.

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 banks and insurance companies around the globe. Our model covers country, industry and sovereign 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

Our model covers both privately held and publicly listed banks and insurance companies.

Primary Model Outputs

The model's primary output is a letter grade score, expressed in lower-case. The score is calculated prior to any group or government support consideration, and is reported on a standalone basis and subject to a sovereign 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 government support (or burden) exerted on a company. A separate white paper describes more in detail the underlying methodology.[2]

Pre-scored Database

We provide clients with access to estimates of creditworthiness for more than 5,000 banks and 1,000 insurers globally through time, spanning more than 10 years (when available).[3]

Sensitivity Analysis, Stress-Testing, Peer Comparison and Reporting

Consistent with all our scoring and PD models, clients can score any bank/insurance 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, where many banks/insurance 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 CreditModel Financial Institutions or any of our other models.

[2] See S&P Global Market Intelligence's "Quantitative parental support overlay (2015)" document, for the parental support methodology and S&P Global Market Intelligence's "Quantitative support overlay for Government-related entities (2015)" document, for extraordinary government support methodology.
[3] As of 1, July 2016. For illustrative purposes only.

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

Absolute Contribution

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 the Absolute Contribution (AC). The Absolute Contribution is obtained by first calculating the "Marginal Contribution" (MC), 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[4], thus effectively "removing" or "switching off" the effect due to that variable. Next, the Absolute Contribution (AC) 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 drive a model output. The higher the contribution value, the more the input "contributes" to the model output.

Imputation

It is always desirable to have a model that can still offer a prediction when only partial information of a company is provided. The imputation methodology for CreditModel Financial Institutions utilizes a Nearest Neighbor approach to identify companies with similar characteristics to the company with missing inputs; then we run a regression to estimate the missing input from similar companies with complete financials. Once the missing input is estimated, along with non-missing variables, CreditModel Financial Institutions output is calculated in its normal way for a company. Please refer to the White Paper on Imputation for additional details.[5]

Integration with other S&P Capital IQ Platform Models

CreditModel Financial Institutions 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 Financial Institutions, to establish a timely credit surveillance framework on publicly listed financial institutions. This allows for the detection of early warning signals when the market-driven view is diverging significantly from the long-term view offered by CreditModel.

Credit Risk Assessment for Banks and Insurers

A Tailored Framework

Although banks and insurance companies are often referred to as "financial institutions", their business models are quite different, and thus present specific risk profiles, that may have profound consequences for the stability of the financial system overall. This difference was clearly evidenced during the 2008 sub-prime mortgage crisis, when government interventions in the banking and insurance industry became necessary to avoid the melt-down of capital markets.

[4] The best possible values of each input variables are determined based on extensive analysis among the entire pre-scored database and additional expert judgement is applied to ensure economic sense is reflected.

[5] See S&P Global Market Intelligence's "Imputation of missing company financial ratios (2015)" document.

The core activity of banks is the collection of deposits and issuance of loans, in addition to a variety of fee-based services. Insurers tend to focus on risk pooling and risk transformation. The former provide leverage to the economy and are the main vehicles of transmission of central banks' monetary policies, while the latter provide consumers and businesses with protection against negative events.

Consequently the nature of common liabilities of banks, such as deposits, savings accounts and commercial paper, are short-term, thus bearing significant liquidity risks; in contrast, due to the long duration of liabilities of insurance companies, insurance books of business of global groups can be wound-up by regulatory authorities in an orderly manner. [1]

S&P Global Ratings uses a separate rating approach for banks and for insurance companies. [2,3] S&P Global Market Intelligence's CreditModel Financial Institutions takes such differences into account by splitting banks and insurance companies into two separate groups, including only the relevant risk drivers.

A Differentiated Model Development Process

Trained on S&P Global Ratings and Financial Data

We trained CreditModel Financial Institutions using more than 10 years of S&P Global Rating's historical ratings for banks and insurance companies, from 2001 and from 2005 respectively. 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 3300 observations globally for banks, that we complemented with additional 595 internal standalone assessments to enrich our training dataset for banks. In addition, we collected 1354 observations for Insurers globally. We collected all relevant financial items for the same companies, from S&P Global Market Intelligence's standardized fundamentals database.

