Credit Risk Scoring - Basics

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Setting the Stage
Annual Corporate Default Rates have Risen
Forward-looking Default Risk is Going up in Many Industries

Median market-based default probability for US Industries

Source: Moody’s CreditEdge
Banks are Pulling Back on Credit

» For the first time since 2010 banks' increased their downgrades
» Upgrades at lowest level since 2010
Challenges in Credit Risk Management
What credit risk challenge(s) keeps you up at night?

- Data Quality & Availability
- Technology
- Unforeseen Issues
- Systematic Framework
- Different Approaches
- Comprehensive Assessment
- Organization Challenges or Changes
- Standardized Process
- Strong Model
- Global Risk
- Ongoing Monitoring
- Industry Challenges
Assessing Counterparty Credit Risk

Typical Analysis

1. Evaluate potential customer
2. Perform sector analysis
3. Determine credit score
4. Set credit limits and terms
5. Monitor exposures

Common Challenges

- Absence of a standardized process
- Insufficient data on public & private firms
- Lack of peer, industry and regional insight
- Ineffective risk monitoring system
Where are the risks associated with counterparties?
What are the consequences of credit risk?

- Bad Debt & Loss of Income
- Disruption to Supply Chain
- Miscalculation of Capital Reserves
- Unforeseen Damages
Key Requirements for an Effective Credit Risk Framework

» Consistency

» Efficiency

» Transparency

» Accuracy
## Challenges in Corporate Credit Risk Management

<table>
<thead>
<tr>
<th>Data Quality &amp; Availability</th>
<th>Standardized Processes</th>
<th>Credit Risk Models</th>
<th>Ongoing Monitoring</th>
<th>Other Risk Drivers</th>
</tr>
</thead>
<tbody>
<tr>
<td>What is the data quality?</td>
<td>How to minimize errors?</td>
<td>What are the most effective credit risk tools?</td>
<td>How to manage counter-party risk?</td>
<td>What other factors should be taken into consideration?</td>
</tr>
<tr>
<td>• Limited up to date data and ongoing availability</td>
<td>• Storing data in a single system of record for consistency</td>
<td>• Using the best model not just any model</td>
<td>• Early warning indicator of risk deteriorations</td>
<td>• Understand unexpected shifts that provide additional transparency</td>
</tr>
<tr>
<td>• Data captured at origination may not be complete for ongoing data analysis</td>
<td>• Improving operational controls by standardizing credit policies</td>
<td>• Improve credit decisions with accurate and predictive risk models</td>
<td>• Dashboard reports showing borrower risk migration</td>
<td>• Incorporate qualitative factors for a comprehensive analysis</td>
</tr>
<tr>
<td>• Data management is important for historical and forward looking analysis</td>
<td>• Setting up workflow processes to ensure systematic origination processes</td>
<td>• Leveraging risk models for underwriting and ongoing monitoring of counterparty risk</td>
<td>• Setting limits and pricing based on risk levels</td>
<td></td>
</tr>
</tbody>
</table>
What does a comprehensive credit risk model do?

It helps measure what you stand to lose with default and recovery risk measures.

$$EL = PD \times LGD \times EAD$$

which means:

When I lend you money, the amount of money I could potentially lose depends on three things...

- **Expected Loss**: $45K
- **Probability of Default**: 3%
- **Loss Given Default**: 30¢ on the dollar
- **Exposure at Default**: $5MM of the $10MM I originally lent you
Identifying a good credit risk model
Common types of credit risk models available

**Typical Analysis**
- Evaluate potential customer
- Perform sector analysis
- Ask for credit score
- Set credit limits and terms
- Monitor exposures

**Common Challenges**
- Absence of a standardized process
- Insufficient data on public & private firms
- Lack of peer, industry and regional insight
- Ineffective risk monitoring

**Counterparty Credit Risk Models**

- **Credit Agency Ratings (through the cycle)**
  - **PROS:**
    - thorough
    - widely understood
    - long track record
  - **CONS:**
    - lagging indicator
    - labor intensive
    - subjective
    - for rated firms

- **Financial statement-driven**
  - **PROS:**
    - transparent
    - consistent
    - intuitive
  - **CONS:**
    - backward looking
    - updated only with new statements

- **Market-driven (point in time)**
  - **PROS:**
    - forward looking
    - very reactive
    - very predictive
    - wide coverage
  - **CONS:**
    - volatile
    - requires external data

**PROS:**
- Forward looking
- Very reactive
- Very predictive
- Wide coverage

**CONS:**
- Volatile
- Requires external data

Lack of peer, industry and regional insight
A good counterparty credit risk solutions utilizes the best aspects of all available approaches.

