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STARMINE CREDIT RISK MODELS

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Structural Credit Risk Model

The StarMine Structural Credit Risk Model (SCR) is the first component of the StarMine Credit Risk Model suite. StarMine SCR evaluates the equity market's view of credit risk via StarMine's proprietary extension of the structural default prediction framework introduced by Robert Merton that models a company's equity as a call option on its assets.

In this framework, the probability of default (PD) equates to the probability that the option expires worthless. StarMine SCR produces daily updated estimates of the probability of default or bankruptcy within one year for 35,000 companies globally, including financials. The default probabilities are also mapped to letter ratings and ranked to create 1-100 percentile scores. Our analysis shows that StarMine SCR is considerably more accurate at predicting defaults than the Altman Z-Score or a basic Merton model, capturing 85% of default events within a 12-month horizon in its bottom quintile of scored companies. In addition to obvious uses for risk management and fixed income security selection, StarMine SCR can also be used to enhance equity selection performance.

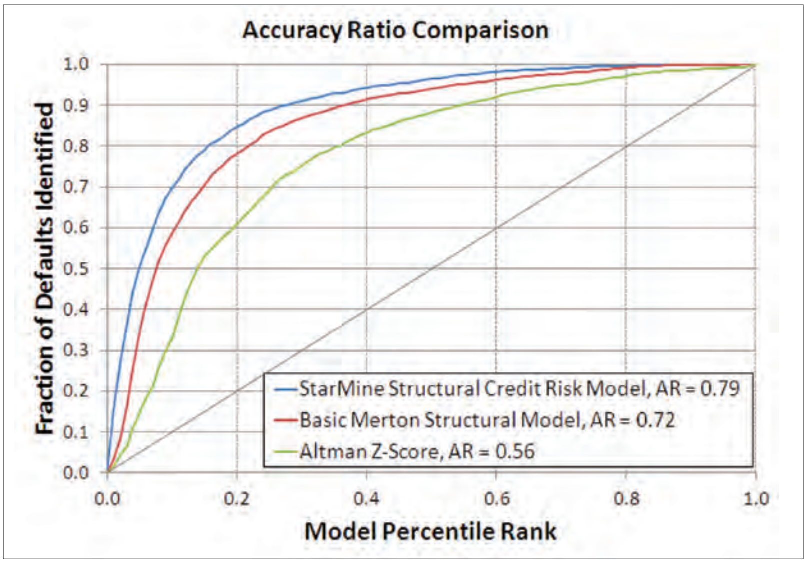

Figure 1. Default prediction comparison. StarMine SCR provides superior default prediction power.

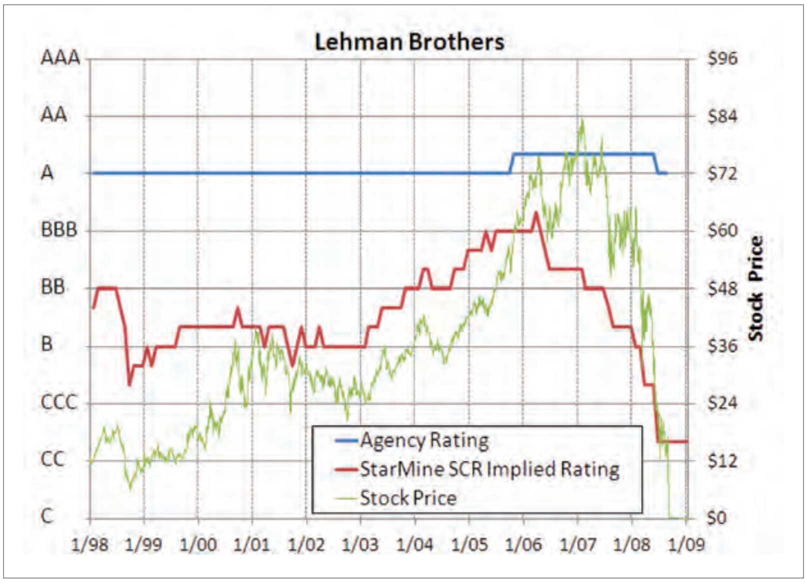

Figure 2. Performance on Lehman Brothers.

StarMine has improved three primary components of the Merton model framework based on quantitative analysis of historical data. The three components of StarMine SCR are:

1) A leverage component that compares the value of the company's assets to its liabilities. In general, the greater the liabilities relative to assets, the higher the default point and the more likely a default event.
2) An asset drift component that represents the non-random component of the change in asset value over time. The greater the asset drift rate, the farther the company moves away from default.
3) A volatility component that represents the volatility of the market value of the company's assets. The more volatile the company's assets, the more likely it is that the company's asset value will drop below the default point and the company slip into insolvency.

StarMine SCR provides a single output for each company rather than separate predictions for specific debt issuances. The model was trained to predict bankruptcies and debt service defaults, not including technical defaults.

MORE POWERFUL DEFAULT PREDICTIONS

StarMine SCR provides more accurate assessments of default risk than common alternatives, capturing 85% of defaulting firms in its bottom quintile of rated companies. Figure 1 compares the power of StarMine SCR in identifying corporate failures with other frameworks. An example of the model's timely response can be seen in the behavior of its evaluation of Lehman Brothers in Figure 2.

StarMine's research identified the drivers of the power of the structural model framework, which allowed them to enhance the traditional framework by:

- Leveraging StarMine's equity alpha model expertise by incorporating StarMine Val-Mo in the drift rate formulation
- Systematically optimizing the formulations for default point and volatility, for example, by employing different treatment of balance sheet liabilities for banks and insurance companies
- Creating a closed-form solution for the model equations, thereby eliminating erroneous outputs inherent in numerically solving the simultaneous non-linear equations used in most structural model frameworks

The result is a model that significantly outperforms competing formulations and ratings for use in:

- Credit risk management
- Cross-asset arbitrage strategies
- Equity and fixed-income investments

MAPPING STARMINE SCR TO LETTER RATINGS

Although the traditional credit ratings agencies have been the subject of much controversy and criticism in recent years, many investors are accustomed to the letter rating scales commonly employed by the rating agencies. For these users, we examined the historical distribution of agency ratings on a common universe of companies and mapped the StarMine SCR default probabilities to letter ratings such that the distribution of StarMine SCR ratings is consistent with the distribution of agency ratings.