Table 1: Model Development Sample Region Summary

Region	Number of Observations for Banks	Number of Observations for Insurance Companies
North America	580	532
EMEA	1490	394
Asia Pacific	744	277
Emerging Markets	1108	151
Total	**3922**	**1354**

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

Distinct Systemic Risk Data for Banks and Insurance Companies

As mentioned above, it is crucial to consider the environment in which a financial institution operates when constructing a global model.

S&P Global Ratings Banking Industry Country Risk Assessment (BICRA) score reflects the strengths and weaknesses of a country's banking industry within the context of its macroeconomic environment. A BICRA score is a combination of multiple factors reflecting a country's economy, financial regulatory infrastructure, and the credit culture of its banking industry. For Insurance Companies, S&P Global Ratings has developed Insurance Industry Country Risk Assessments (IICRA), that help capture risks specific to the insurance industry, such as return on equity, barriers to entry, product risk, market growth prospects and institutional framework, on top of the more widely shared country and economic risks. BICRA and IICRA scores are

made available by S&P Global Ratings for more than 80 countries, worldwide and are updated on a regular basis.

S&P Global Market Intelligence has extended coverage of S&P Global Ratings factors to all 247 countries, by conducting extensive research that includes comparing the geographic location of countries to pinpoint regional influences, independence (or not) of their central banks, the degree and evolution of a country's economic development and financial regulatory environment and its type of political system.

CreditModel Financial Institutions uses these factors to help depict the characteristics of a country's financial sector, its macroeconomic environment, and its degree of microeconomic development.

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 which helps to prescreen what could be included as 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 financial institutions, we referred to the list of "risk dimensions"[6] that S&P Global Ratings use for the analysis of financial institutions, 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 rating agency would analyze a bank or an insurance company. In addition to this, when possible, we tried to introduce appropriate *quantitative* proxies to cover those *qualitative* elements that rating agencies usually consider in their final assessment.

The S&P Global Market Intelligence tables below are all as of August 2016.

[6] Such as Business Position and Capital and Earnings.

Table 2a: Risk Dimensions Covered for Banks

Dimension	Banks Factor
Business Position	Total Assets
Capital and Earnings	EBT Interest Coverage
	Retained Earnings / Capital
	Tier 1 Ratio Capital Ratio
Funding and Liquidity	Loans / Deposits
	Common Equity / Total Assets
	Operating Cash Flow / Total Assets
	Deposits Growth
Risk Position	Net Operating Income after loan loss provisions / Revenues
	Loan Loss Provisions / Loans
Systemic risk factors	Banking Industry Country Risk Score
	Adjusted Consumer Price Index

Table 2b: Risk Dimensions Covered for Insurance Companies

Dimension	Insurance Companies Factor
Competitive Position	Total Assets
	Operating Expenses / Total Assets
	Net Income / Total Revenues
Capital and Earnings	Total Adjusted Common Equity / Total Adjusted Assets
	Retained Earnings / Capital
	Current Liabilities / Net Worth
Financial Flexibility	Debt / Capital
Funding and Liquidity	Operating Cash Flow / Total Assets
Systemic risk factors	Insurance Industry Country Risk Score

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

- Potential differences in the explanatory power of factors between private and public banks.
- Early warning signals such as low values for tier 1 capital as defined by the latest regulatory guidelines.

Table 3: Types of dummy variables

Dummy Type	Factors	Sector
Slope Dummy	Company Type (Private / Public) x Total Assets	Banks
	Nonperforming assets / Total Assets	Banks
	Retained Earnings / Capital	Banks
Pure Dummy	Property and Casualty Sector	Insurance
Extra Feature	Debt / Capital	Insurance
	Total Assets	Insurance
	Retained Earnings / Capital	Insurance

Entity Type, Regional and Sector Segmentation

In order to achieve optimal model performance and stability of the results, the model was separately trained for banks and insurance companies, and an additional regional segmentation was applied, looking at similarities of available financials and rating distributions, as well as taking into account other macroeconomic considerations.

Table 4a: Regional sub-models for Banks

Sub-Model	Region	Region
EU&NA	NA	North America
	EU	Europe
EM	EM	Emerging Markets
Other	AM	Asia Mature
	JPN	Japan
	PAC	Pacific

Table 4b: Regional sub-models for Insurers

Sub-Model	Region	Region
NA EU	NA	North America
	EU	Europe
Non NA EU	EM	Emerging Markets
	AM	Asia Mature
	JPN	Japan
	PAC	Pacific

Integration of Most Recent Regulatory Developments

It is imperative for a model to evolve with the market. So we have added to the model factors that have become the focus of attention following changes in the regulatory environment. An example is our use of the tier-1 capital ratio that is being leveraged to discriminate banks with a value less than 6.6%.