**Typical Analysis**
- Evaluate potential customer
- Perform sector analysis
- Assess credit score
- Set credit limits and terms
- Monitor exposures

**Common Challenges**
- Lack of peer, industry and regional insight
- Ineffective risk monitoring
- Insufficient data on public & private firms
- Absence of a standardized process

**Counterparty Credit Risk Models**

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  - volatile
  - requires external data

**Underwrite with consistent and transparent model**

**Benchmark to third party metrics such as agency ratings**

**Monitor risk exposure with forward-looking market based metric**
Financial statement-based ratings offer a stable underwriting metric

Market-based model predicts default very well
Case Study: Sabine and Forest Oil merger

What we knew in 2014…

Sabine Oil and Gas
» Privately held (market-driven model won’t work)

Forest Oil
» Publically traded [NYSE:FST] (market-based model available)

Merger announced in May 2014
» New Company to be called “Sabine Oil & Gas Corporation”
» Traded under [NYSE: SABO]

Then…

Sabine Oil & Gas Corp files for bankruptcy in July 2015
Using RiskCalc econometric model and YE2013 financials we calculate Sabine has 8.46% default probability.

YE2014 financials show 11.32% default probability, implied rating in C category.

---

**SABINE OIL & GAS CORP** (Sector mining)

| Statement Date | 12/01/2013 |
| Current Date   | 03/01/2014 |
| EDF Mode       | FSO        |

**EDF**

<table>
<thead>
<tr>
<th>1-Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected Default Frequency (EDF)</td>
</tr>
<tr>
<td>Bond Default Rate Mapping</td>
</tr>
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</table>

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</tbody>
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---

**Credit Opinion: Sabine Oil & Gas LLC**

Global Credit Research - 13 May 2014

*Houston, Texas, United States*

**Ratings**

- **Moody's Rating**: *B3*
- **Corporate Family Rating**: *Caa1/LGD4*
- **Sr Sec Bank Credit Facility**: *Caa2/LGD6*
- **Senior Unsecured**: Speculative Grade Liquidity
- **Speculative Grade Liquidity**: SGL-3

*Placed under review for possible upgrade on May 6, 2014

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Source: RiskCalc and Moody's.com
Forest Oil's market-based model has quick reaction to credit risk, acting as a leading indicator of downgrades and default.

Source: CreditEdge
Checking the boxes for a good Credit Risk Model

Characteristics of Good Candidate Risk Factors

☐ Able to distinguish defaulters from non-defaulters (i.e., “action” in the underlying data sample)

☐ Clear, objective, and uniformly understood

☐ Capable of being assessed in a reasonable timeframe using accessible, consistently available data

☐ Possessing unique information value (i.e., non-duplicative, non-correlated)

☐ Supported by intuition and general business sense

☐ Measurable and verifiable (using historical data at some point in future)
Putting a credit model into practice
How are credit risk scores used?

They are used in a common and consistent language across the firm – a Master Rating Scale (MRS)

A Master Rating Scale helps ensure the interpretation of risk is consistent

» Across the firm (front to back office) globally
» Across segments (portfolios)
» Over time as underwriters and analysts change
» Provides a good distribution for credit risk
Credit Scores have many uses

- Pre-qualification
- Deal approval
- Exposure loss estimation
- Risk-based pricing
- Limit Setting
- Reserve estimation
- Risk monitoring
- Peer Comparison

Moody's Analytics

Score

D
C
Ca
Caa
B
Ba
Baa
A
Aa
Aaa

Underwriting

Pricing

Limit Setting

Zero Limits
Low Limits
Medium Limits
High Limits
Credit Risk Management Best Practices

- **Granularity**
  Increases the power to diversify the risk between similar credits

- **Ongoing Monitoring & Early Warning Signal**
  Detects credit deterioration by combining relevant data and rank orders risk well

- **Assessment of Risk Drivers**
  Relative contributions and sensitivity measures provide an understanding of the risk drivers by providing transparency

- **Benchmarking**
  Benchmark an obligor to the sample pool and/or other firms in the portfolio or peer groups by industry and asset size