IMPROVE EQUITY SELECTION PERFORMANCE

StarMine SCR can also add value in equity selection frameworks. By eliminating the riskiest 20% of companies identified by the StarMine SCR PD, one can significantly improve upon the risk-adjusted performance of even the most powerful quantitative multi-factor equity selection models. Figure 3 shows backtest results from applying a simple screen that requires the StarMine SCR PD to be less than 0.23% (eliminating approximately the bottom 20% of companies by StarMine SCR score) to a long-short (L-S) strategy based on StarMine's Value-Momentum (Val-Mo) model. The basic Val-Mo strategy goes long global non-micro cap stocks with top decile Val-Mo scores and short those with bottom decile scores. Adding the StarMine SCR screen to the portfolio improves the overall Sharpe ratio by 23%, from 1.96 to 2.4. The improvement is also quite consistent across years, not limited to severe bear markets or periods when one would expect risk-aversion measures to work well.

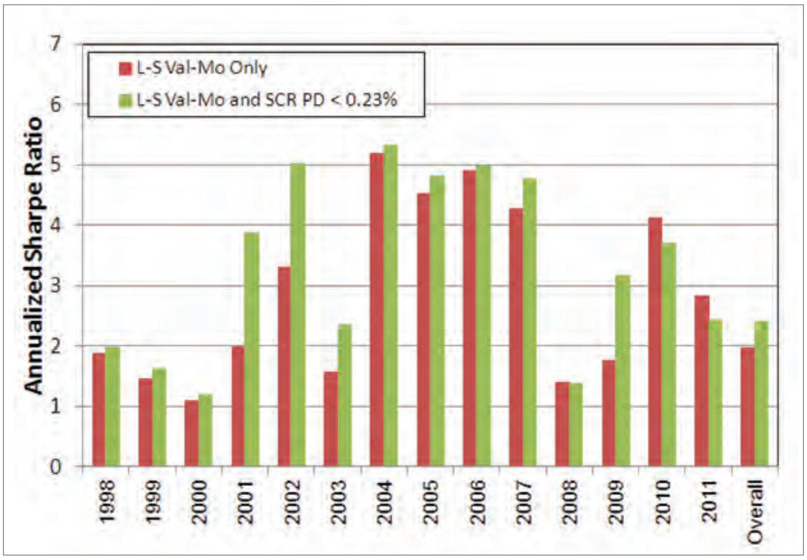

Figure 3. Sharpe ratio in an equity long-short strategy. StarMine SCR can add value in equity selection.

CONCLUSIONS

StarMine SCR leverages the framework of the Merton model and improves on the basic formulation by:

- Optimizing the formulations for asset value, default point, asset drift and volatility
- Eliminating erroneous outputs inherent when numerically solving simultaneous non-linear equations; StarMine SCR uses only closed-form calculations and does not depend on numerical solving
- Robustly handling corner conditions, missing values and special situations

StarMine SCR generates default probability estimates, letter ratings, 1-100 percentile rankings, and intermediate variables on over 35,000 global companies every day.

Smartratios Credit Risk Model

The StarMine SmartRatios Credit Risk Model is the second component of the StarMine Credit Risk Model suite. The SmartRatios Model is an intuitive and robust default prediction model that provides a view of a firm's credit condition and financial health by analyzing a wide array of accounting ratios that are predictive of credit risk. The model produces daily updated estimates of the probability of default or bankruptcy within one year for 35,000 companies globally, including Financials. The default probabilities are also mapped to traditional letter ratings and ranked to produce 1-100 percentile scores.

The SmartRatios model groups various accounting ratios, along with industry-specific metrics, into 5 components: Profitability, Liquidity, Leverage, Coverage and Growth, which are combined in a logistic regression framework. The final default probability is also a function of geographic region. The main advantages of the SmartRatios model over traditional accounting-based credit models include:

- Incorporating information from both reported actuals and forward-looking analyst estimates via StarMine's proprietary SmartEstimate
- Utilizing industry-specific metrics for companies in the Banking, Insurance, Utility, Retail, Airline and Oil & Gas industries
- Combining the accounting ratios in a weighting scheme that ensures the most important ratios for a given sector receive the most weight
- Handling outliers and missing data seamlessly and intelligently

As a result, the SmartRatios model significantly outperforms traditional accounting-based credit models on default prediction. In addition, it can provide incremental value in an equity investment strategy. Finally, it can also serve as a leading indicator of future changes in agency ratings when the SmartRatios rating and the agency rating differ significantly.

MORE POWERFUL DEFAULT PREDICTIONS

Our research shows that analyst estimates have significantly more explanatory power in predicting defaults than reported actuals alone. Figure 4 compares the default prediction power of common financial ratios built using FY1 SmartEstimates vs. the reported FY0 actuals.

On the model level, the SmartRatios model is more powerful than common alternatives such as the Altman Z-score and the Ohlson O-score. The model accurately predicts 80% of default events at the 20th percentile of model scores compared to 60% for the Altman Z-score and Ohlson O-score.

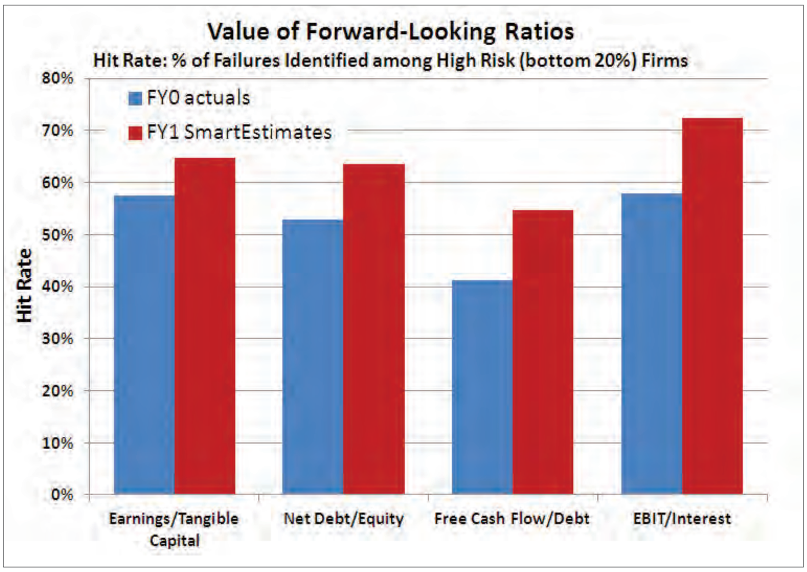

Figure 4. Value of SmartRatios in Default Prediction.

Figure 5 compares the power of the SmartRatios model in identifying corporate failures with other frameworks.