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 the case of multi-state ratings, 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

We assume that a financial institutions' rating should not be better than the sovereign country rating at the same time. We apply this assumption to our result by capping any estimated score by the Sovereign Risk Score prevailing at that moment. The sovereign risk score is the one belonging to the country where the firm is headquartered.

Sovereign foreign currency scores are used since local currency scores may underestimate the credit risk in the country. The sovereign foreign currency score is a current opinion of a country's overall capacity to meet its foreign currency-denominated financial obligations and is evaluated on the basis of the country's individual credit characteristics.

S&P Global Market Intelligence produces the Sovereign foreign currency scores, by applying S&P Global Ratings Sovereign foreign currency rating for the countries publicly rated by S&P Global Ratings and extending the coverage globally, also to sovereigns not covered by S&P Global Ratings, with a "proxy" mechanism that takes into account geographic proximity and a range of macroeconomic factors.

Model Performance

CreditModel Financial Institutions was trained on actual S&P Global Ratings credit ratings (prior to group or government support considerations) and outputs a score that aims to statistically match the rating by S&P Global Ratings. Thus, the model's performance can be best measured by looking at the Ratings agreement and other measures of (potential) model bias, both in-sample and out-of-sample, as shown in table 5 and Figure 1. The out-of-sample testing results are nicely aligned and comparable to the in-sample performance, confirming the robustness of the training process.

The S&P Global Market Intelligence tables below are all as of August 2016.

Table 5a: Banks

Panel A: In-Sample (2001-2012)

Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
EU & NA	22.08%	60.92%	84.21%	93.79%
EM	32.27%	77.75%	95.26%	98.56%
Other	33.00%	77.55%	94.62%	99.16%

Panel B: Out-of-Sample (2001-2012)

Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
EU & NA	21.50%	60.48%	84.01%	93.48%
EM	31.41%	77.53%	94.67%	98.38%
Other	31.99%	77.15%	93.28%	98.39%

Panel C: Out-of-Date (2013)

Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
EU & NA	19.44%	49.54%	75.00%	88.89%
EM	23.62%	66.14%	85.83%	95.28%
Other	29.69%	73.44%	93.75%	100.00%

Table 5b: Insurers

Panel A: In-Sample (2005-2012)

Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
NA EU	25.86%	63.31%	84.02%	91.90%
Non NA EU	33.06%	81.31%	95.85%	98.31%

Panel B: Out-of-Sample (2005-2012)

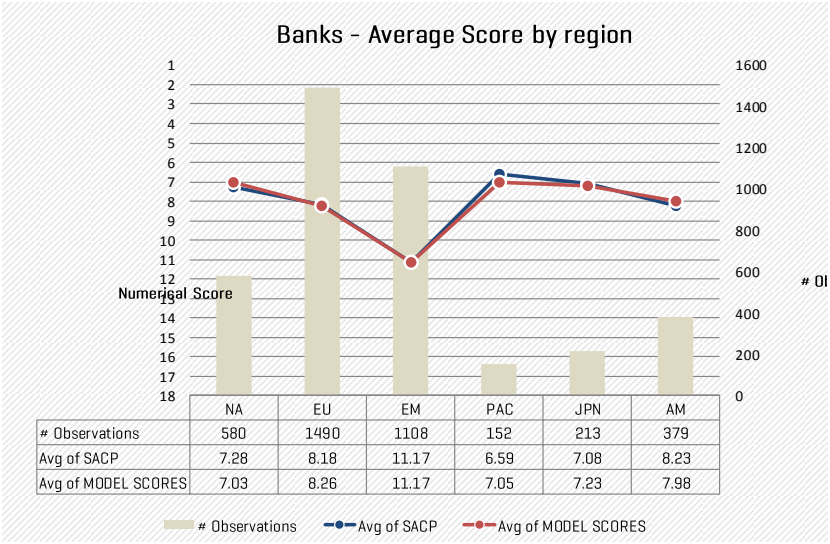
Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
NA EU	25.05%	61.33%	82.93%	91.25%
Non NA EU	30.37%	79.21%	94.39%	97.67%

Panel C: Out-of-Date (2013)