- **Comprehensiveness**
  All encompassing qualitative, probability of default, recovery analytics solution that can be accessed across your organization

- **Extensive sample pool of data**
  Comprehensive asset class data including financial statements and defaults from Moody’s Analytics Credit Research Database

- **Transparency**
  Documented approach, clear methodology, consistent inputs and outputs

- **Empirically Validated**
  Sufficient data to separate development, validation samples and ongoing model performance

- **Accuracy Importance**
  Model has good “power”, high quality of credit ratings differentiation

- **Forward Looking**
  Accounts for effects of Credit Cycle by Industry and Market Performance
Building a scorecard from scratch
Desired end-state: a scorecard which blends empirically-derived risk measures with expert judgment

Example Quantitative Factors
- Liquidity
- Profitability
- Debt Service Coverage
- Leverage

Example Qualitative Factors
- Market Share
- Diversification
- Mgmt Experience
- Supplier Pressure

Quantitative Model
- Quantitative PD%

Qualitative Overlay
- Qualitative Score (0-100)

Total Score

Final Output
- Borrower Rating
- Rating-Implied PD

Rating PD
- Rating Grade | PD
- 1            | 0.08%
- 2            | 0.30%
- 3            | 0.67%
- 4            | 0.98%
- 5            | 1.58%
- ...          | ...
First step: appropriately segment your portfolios for risk measurement purposes

General considerations for segmentation include:

» Sector
» Size (i.e., total assets or net sales)
» Ownership type (private vs. public ownership)
» Geography (country)
» Segment materiality
» Data availability

The portfolio should be divided into segments that share common risk characteristics.
Once the portfolio has been segmented, there are fundamental decisions to be made about the scorecards.

1. How many scorecards?
   - MORE
     - Accuracy,
     - Stability and
     - Consistency
     - Flexible, Easy to
     - Manage, Cost Effective
   - LESS
     - Efficiency/
     - Maintenance

2. How customized?
   - High
     - Cost Effective, Quick
     - Delivery, Easy to Deploy
   - Low
     - Standardized,
     - Off the Shelf
     - Leveraged
     - and Tailored
     - Fully
     - Customized

3. Modeling Approach
   - Purely Judgmental
   - Statistically driven
     - Expert opinion input
   - Purely Empirical
Once you have decided on the approach: you must identify quantitative and qualitative factors to evaluate

**Subject Matter Experts**
- Lenders
- Underwriters
- Investors
- Credit Administrators
- Loan Reviewers
- Equity Analysts

**Existing Precedents**
- Vended models
- Documented academic models, frameworks, checklists, policies, etc.
- Existing model override reasons

**Rating Agency Methodologies**
- Sector-focused methodologies and ratings criteria

**Brainstorming**
- White-boarding sessions
- Surveys
- Loan file reviews
- Workshops
Moody’s follows a well-established process when developing a risk rating scorecard.
Example of Single Factor Analysis – Probability of Default

Each level of a ratio is associated with a different default rate, and their weights are chosen to maximize the fit between predicted default rate and observed default rate in the database.

Example: If the Liquidity ratio for a firm is in the 70th percentile that means that 70% of the sample had a lower Liquidity ratio than that firm.
Once a scorecard is developed, it is important to test its accuracy and stability through validation

What does validation involve?

» Validation is the process of rendering a statistically derived conclusion about the usefulness and reliability of a scorecard

» Validation makes use of historical data to determine whether or not the scorecard is robust

» Validation answers important questions about the accuracy and stability of the scorecard as a decision making tool

Why is validation important?

» Validation ensures that the scorecards are at least as good as an industry benchmark

» Regulators increasingly expect it – this trend is expected to continue and expand to more and more industries

» Validation can also help ensure that strong borrowers are not turned away – and weak borrowers are not extended credit
Use the most accurate model, not a model that is “good enough”

1. **Accuracy** - Measures the likelihood of an expected outcome

2. **Power** - A accurate model should rank order risk correctly by using meaningful and predictive inputs

3. **Validation** - Measuring Model Performance

   Assume 100 companies were rated one year ago and ten of those companies defaulted.