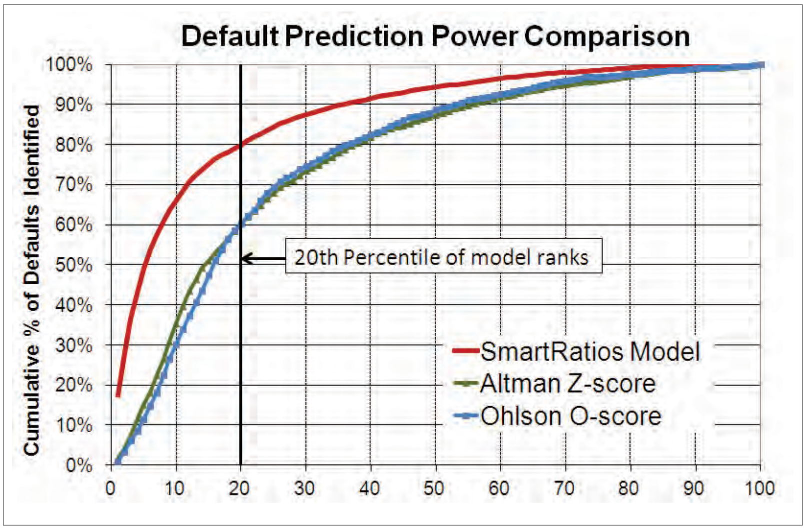

Figure 5. Default Prediction Power Comparison.

IMPROVE EQUITY SELECTION PERFORMANCE

The model can also add value in equity selection frameworks. Using the SmartRatios model as a simple screen to filter out risky securities significantly improves the risk-adjusted performance of even the most powerful quantitative multi-factor equity selection models. Figure 6 shows how the Sharpe ratio and return of a long-only portfolio based on StarMine's Value-Momentum (Val-Mo) model monotonically increase as we tighten the screen based on the SmartRatios model. The basic Val-Mo strategy goes long stocks in the top quintile of Val-Mo scores within the universe of Top 2000 stocks by market cap globally. By keeping only the stocks with PD less than 0.16% in the portfolio, we are able to improve the Sharpe ratio by ~20% and quintile return by ~20%. This demonstrates that the SmartRatios model can add value to a real-world equity investment strategy in a portfolio of large, tradable securities.

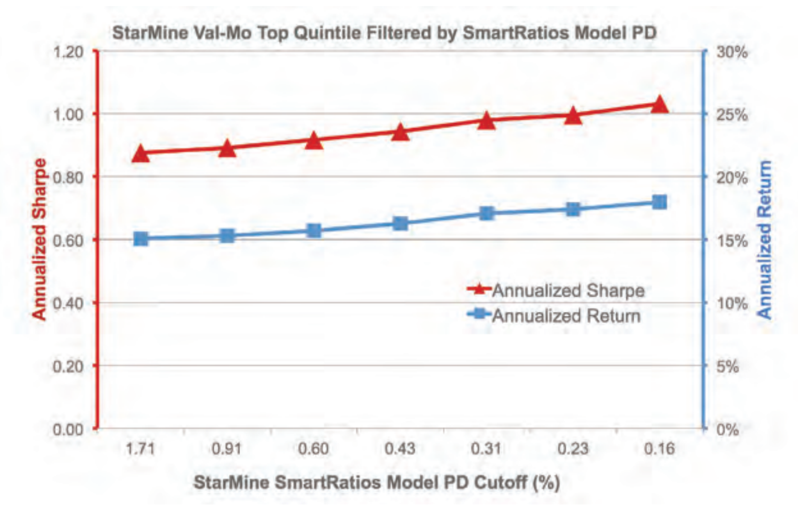

Figure 6. SmartRatios adds value in equity selection.

PREDICT CHANGES IN AGENCY RATING

To enable comparison to agency ratings and allow ease of use for those who are calibrated to letter grades, the SmartRatios PD is mapped to letter ratings by examining the historical distribution of agency ratings on a common universe of companies. We then mapped the StarMine SmartRatios default probabilities to letter ratings such that the distribution of SmartRatios ratings is consistent with the distribution of agency ratings. We found that when the SmartRatios rating differs significantly from the agency rating, the agency rating moves toward the SmartRatios rating at least 80% of the time that it moves. In other words, the agency ratings are 4-5 times as likely to move toward the SmartRatios rating as they are to move away from it. This finding is illustrated in Figure 7, which implies that the SmartRatios model can be used as a leading indicator of the future moves in agency ratings.

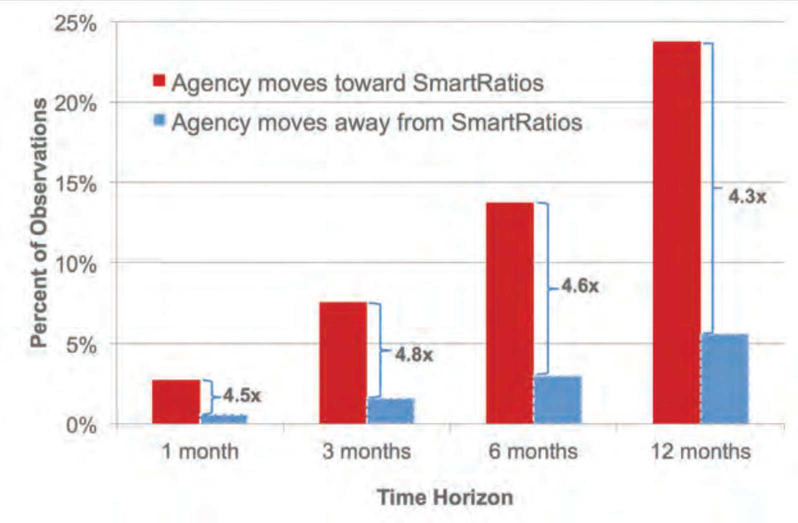

Figure 7. Direction of future changes in agency ratings when they differ significantly from SmartRatios ratings.

StarMine SmartRatios model generates default probability estimates, letter ratings, 1-100 percentile rankings, and component scores on over 35,000 global companies every day.

Text Mining Credit Risk Model

The StarMine Text Mining Credit Risk Model (TMCR) is a third addition to StarMine's ongoing work in credit risk modeling. StarMine TMCR assesses the risk in publically traded companies by systematically evaluating the language in Reuters News, StreetEvents conference call transcripts, corporate filings(10-K, 10-Q, and 8-K) and select broker research reports to predict which firms are likely to come under financial distress and which are likely to thrive.