Sub-Model	Exact Match	+-1 Notch	+-2 Notches	+-3 Notches
NA EU	31.40%	74.38%	90.91%	96.69%
Non NA EU	22.22%	63.89%	80.56%	88.89%

The figures that follow show the consistency of the model performance by region as represented by the alignment with S&P Global Ratings credit ratings.[7]

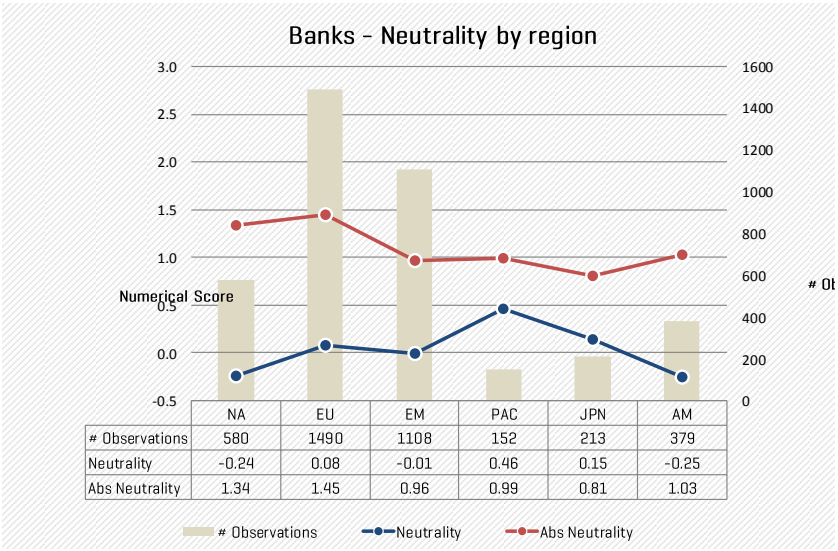
Figure 1: Banks Scores



	NA	EU	EM	PAC	JPN	AM
# Observations	580	1490	1108	152	213	379
Avg of SACP	7.28	8.18	11.17	6.59	7.08	8.23
Avg of MODEL SCORES	7.03	8.26	11.17	7.05	7.23	7.98

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

Figure 2: Banks Neutrality

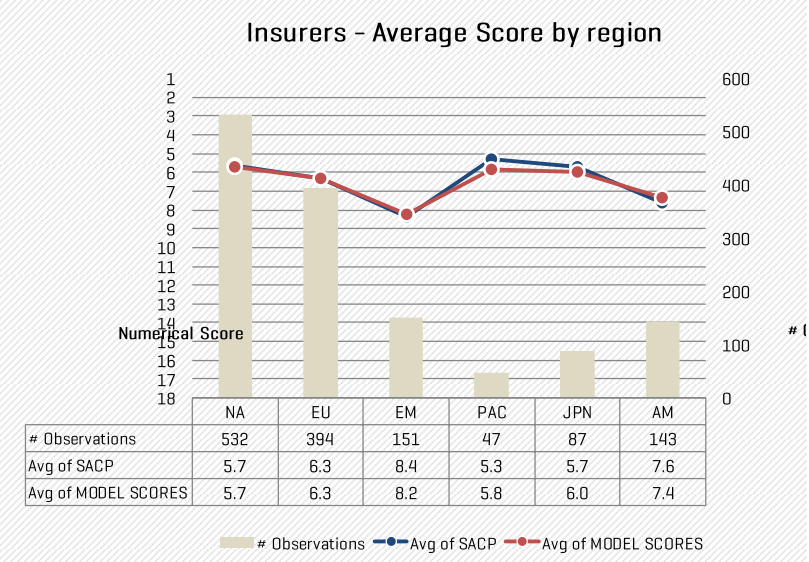


	NA	EU	EM	PAC	JPN	AM
# Observations	580	1490	1108	152	213	379
Neutrality	-0.24	0.08	-0.01	0.46	0.15	-0.25
Abs Neutrality	1.34	1.45	0.96	0.99	0.81	1.03

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

[7] 'Neutrality' measures the average of the score differences (model score – SACP), while 'absolute neutrality' measures the average of the absolute differences (|model score – SACP). SACP is an abbreviation for standalone credit profile.