   How good is your model? How much did you or could you lose?
Measuring Power - a “Power Curve”

Accuracy Ratio = \( \frac{B}{A + B} \)
There is no “one-size-fits-all” approach for effective ratings, but there are common attributes

**Attributes of Deficient Ratings**

- Too few risk grades and/or excessive concentration in just a few risk grades
- Lack of consistent risk grading approach across portfolios (e.g., a “4” in CRE does not present the same risk as a “4” in C&I)
- Inconsistent interpretation or unclear definition across internal risk grades
- Lack of clear written policies describing what each risk grade actually means
- Failure to decompose risk into key drivers – separating borrower risk from facility risk
- Lack of independence across those who assign ratings and those who use ratings

**Attributes of “Best Practice” Ratings**

- Universal, consistent and uniformly applied risk grades serving as common language across institution (e.g., EL)
- Risk grades mapped to quantified absolute risk parameters (e.g., PD)
- Sufficient granularity across the master rating scale
- Calibrated to observed or benchmarked experience
- Grades assigned based on objective (measurable) versus subjective criteria
- Actionable and applicable to other credit-related activities
Q&A
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Charles.Dafler@moodys.com

Mehna Raissi  
Senior Director, Product Management  
Mehna.Raissi@moodys.com
APPENDIX
Examples of Risk Rating Models
RiskCalc – Financial Statement Driven Model with Forward Looking Credit Cycle Adjustment
RiskCalc data source: the Credit Research Database

<table>
<thead>
<tr>
<th>Country</th>
<th>Last Updated</th>
<th>Borrowers</th>
<th>Defaults</th>
<th>Default Range</th>
<th>Statements</th>
<th>Range</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td></td>
<td>111,949</td>
<td>5,749</td>
<td></td>
<td>375,144</td>
<td></td>
<td></td>
</tr>
<tr>
<td>India</td>
<td>12-2014</td>
<td>20,390</td>
<td>-</td>
<td></td>
<td>65,315</td>
<td>1990-2013</td>
<td>-</td>
</tr>
<tr>
<td>Malaysia</td>
<td>6-2012</td>
<td>16,666</td>
<td>222</td>
<td>2002-2011</td>
<td>58,262</td>
<td>1930-2014</td>
<td>1999-2010</td>
</tr>
<tr>
<td>Asia Pacific</td>
<td></td>
<td>1,429,029</td>
<td>59,302</td>
<td></td>
<td>5,019,200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Poland</td>
<td>12-2014</td>
<td>146,109</td>
<td>-</td>
<td></td>
<td>611,967</td>
<td>1994-2013</td>
<td>-</td>
</tr>
<tr>
<td>Europe</td>
<td></td>
<td>15,587,642</td>
<td>1,683,327</td>
<td></td>
<td>77,660,667</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>3-2014</td>
<td>22,997</td>
<td>-</td>
<td></td>
<td>60,749</td>
<td>1993-2012</td>
<td>-</td>
</tr>
<tr>
<td>Americas</td>
<td></td>
<td>435,469</td>
<td>66,084</td>
<td></td>
<td>2,472,353</td>
<td></td>
<td></td>
</tr>
<tr>
<td>World</td>
<td></td>
<td>17,564,089</td>
<td>1,814,462</td>
<td></td>
<td>85,527,364</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Includes all records found in the “core CRD database” as of 12/01/15. The defaults counts are based on the most inclusive definition of default. The full range of statement and default years is presented above. Only the last 10 years of history are presented in the "Statements & Defaults by Year" graphs below.
RiskCalc Determines PD from Credit Ratios and Credit Cycle

Ratio drivers point out many weaknesses in firm’s financials
Compares borrowers against peer group for additional transparency
Incorporates qualitative factors in credit assessment

Qualitative factors focused on industry/market (customer power), management (experience in industry), company (years in relationship) and balance sheet factors (audit method)
CreditEdge – Public Firm PD Model

AT&T INC

Overview  EDF  CDS  Bonds  Financials  Peer Analysis  What-if  Profile  News & Research

0.02%  0.00%  Aa1  +1 Notch  A3  A-  0.06%  0.02%
As of Nov 06, 2014  3 Month Change  As of Nov 06, 2014  3 Month Change  As of Jan 29, 2013  Moody's Rating  S&P Rating  As of Nov 05, 2014  As of Nov 05, 2014
1-Yr EDF  Change  Implied Rating  Change  Moody's Rating  S&P Rating  1-Yr TTC EDF  1-Yr CDS-I EDF

EDF Summary

EDF vs TTC EDF

EDF vs GLOBAL TELEPHONE GROUP
CreditEdge determines PD Based on Forward-Looking Market Valuations

One-Year Expected Default Frequency (EDF™) Measures
CreditEdge Excel Add-in – Risk Dashboard

Moody's Analytics

Calculate the change in value for the "EDF - 1 Year (Annualized)" data point and compare the company "EDF - 1 Year (Annualized)" to industry group statistics.