StarMine TMCR is the only commercial credit risk model to measure corporate financial health by quantitatively analyzing text. Utilizing a wide range of textual documents allows StarMine TMCR to score 8,000 US securities and 15,000 securities outside the US. By scoring individual documents, StarMine TMCR will allow analysts to quickly identify the most important documents out of the potentially hundreds they may be responsible for reading. In addition, StarMine TMCR can provide quants with a quantitative measure of what had traditionally been qualitative data. Detailed analysis shows that StarMine TMCR accurately predicts 82% of default events within a 12-month horizon in its bottom quintile of scores and is a better predictor of defaults than the Altman Z-Score. The model can also generate alpha for investment managers and is an excellent complement to StarMine's other two credit risk models, the StarMine Structural Credit Risk Model and the StarMine SmartRatios Credit Risk Model.

OVERVIEW OF TEXT MINING APPROACH

At the core of StarMine TMCR is a classic "bag of words" text mining algorithm. A bag of words text mining algorithm breaks a document into its constituent words and phrases and establishes relationships between the frequencies of these words and phrases and a known training variable, such as observed defaults. In developing StarMine TMCR, StarMine scored each of hundreds of thousands of words and millions of phrases across more than ten years of history and millions of individual documents to determine proprietary dictionaries of words that are useful for robustly assessing company credit risk.

StarMine TMCR calculates the frequency of the key language in a document and then uses a learning algorithm to calculate an overall score for the document. Our approach also allows us to provide four "category" outputs – income statement related, balance sheet and debt structure related, legal obligations and terms, and external and market events – providing insight into the types of language that drives the StarMine TMCR score. StarMine TMCR aggregates the overall document scores by document source to generate our four company level component scores – Transcripts, News, Filings, and Broker Research – and then non-linearly combines the component scores to generate the overall StarMine TMCR Default Probability, 1-100 Rank, and Implied Rating.

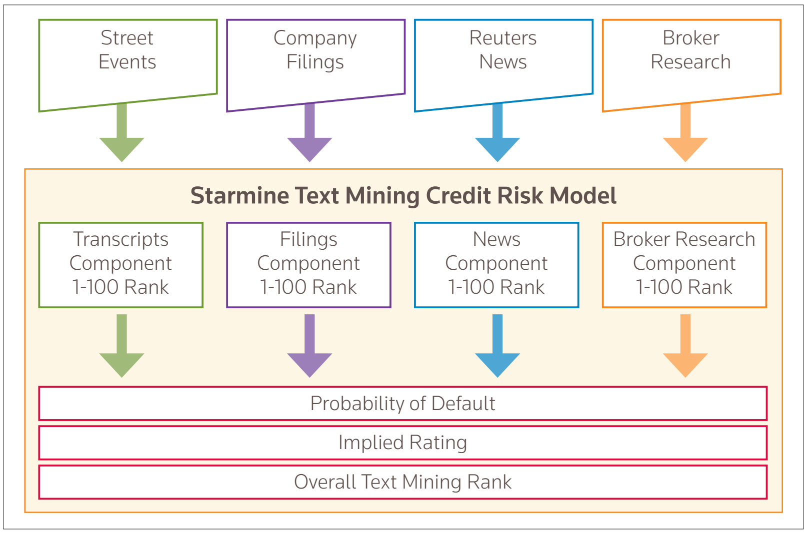

Figure 8. Construction of StarMine TMCR.

POWERFUL DEFAULT PREDICTIONS

We measure the accuracy of StarMine TMCR in predicting default and bankruptcy events and compare its accuracy to that of the widely-used Altman Z-Score in Figure 9. StarMine TMCR performs significantly better than the Altman Z-score, capturing 82% of default events in the bottom quintile of model scores versus 66% for the Altman Z-Score.

StarMine TMCR includes many adjustments and enhancements that improve its default prediction accuracy and alpha generating potential:

- Explicitly accounting for the presence or absence of crucial sections in 8-K documents
- Analyzing the text in the Management Discussion section of 10-K and 10-Q documents separately from the Notes to Financials section
- Removing broker research disclosure sections
- Eliminating machine generated news and machine generated broker research documents from our analysis
- Placing more weight on the News Component for companies with high news volume

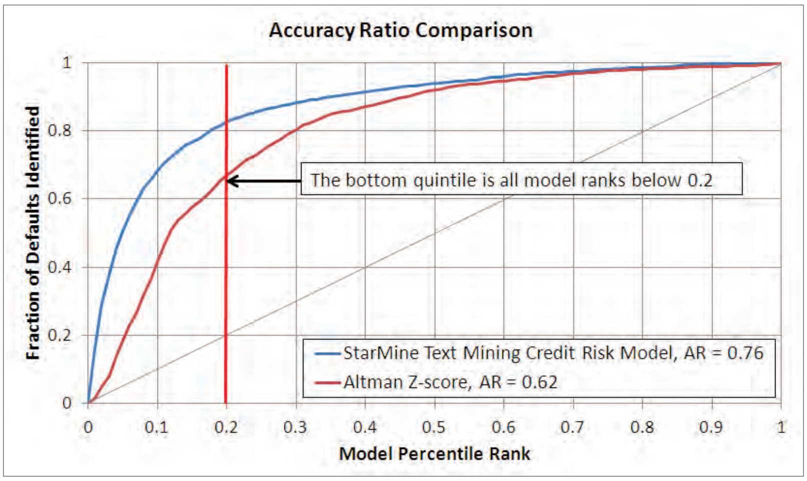

Figure 9. Default prediction comparison of StarMine TMCR and the Altman Z-score.

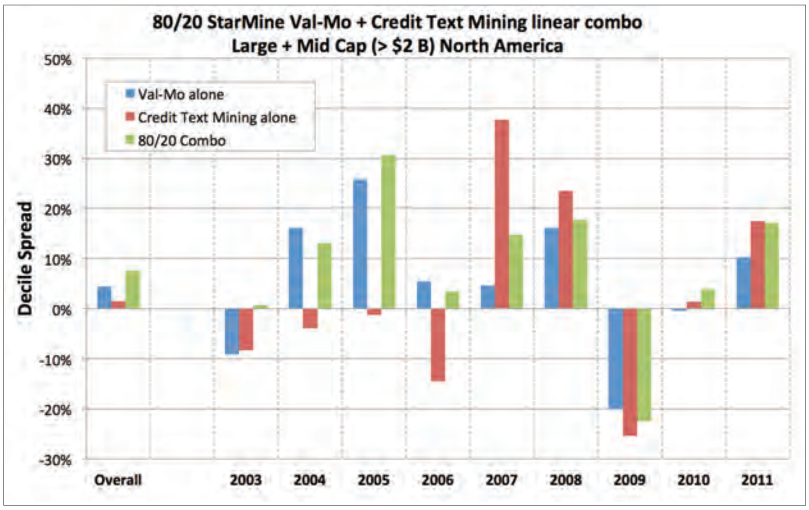

Figure 10. StarMine TMCR can add value to even the best multi-factor stock selection models.