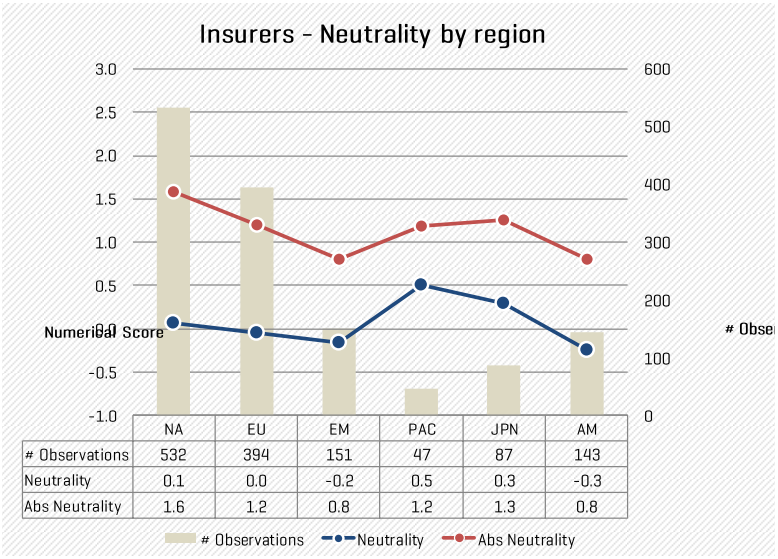
Figure 3: Insurers Scores



	NA	EU	EM	PAC	JPN	AM
# Observations	532	394	151	47	87	143
Avg of SACP	5.7	6.3	8.4	5.3	5.7	7.6
Avg of MODEL SCORES	5.7	6.3	8.2	5.8	6.0	7.4

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

Figure 4: Insurers Neutrality



	NA	EU	EM	PAC	JPN	AM
# Observations	532	394	151	47	87	143
Neutrality	0.1	0.0	-0.2	0.5	0.3	-0.3
Abs Neutrality	1.6	1.2	0.8	1.2	1.3	0.8

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

Case Studies

Banks

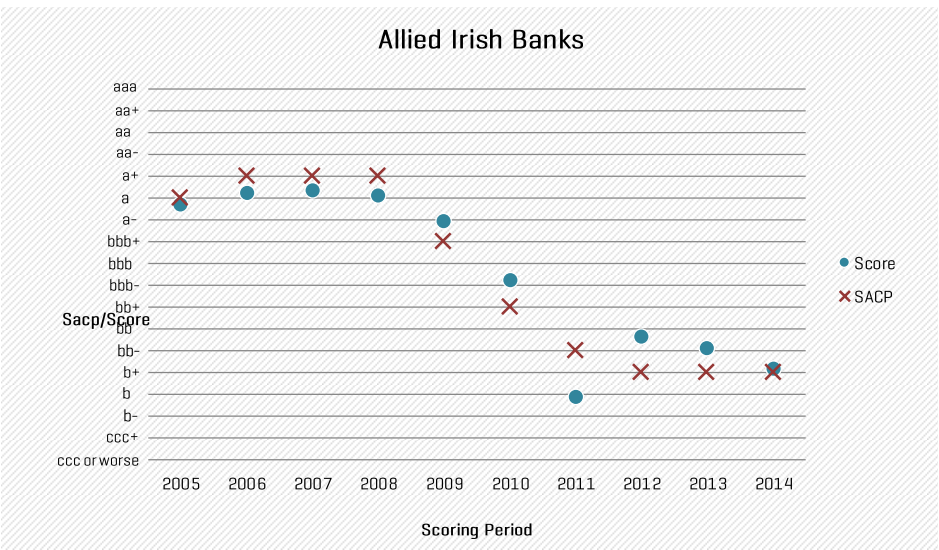
Allied Irish Banks, p.l.c. provides banking and financial products and services to personal, business, and corporate customers in the Republic of Ireland and the United Kingdom. It operates a network of 200 branches, 70 EBS outlets, and 16 business centers. Allied Irish Banks, p.l.c. was founded in 1825 and is headquartered in Dublin, Ireland. Allied Irish Banks was first rated by S&P Global Ratings in 1988.

Figure 5 shows the evolution of the Stand-Alone Credit Profile (SACP) and the CMFI score for the period 2005-2014. The scores presented are derived from the credit factors corresponding to the fiscal year before each scoring period. According to S&P

Global Ratings, among the main strengths of the company until 2008 are the high market share and its sound funding and liquidity levels. [8] On the other hand, the main weakness is the high exposure to property-related lending in both Ireland and the U.K. Although the company maintains its strong domestic market position after 2008, the unfavorable economic environment led to a weaker funding profile, weaker asset quality and low profitability. As a result, it was downgraded several times from 12 February 2009 until 2 February 2011 falling from an Issuer Credit Rating of A+ to BB. Its SACP has been even worse (b+) reflecting the government support for the issuer.

CMFI score closely follows the company's consecutive downgrades since it mainly reflects its weakened financials. Specifically, EBT Interest Coverage, Retained Earnings over Debt and Equity ratio constantly decrease from 2008 to 2011 and fall into negative levels beginning in the 2010 scoring period. Moreover, the Non-Performing Assets over Total Assets ratio increases to levels above 3.4% since the 2010 scoring period. The model score for the 2011 scoring period is significantly deteriorated by the decrease in the Tier 1 Capital Ratio to 4.3%, which is below the model's threshold of 6.6%, but it never differs by more than 2 notches vs. the corresponding S&P Global Ratings rating. Both Non-Performing Assets and Tier 1 credit indicator value changes "activate" the model's early warning signals. The reversal of the Tier 1 Capital Ratio, along with a significant increase of the Equity over Equity and Debt ratio, affects positively the CMFI score which is gradually perfectly aligned with the SACP during the period 2012-2014.

Figure 5: Banks Case Study



Source: S&P Global Market Intelligence. Data as of June 3, 2015. For illustrative purposes only.

Insurers

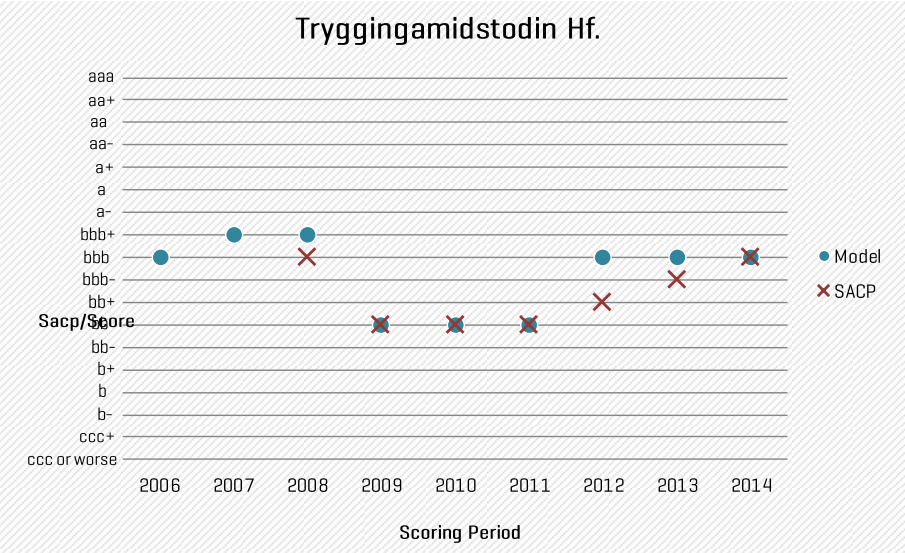
Tryggingamidstodin Hhf (TM) was established in Reykjavik, Iceland, in 1956 to provide non-life insurance to the fisheries sector. In 1998 it became the first listed insurer in Iceland. Today, TM, together with its subsidiaries, provides a range of insurance products and financial services to individuals and companies in Iceland. The company operates through Non-Life Insurance, Life Insurance, and Financial Operation segments. It offers life; marine, flight, and cargo; motor; general liability; accident and

[8] Refer to S&P Global Ratings Full Analysis reports found in https://www.capitaliq.com/CIQDotNet/GCPCompany/GCPTearsheet.aspx?leftlink=true&companyId=324875

health; and other insurance products. TM was first rated by S&P Global Ratings in early 2008 with 'bbb' (SACP - see figure below). One year later, in October 2009, TM was downgraded by three notches to 'bb' (SACP - junk category). TM's creditworthiness gradually improved until 2014, when it was finally rated with a standalone assessment of 'bbb', back to the investment grade category. [9] As we will show below, the model successfully predicted and even anticipated the ratings' movement despite the unusually high volatility of TM's standalone assessment.