MAPPING STARMINE TMCR TO LETTER RATINGS

Many investors are accustomed to the letter rating scales commonly employed by the rating agencies. For these users, we examined the historical distribution of agency ratings on a common universe of companies and mapped the StarMine TMCR default probabilities to letter ratings such that the distribution of StarMine TMCR ratings is consistent with the distribution of agency ratings.

GENERATE ALPHA IN EQUITY SELECTION

To assess the value of StarMine TMCR in equity selection, we tested if it could improve the performance of our best performing alpha model, StarMine Val-Mo, in a simple linear combination. Figure 10 displays the performance of an 80/20 linear combination of the StarMine Val-Mo score with the StarMine TMCR score. To make the test more relevant for investment managers, we restricted the test to large and mid-cap stocks in North America. This is also the universe for which we have the largest number of documents and therefore the most information for StarMine TMCR. We see that the overall annualized decile spread for StarMine Val-Mo alone was 4.4%. For the 80/20 Val-Mo + TMCR linear combo the decile spread increased to 7.6%, an improvement of 72% over StarMine Val-Mo alone. Also notable is that StarMine TMCR added value in every year since 2007 except for the risk rally of 2009.

CONCLUSIONS

StarMine TMCR employs a robust text mining framework utilizing powerful financial health-specific dictionaries to assess the credit risk in publically traded companies. The model analyzes over 900,000 documents to create daily estimates of default probability, letter ratings, and 1-100 percentile ranks on over 23,000 securities globally. StarMine TMCR allows analysts to quickly identify the most important documents for a company and gives quants a quantitative edge by systematically analyzing a large body of previously untapped qualitative data. Detailed analysis shows that StarMine TMCR is more accurate than the Altman Z-Score in predicting defaults and can also add value to powerful multi-factor stock selection models for even the most liquid and heavily followed securities.

Combined Credit Risk Model

The StarMine Combined Credit Risk Model (CCR) is StarMine's comprehensive estimate of credit risk at the company level that incorporates information from the StarMine Structural, SmartRatios, and Text Mining Credit Risk Models into one overall estimate of corporate credit risk. By incorporating information from multiple independent data sources – from the equity market, from analysis of financials, and from analysis of the language in important textual documents – StarMine CCR creates powerful default predictions and assessments of credit risk that are more accurate than using any one data source alone.

StarMine CCR is a valuable tool for financial professionals in the assessment of credit and counterparty risk, for fixed income security selection and valuation, and for equity selection. The model produces daily updated estimates of the probability of default or bankruptcy within one year for over 40,000 companies globally, including those in the financial sector. The default probabilities are also mapped to traditional letter ratings and ranked to produce 1-100 percentile scores.

StarMine CCR uses a logistic regression framework in which the weights allotted to the Text Mining model and the other two models are conditioned on the volume of text on a given company. The weight on the Text Mining model increases with increasing text volume. In this way CCR puts the most weight on the models that are most effective for a given company. StarMine CCR makes use of information from whichever of the three models is available for a given company, but requires only one to produce its final default probability estimate and score. The three model inputs to StarMine CCR are:

- StarMine Structural Credit Risk Model (SCR) evaluates the equity market's view of credit risk via StarMine's proprietary extension of the structural default prediction framework that models a company's equity as a call option on its assets.
- StarMine SmartRatios Credit Risk Model (SRCR) provides a view of a firm's financial health by analyzing a wide array of accounting ratios that are predictive of credit risk, and incorporates both reported information and forward-looking estimates via the StarMine SmartEstimate in its ratio analysis.
- StarMine Text Mining Credit Risk Model (TMCR) systematically assesses the language in Reuters news, StreetEvents conference call transcripts, corporate filings (10-K, 10-Q, and 8-K), and permissioned broker research reports to predict which firms are likely to come under financial distress and which are likely to thrive.

StarMine CCR also considers past changes in StarMine SCR, as our research revealed past changes in StarMine SCR to be predictive of future changes in credit risk. More information, including detailed white papers and historical testing files, is available for all three input models.

MORE POWERFUL DEFAULT PREDICTIONS

By incorporating information from multiple independent and complementary data sources via the three underlying StarMine credit risk models, StarMine CCR creates powerful default predictions that are more accurate than using any one alone. Figure 1 displays the default prediction performance as measured by the Accuracy Ratio of StarMine CCR along with that of its three input models over all companies and as a function of the text document volume used by StarMine TMCR. StarMine CCR's comprehensive view of credit risk is more powerful than any one of its input models.

Because data availability can vary considerably from one company to another, StarMine CCR makes use of any and all information available to it and employs a weighting scheme that ensures the most weight is given to the models most effective for a given company. The weighting scheme is a function of the total amount of textual data used by StarMine TMCR, as TMCR's performance is strongly dependent on the amount of information in the form of textual documents available to it, which can be seen in Figure 1. We see that TMCR's performance is nearly the best of the three input models on companies for which it has a high volume of text documents, which also tend to be the larger, more liquid and heavily followed companies that are of most interest to investment managers.

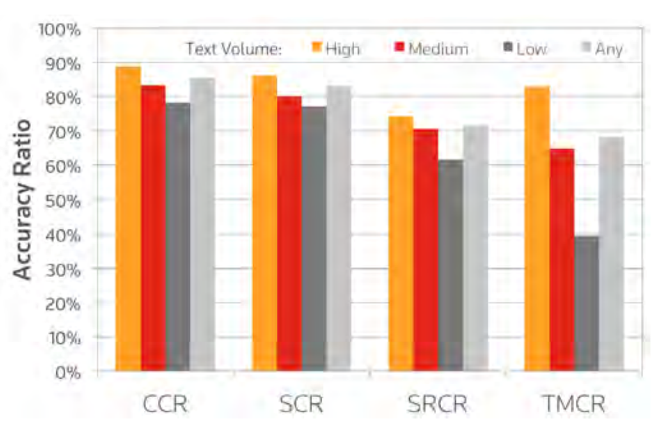

Figure 11. Default prediction power of StarMine CCR and its three input models overall and as a function of text document volume used by StarMine TMCR. Sample is comprised of all global companies scored by all four models from Jan 2002 to Dec 2010.