TM's 'bbb' assessment in 2008 reflected its good capitalization and competitive position, offset by its marginal operating performance. In 2009, TM was downgraded to 'bb', in light of the filing for bankruptcy protection by its parent company (Stodir Hf) and exacerbated by TM's heavy losses reported in 2008; net income to the company plunged 500% to -17640 (million ISK) resulting in the collapse of the company's retained earnings to -279 (million ISK). CM FI provided a strong signal showing the deterioration of the company's creditworthiness, by scoring TM with 'bb' from a previous 'bbb+'. TM's model score remained stable at 'bb', well aligned with its standalone assessment, until 2012, when the company's model score improved significantly, largely due to TM's strengthening liquidity and capital profile. TM's improved operating performance also resulted in a gradual uplift of the company's standalone assessment, which finally converged with the model score ('bbb') in 2014. The figure that follows clearly shows that Credit Model FI anticipated the movement by S&P Global Ratings in the period between 2012 and 2014.

Figure 6: Insurers Case Study



Source: S&P Global Market Intelligence. Data as of June 3, 2015. For illustrative purposes only.

Conclusion

We developed a global scoring model for financial institutions (banks and insurance companies), utilizing a state-of-the-art statistical framework and trained on S&P Global Ratings credit ratings. Input factors are both financials, which are updated with the highest possible frequency, (i.e. up to every quarter as publicly listed companies report financials), plus a range of systemic risk factors that are regularly maintained and 100% tailored to each specific industry to account for country, sovereign,

[9] Refer to S&P Global Ratings Full Analysis reports found in https://www.capitaliq.com/CIQDotNet/GCPCompany/GCPTearsheet.aspx?leftlink=true&companyId=20376386

economic, and industry risks. The model generates scores that align with S&P Global Ratings credit ratings for the rated universe, prior to inclusion of group and government support, and thus exhibit the typical long-term and stable nature of their counterparts.

APPENDIX A

CreditModel Financial Institutions: Supported Industries (as of July 2016)

Industry	PICs[10] Code	Sub Industry
Banks	40101010	Diversified Banks
		Large, geographically diverse banks with a national footprint whose revenues are derived primarily from conventional banking operations, have significant business activity in retail banking and small and medium corporate lending, and provide a diverse range of financial services. Excludes banks classified in the Regional Banks and Thrifts & Mortgage Finance Sub-Industries. Also excludes investment banks classified in the Investment Banking & Brokerage Sub-Industry.
	40101015	Regional Banks
		Commercial banks whose businesses are derived primarily from conventional banking operations and have significant business activity in retail banking and small and medium corporate lending. Regional banks tend to operate in limited geographic regions. Excludes companies classified in the Diversified Banks and Thrifts & Mortgage Banks sub-industries. Also excludes investment banks classified in the Investment Banking & Brokerage Sub-Industry.
Thrifts & Mortgage Finance	40102010	Thrifts & Mortgage Finance
		Financial institutions providing mortgage and mortgage related services. These include financial institutions, whose assets are primarily mortgage related, savings & loans, mortgage lending institutions, building societies and companies providing insurance to mortgage banks.
Insurance Companies	40301020	Life and Health Insurance
		Companies providing primarily life, disability, indemnity or supplemental health insurance. Excludes managed care companies classified in the Managed Health Care Sub-Industry.
Thrifts & Mortgage Finance	40301030	Multi-line Insurance
		Insurance companies with diversified interests in life, health and property and casualty insurance.
Thrifts & Mortgage Finance	40301040	Property and Casualty Insurance
		Companies providing primarily property and casualty insurance.
Insurance Companies	40301050	Reinsurance
		Companies providing primarily reinsurance.

[10] PICs stands for Primary Industry Classifications, and is maintained on the S&P Market Intelligence's Capital IQ Platform.