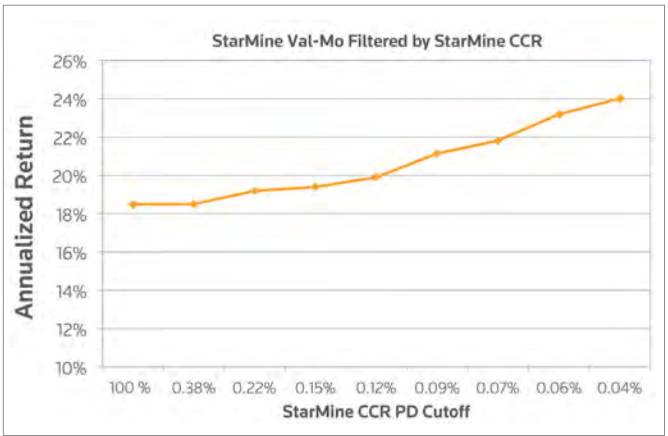

Figure 12. Using StarMine CCR to remove high risk companies from equity portfolios can improve annualized performance by 30%.

IMPROVE EQUITY PORTFOLIO PERFORMANCE

StarMine CCR can also add value for equity portfolios. We tested using the default probability (PD) from StarMine CCR in a long-only framework to screen out securities from portfolios created from the top quintile of our single most powerful alpha model, StarMine Val-Mo. We show the results of this test using the largest 3000 stocks globally over the Jan 1998 to May 2013 period in Figure 2. The leftmost point in Figure 2 represents the performance of the StarMine Val-Mo top quintile alone. As we move toward the right, a StarMine CCR screen is added to eliminate increasing numbers of risky companies from the portfolios. Each subsequent point eliminates about an additional 10% of the riskiest companies such that the rightmost points keep only the top ~20% of low risk companies that also have top quintile Val-Mo scores. We see that the annualized return increases as we tighten the screen based on StarMine CCR, from 18.5% with Val-Mo alone to 24% with Val-Mo plus CCR PD ≤ 0.04%. This demonstrates that StarMine CCR can add value to even the most powerful quantitative multi-factor equity selection model in a real-world equity investment strategy with a portfolio of large, tradable securities.

CONCLUSIONS

StarMine CCR provides StarMine's best estimate of credit risk at the company level for over 40,000 companies globally every day. It combines the information from the StarMine Structural, SmartRatios, and Text Mining Credit Risk Models into one comprehensive estimate of corporate credit risk that is more accurate than using any one data source alone. StarMine CCR is a valuable tool for financial professionals in the assessment of credit and counterparty risk, for fixed income security selection and valuation, and for equity selection.

StarMine Combined Credit Risk model generates default probability estimates, letter ratings, 1-100 percentile rankings, and component scores on over 40,000 global companies every day. The model output is available as a daily datafeed and in Thomson Reuters desktop products. Historical testing files are also available for those who wish to backtest the model. Contact your Thomson Reuters representative to determine the delivery option that works best for you.

QUESTIONS?

For more information including delivery options and historical files for backtesting, please contact your Thomson Reuters representative or StarMine Quantitative Consulting:
starmine.quantconsulting@thomsonreuters.com

THOMSON REUTERS STARMINE DEFAULT PROBABILITIES

Glossary of Terms

StarMine Structural Credit Risk Model

The StarMine Structural Credit Risk Model (SCR) estimates the probability that a company will go bankrupt or default on its debt obligations over the next 1-year period by assessing the equity market's view of credit risk. StarMine SCR is StarMine's proprietary extension of the Merton-based structural default prediction framework that models a company's equity as a call option on its assets. A company's equity volatility, market value of equity, and liability structure are used to infer a market value and volatility of assets.

The final default probability is equivalent to the probability that the market value of assets will fall below a default point, which is a function of the company's liabilities, within 1 year. The StarMine Structural Credit Risk Model improves upon the traditional structural model framework in numerous ways. For example, by leveraging StarMine's equity alpha model expertise and incorporating StarMine Val-Mo in the drift rate formulation, by employing a different treatment of balance sheet liabilities for banks and insurance companies, and by optimizing the formulation of volatility and default point.

CREDIT STRUCTURAL PD

The probability, as estimated by the StarMine Structural Credit Risk Model (SCR), that the company will go bankrupt, or default on its debt obligations, over the next 1-year period. StarMine SCR is StarMine's proprietary extension of the Merton-based structural default prediction framework that assesses the equity market's view of credit risk via an options theoretic approach.

CREDIT STRUCTURAL IMPLIED RATING

Letter rating created by mapping the default probability estimated by StarMine SCR to a letter grade.

CREDIT STRUCTURAL COMPONENT RANK

The global 1-100 percentile rank of a company's 1-year default probability based on the StarMine SCR model. Higher scores are given to companies with lower default probabilities.

CREDIT STRUCTURAL REGION RANK

The 1-100 percentile rank, among other firms in the same region, of a company's 1-year default probability based on the StarMine SCR model. Higher scores are given to companies with lower default probabilities.

Regional Ranks are assigned based on the universe of companies in their respective regions:

- Developed Asia
- Developed Europe
- Emerging Markets
- Japan
- North America

CREDIT STRUCTURAL COUNTRY RANK

The 1-100 percentile rank, by security country, of a company's 1-year default probability based on the StarMine SCR model. Higher scores are given to companies with lower default probabilities.

CREDIT STRUCTURAL SECTOR RANK

The 1-100 percentile rank, among other firms in the same region and 2-digit sector, of a company's 1-year default probability based on the StarMine SCR model. Higher scores are given to companies with lower default probabilities. **Refer to Table 1. Thomson Reuters Business Classification for the list of sectors.**

CREDIT STRUCTURAL INDUSTRY RANK

The 1-100 percentile rank, among other firms in the same region and 6-digit industry, of a company's 1-year default probability based on the StarMine SCR model. Higher scores are given to companies with lower default probabilities. **Refer to Table 1. Thomson Reuters Business Classification for the list of industries.**

CREDIT STRUCTURAL ASSET DRIFT

The non-random component of the change in asset value over time expressed as an annualized rate of change of the market value of the firm's assets. In general, the higher the asset drift, the less likely a default event.

CREDIT STRUCTURAL ASSET VOLATILITY

The annualized volatility of the market value of the firm's assets. In general, the more volatile the value of the company's assets, the more likely it is that the company's asset value will drop below the default point and the company slip into insolvency.

CREDIT STRUCTURAL ASSET LEVERAGE

A ratio that compares the value of a company's assets to its debt. Specifically, it is the ratio of the market value of the firm's debt to the market value of its assets. In general, the greater the leverage, the higher the default point and the more likely a default event.

StarMine SmartRatios Credit Risk Model

The StarMine SmartRatios Credit Risk Model estimates the probability that a company will go bankrupt or default on its debt obligations over the next 1-year period based on rigorous analysis of a company's financials. The SmartRatios model utilizes a wide array of accounting ratios in its assessment of credit risk and financial health. The accounting ratios are grouped into 5 key components: Profitability, Coverage, Leverage, Liquidity and Growth, which are combined in a logistic regression framework to produce the final default probability.

Wherever possible, the SmartRatios model makes use of forward-looking analyst estimates, via the StarMine SmartEstimate, in its accounting-ratio analysis, making its forecasts more accurate and timely than other formulations that rely exclusively on backward-looking reported financials. The SmartRatios model also accounts for regional differences in default rates and utilizes industry-specific metrics for banks, insurers, utilities, and other industries. In combining the components to produce the final default probability, it does so in a framework that ensures the most important ratios for a given sector receive the most weight.

CREDIT SMARTRATIOS PD

The estimated probability that the company will go bankrupt, or default on its debt obligations, over the next 1-year period based on the StarMine SmartRatios Credit Risk Model. The model provides a view of a firm's credit condition and financial health by analyzing a wide array of accounting ratios that are predictive of credit risk.

CREDIT SMARTRATIOS IMPLIED RATING

Letter rating created by mapping the default probability estimated by the StarMine SmartRatios Credit Risk Model to a letter grade.

CREDIT SMARTRATIOS GLOBAL RANK

The current global 1-100 percentile rank of a company's 1-year default probability based on the SmartRatios Credit Risk Model. Higher scores are given to companies with lower default probabilities.

CREDIT SMARTRATIOS REGION RANK

The current regional 1-100 percentile rank of a company's 1-year default probability based on the SmartRatios Credit Risk Model. Higher scores are given to companies with lower default probabilities.

Regional Ranks are assigned based on the universe of companies in their respective regions:

- Developed Asia
- Developed Europe
- Emerging Markets
- Japan
- North America

CREDIT SMARTRATIOS COUNTRY RANK

The current 1-100 percentile rank, by country, of a company's 1-year default probability based on the SmartRatios Credit Risk Model. Higher scores are given to companies with lower default probabilities.

CREDIT SMARTRATIOS SECTOR RANK

The current 1-100 percentile rank, among other firms in the same region and 2-digit sector, of a company's 1-year default probability based on the SmartRatios Credit Risk Model. Higher scores are given to companies with lower default probabilities. **Refer to Table 1. Thomson Reuters Business Classification for the list of sectors.**

CREDIT SMARTRATIOS INDUSTRY RANK

The current 1-100 percentile rank, among other firms in the same region and 6-digit industry, of a company's 1-year default probability based on the SmartRatios Credit Risk Model. Higher scores are given to companies with lower default probabilities. **Refer to Table 1. Thomson Reuters Business Classification for the list of industries.**

CREDIT SMARTRATIOS PROFITABILITY COMPONENT

The current 1-100 percentile rank percentile rank that reflects only the profitability factors of the SmartRatios Credit Risk Model. Higher scores are given to companies with higher profitability. Ratios utilized in this component include return on tangible capital, profit margin, unrealized losses to tangible capital, as well as industry specific metrics.

CREDIT SMARTRATIOS COVERAGE COMPONENT

A percentile rank that reflects only the coverage factors of the SmartRatios Credit Risk Model. Higher scores are given to companies with stronger (low risk) coverage ratios. Ratios utilized in this component include EBITDA/interest, EBIT/interest, free cash flow/debt, as well as industry specific metrics.

CREDIT SMARTRATIOS GROWTH COMPONENT

The global 1-100 percentile rank of the Growth component of the SmartRatios Credit Risk Model. Higher scores are given to companies with higher and more stable growth as measured by earnings, revenue, and profitability.

CREDIT SMARTRATIOS LEVERAGE COMPONENT

The global 1-100 percentile rank of the leverage component of the SmartRatios Credit Risk Model. Higher scores are given to companies with lower (low risk) leverage. Ratios utilized in this component include assets/equity, net debt/equity, unfunded pension liability to equity, as well as industry specific ratios.

CREDIT SMARTRATIOS LIQUIDITY COMPONENT

The global 1-100 percentile rank of the Liquidity component of the SmartRatios Credit Risk Model. Higher scores are given to companies with stronger (low risk) liquidity positions. Ratios utilized in this component include cash/debt, quick ratio, change in quick ratio, short-term debt/total debt, as well as industry specific ratios.

StarMine Text Mining Credit Risk Model

The StarMine Text Mining Credit Risk Model (TMCR) assesses the risk in publically traded companies by systematically evaluating the language in Reuters News, StreetEvents conference call transcripts, corporate filings (10-K, 10-Q, and 8-K) and select broker research reports to predict which firms are likely to come under financial distress and which are likely to thrive.

By scoring individual documents, StarMine TMCR allows analysts to quickly identify the most important documents out of the potentially hundreds they may be responsible for. In addition, StarMine TMCR provides users with a quantitative measure of what had traditionally been qualitative data. Detailed analysis shows that StarMine TMCR accurately predicts 82% of default events within a 12-month horizon in its bottom quintile of scores, is a better predictor of defaults than the Altman Z-Score and can also generate alpha for investors.

CREDIT TEXT MINING PD

The probability, according to the StarMine Text Mining Credit Risk Model, that the company will go bankrupt, or default on its debt obligations, over the next 1-year period. The Text Mining model systematically assesses the language in Reuters News, StreetEvents conference call transcripts, corporate filings (10-K, 10-Q, and 8-K) and broker research reports to predict which firms are likely to come under financial distress and which are likely to thrive.

CREDIT TEXT MINING IMPLIED RATING

Letter rating implied by the current estimated forward 1-year default probability from the StarMine Text Mining Credit Risk Model.

CREDIT TEXT MINING GLOBAL RANK

The current global 1-100 percentile rank of a company's 1-year default probability based on the Text Mining StarMine Credit Risk Model. Higher scores indicate companies that are less likely to go bankrupt, or default on their debt obligations, within the next 1-year period.

CREDIT TEXT MINING REGION RANK

The current 1-100 percentile rank, among other firms in the same region, of a company's 1-year default probability based on the StarMine Text Mining Credit Risk Model. Higher scores indicate companies that are less likely to go bankrupt, or default on their debt obligations, within the next 1-year period.