APPENDIX B

CreditModel Financial Institutions: Global Coverage (as of July 2016)

Country	Country	Country	Country
Afghanistan	Dominica	Lithuania	Saint Martin
Åland Islands	Dominican Republic	Luxembourg	Saint Pierre & Miquelon
Albania	Ecuador	Macau	Saint Vincent & Grenadines
Algeria	Egypt	Macedonia	Samoa
American Samoa	El Salvador	Madagascar	San Marino
Andorra	Equatorial Guinea	Malawi	Sao Tome and Principe
Angola	Eritrea	Malaysia	Saudi Arabia
Anguilla	Estonia	Maldives	Senegal
Antarctica	Ethiopia	Mali	Serbia
Antigua & Barbuda	Falkland Islands	Malta	Seychelles
Argentina	Faroe Islands	Marshall Islands	Sierra Leone
Armenia	Fiji	Martinique	Singapore
Aruba	Finland	Mauritania	Sint Maarten
Australia	France	Mauritius	Slovakia
Austria	French Guiana	Mayotte	Slovenia
Azerbaijan	French Polynesia	Mexico	Solomon Islands
Bahamas	Gabon	Moldova	Somalia
Bahrain	Gambia	Monaco	South Africa
Bangladesh	Georgia	Mongolia	South Georgia & the South Sandwich Islands
Barbados	Germany	Montenegro	South Korea
Belarus	Ghana	Montserrat	South Sudan
Belgium	Gibraltar	Morocco	Spain
Belize	Greece	Mozambique	Sri Lanka
Benin	Greenland	Myanmar	Sudan
Bermuda	Grenada	Namibia	Suriname
Bhutan	Guadeloupe	Nauru	Svalbard & Jan Mayen
Bolivia	Guam	Navassa Island	Swaziland
Bonaire, Sint Eustatius & Saba	Guatemala	Nepal	Sweden
Bosnia-Herzegovina	Guernsey	Netherlands	Switzerland
Botswana	Guinea	New Caledonia	Syria
Brazil	Guinea-Bissau	New Zealand	Taiwan
British Indian Ocean Territory	Guyana	Nicaragua	Tajikistan
British Virgin Islands	Haiti	Niger	Tanzania
Brunei	Heard Island & Mc Donald Islands	Nigeria	Thailand
Bulgaria	Honduras	Niue	Timor-Leste
Burkina Faso	Hong Kong	Norfolk Island	Togo
Burundi	Hungary	North Korea	Tokelau
Cambodia	Iceland	Northern Mariana Islands	Tonga
Cameroon	India	Norway	Trinidad & Tobago
Canada	Indonesia	Oman	Tunisia

Cape Verde	Iran	Pakistan	Turkey
Cayman Islands	Iraq	Palau	Turkmenistan
Central African Republic	Ireland	Palestinian Authority	Turks & Caicos Islands
Chad	Isle of Man	Panama	Tuvalu
Channel Islands	Israel	Papua New Guinea	Uganda
Chile	Italy	Paraguay	Ukraine
China	Jamaica	Peru	United Arab Emirates
Christmas Island	Japan	Philippines	United Kingdom
Cocos (Keeling) Islands	Jersey	Pitcairn Islands	United States
Colombia	Jordan	Poland	United States Virgin Islands
Comoros	Kazakhstan	Portugal	Uruguay
Cook Islands	Kenya	Puerto Rico	Uzbekistan
Costa Rica	Kiribati	Qatar	Vanuatu
Côte d'Ivoire	Kuwait	Republic of the Congo	Vatican City
Croatia	Kyrgyzstan	Réunion	Venezuela
Cuba	Laos	Romania	Vietnam
Curaçao	Latvia	Russia	Wallis & Futuna
Cyprus	Lebanon	Rwanda	Western Sahara
Czech Republic	Lesotho	Saint Barthélemy	Yemen
Democratic Republic of the Congo	Liberia	Saint Helena, Ascension & Tristan da Cunha	Zambia
Denmark	Libya	Saint Kitts & Nevis	Zimbabwe
Djibouti	Liechtenstein	Saint Lucia	

APPENDIX C

Model Development Sample Region Summary

Region	# Observations	# Observations
	Banks	***Insurers***
AM	379	143
EM	1108	151
EU	1490	394
JPN	213	87
NA	580	532
PAC	152	47
Total	3922	1354

Source: S&P Global Market Intelligence. Data as of December 5, 2013. For illustrative purposes only.

References

[1] Raj Singh, “Risk Management – Setting a new course”, Swiss Re (presented at the European Commission, DG MARKT, 12 November 2010).

[2] Standard & Poor’s, “Banks: Quantitative Metrics for Rating Banks Globally: Methodology and Assumptions” (17 July 2013), available on the Global Credit Portal.

[3] Standard & Poor’s, “Insurers: Rating Methodology” (7 May 2013), available on the Global Credit Portal.

[4] S&P Capital IQ, “CreditModel – Financial Institutions” (May 2015), Technical Reference Guide

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