Regional Ranks are assigned based on the universe of companies in their respective regions:

- Developed Asia
- Developed Europe
- Emerging Markets
- Japan
- North America

CREDIT TEXT MINING COUNTRY RANK

The current 1-100 percentile rank, by country, of a company's 1-year default probability based on the StarMine Text Mining Credit Risk Model. Higher scores indicate companies that are less likely to go bankrupt, or default on their debt obligations, within the next 1-year period.

CREDIT TEXT MINING SECTOR RANK

The current 1-100 percentile rank, among other firms in the same region and TRBC Economic Sector, of a company's 1-year default probability based on the StarMine Text Mining Credit Risk Model. Higher scores indicate companies that are less likely to go bankrupt, or default on their debt obligations, within the next 1-year period. The TRBC Economic Sector is analogous to the GICS sector. **Refer to Table 1. Thomson Reuters Business Classification for the list of sectors.**

CREDIT TEXT MINING INDUSTRY RANK

The current 1-100 percentile rank, among other firms in the same region and TRBC Industry Group, of a company's 1-year default probability based on the StarMine Text Mining Credit Risk Model. Higher scores indicate companies that are less likely to go bankrupt, or default on their debt obligations, within the next 1-year period. The TRBC Industry Group is analogous to the GICS industry. **Refer to Table 1. Thomson Reuters Business Classification for the list of industries.**

CREDIT TEXT MINING BROKER RESEARCH COMPONENT

The current global 1-100 rank of a company's credit riskiness based on textual data in broker research documents according to the StarMine Text Mining Credit Risk model. Lower risk companies are given higher scores.

CREDIT TEXT MINING FILINGS COMPONENT

The current global 1-100 rank of a company's credit riskiness based on textual data in 10-K, 10-Q, and 8-K filings according to the StarMine Text Mining Credit Risk model. Lower risk companies are given higher scores.

CREDIT TEXT MINING NEWS COMPONENT

The current global 1-100 rank of a company's credit riskiness based on textual data in Reuters news articles according to the StarMine Text Mining Credit Risk Model. Lower risk companies are given higher scores.

CREDIT TEXT MINING TRANSCRIPTS COMPONENT

The current global 1-100 rank of a company's credit riskiness based on textual data in StreetEvents conference call transcripts according to the StarMine Text Mining Credit Risk Model. Lower risk companies are given higher scores.

TABLE 1. THOMSON REUTERS BUSINESS CLASSIFICATION

TRBC CODE	TRBC NAME	GROUPING
50	ENERGY	SECTOR
501010	COAL	INDUSTRY
501020	OIL & GAS	INDUSTRY
501030	OIL & GAS RELATED EQUIPMENT AND SERVICES	INDUSTRY
501040	RENEWABLE ENERGY	INDUSTRY
51	BASIC MATERIALS	SECTOR
511010	CHEMICALS	INDUSTRY
512010	METALS & MINING	INDUSTRY
512020	CONSTRUCTION MATERIALS	INDUSTRY
513010	PAPER & FOREST PRODUCTS	INDUSTRY
513020	CONTAINERS & PACKAGING	INDUSTRY
52	INDUSTRIALS	SECTOR
521010	AEROSPACE & DEFENSE	INDUSTRY
521020	MACHINERY	INDUSTRY
522010	CONSTRUCTION & ENGINEERING	INDUSTRY
522020	DIVERSIFIED TRADING & DISTRIBUTING	INDUSTRY
522030	COMMERCIAL SERVICES & SUPPLIES	INDUSTRY
523010	INDUSTRIAL CONGLOMERATES	INDUSTRY
524010	AIR FREIGHT & COURIER SERVICES	INDUSTRY
524020	AIRLINE SERVICES	INDUSTRY
524030	MARINE SERVICES	INDUSTRY
524040	TRANSPORTATION	INDUSTRY
53	CYCLICAL CONSUMER GOODS & SERVICES	SECTOR
531010	AUTOMOBILES & AUTO PARTS	INDUSTRY
532020	TEXTILES & APPAREL	INDUSTRY
532030	HOMEBUILDING & CONSTRUCTION SUPPLIES	INDUSTRY
532040	HOUSEHOLD GOODS	INDUSTRY
532050	LEISURE PRODUCTS	INDUSTRY
533010	HOTELS & ENTERTAINMENT SERVICES	INDUSTRY
533020	MEDIA & PUBLISHING	INDUSTRY
534020	DIVERSIFIED RETAIL	INDUSTRY
534030	SPECIALTY RETAILERS	INDUSTRY

TRBC CODE	TRBC NAME	GROUPING
54	NON-CYCLICAL CONSUMER GOODS & SERVICES	SECTOR
541010	BEVERAGES	INDUSTRY
541020	FOOD & TOBACCO	INDUSTRY
542010	PERSONAL & HOUSEHOLD PRODUCTS & SERVICES	INDUSTRY
543010	FOOD & DRUG RETAILING	INDUSTRY
55	FINANCIALS	SECTOR
551010	BANKING SERVICES	INDUSTRY
551020	INVESTMENT BANKING & INVESTMENT SERVICES	INDUSTRY
551030	DIVERSIFIED FINANCIAL SERVICES	INDUSTRY
553010	INSURANCE	INDUSTRY
554020	REAL ESTATE OPERATIONS	INDUSTRY
554030	RESIDENTIAL & COMMERCIAL REITS	INDUSTRY
555010	INVESTMENT TRUSTS	INDUSTRY
56	HEALTHCARE	SECTOR
561010	HEALTHCARE EQUIPMENT & SUPPLIES	INDUSTRY
561020	HEALTHCARE PROVIDERS & SERVICES	INDUSTRY
562010	PHARMACEUTICALS	INDUSTRY
562020	BIOTECHNOLOGY & MEDICAL RESEARCH	INDUSTRY
57	TECHNOLOGY	SECTOR
571010	SEMICONDUCTORS & SEMICONDUCTOR EQUIPMENT	INDUSTRY
571020	COMMUNICATIONS EQUIPMENT	INDUSTRY
571030	COMPUTERS & OFFICE EQUIPMENT	INDUSTRY
572010	SOFTWARE & IT SERVICES	INDUSTRY
58	TELECOMMUNICATIONS SERVICES	SECTOR
581010	TELECOMMUNICATIONS SERVICES	INDUSTRY
59	UTILITIES	SECTOR
591010	ELECTRIC UTILITIES	INDUSTRY
591020	NATURAL GAS UTILITIES	INDUSTRY
591030	WATER & OTHER UTILITIES	INDUSTRY
591040	MULTILINE UTILITIES	INDUSTRY

FOR MORE INFORMATION

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