1. Enter up to 500 company identifiers in cells B14 to B516.
2. Enter a date for which to view current values in cell B8.
3. Enter a prior date to compare current values to in cell B9.

Current Date:
Previous Date:

<table>
<thead>
<tr>
<th>Company Name</th>
<th>EDF</th>
<th>Implied Rating</th>
<th>EDF Change</th>
<th>CreditEdge Primary Industry</th>
<th>CURRENT RANK</th>
<th>RANK MOMENTUM</th>
</tr>
</thead>
<tbody>
<tr>
<td>FOREST OIL CORP</td>
<td>24.56%</td>
<td>Ca</td>
<td>24.44%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>Improvement</td>
</tr>
<tr>
<td>DYNEGY INC</td>
<td>7.52%</td>
<td>B9</td>
<td>8.63%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>QUICKSILVER RESOURCES INC</td>
<td>22.11%</td>
<td>B3</td>
<td>22.03%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>YRC WORLDWIDE INC</td>
<td>0.40%</td>
<td>B3</td>
<td>1.12%</td>
<td>TRUCKING</td>
<td></td>
<td>No change</td>
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<tr>
<td>MCCLATCHY CO - CLA</td>
<td>7.97%</td>
<td>B9</td>
<td>8.29%</td>
<td>PUBLISHING</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>BONTON STORES INC</td>
<td>9.21%</td>
<td>Caa3</td>
<td>7.24%</td>
<td>CONSUMER PRODUCTS RET/WHSL</td>
<td>4TH QTRTL</td>
<td>Improvement</td>
</tr>
<tr>
<td>PENNEY J (C) CO</td>
<td>4.77%</td>
<td>Caa3</td>
<td>5.68%</td>
<td>PRINTING</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>CENVEO INC</td>
<td>8.83%</td>
<td>Caa3</td>
<td>10.68%</td>
<td>CONSUMER DURABLES RET/WHSL</td>
<td>90TH PCTLT</td>
<td>Improvement</td>
</tr>
<tr>
<td>RADIOCHECK CORP</td>
<td>26.18%</td>
<td>Caa3</td>
<td>16.33%</td>
<td>BUSINESS PRODUCTS WHSL</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>SUPERVALU INC</td>
<td>2.59%</td>
<td>Caa3</td>
<td>2.95%</td>
<td>AUTOMOTIVE</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>SEARS HOLDINGS CORP</td>
<td>5.61%</td>
<td>Caa3</td>
<td>5.86%</td>
<td>TELEPHONE</td>
<td></td>
<td>No change</td>
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<tr>
<td>ALLIANCE ONE INTL INC</td>
<td>6.45%</td>
<td>Caa3</td>
<td>5.58%</td>
<td>ENTERTAINMENT &amp; LEISURE</td>
<td></td>
<td>No change</td>
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<tr>
<td>ACCURIDE INC</td>
<td>5.50%</td>
<td>Caa3</td>
<td>4.75%</td>
<td>CONSTRUCTION</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>CINCINNATI BELL INC</td>
<td>3.52%</td>
<td>Caa3</td>
<td>3.62%</td>
<td>ENTERTAINMENT &amp; LEISURE</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>BOYD GAMING CORP</td>
<td>3.79%</td>
<td>Caa3</td>
<td>4.25%</td>
<td>CONSTRUCTION</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>BEERER MONDES USA INC</td>
<td>4.75%</td>
<td>Caa3</td>
<td>4.43%</td>
<td>CONSTRUCTION</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>CASINO CASINO CORP</td>
<td>5.61%</td>
<td>Caa3</td>
<td>5.86%</td>
<td>CONSTRUCTION</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>UNITED STATES STEEL CORP</td>
<td>0.75%</td>
<td>Caa1</td>
<td>0.15%</td>
<td>STEEL &amp; METAL PRODUCTS</td>
<td></td>
<td>Improvement</td>
</tr>
<tr>
<td>MERITOR INC</td>
<td>1.01%</td>
<td>Caa1</td>
<td>0.74%</td>
<td>AUTOMOTIVE</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>PEBBLESTONE ENERGY CORP</td>
<td>1.92%</td>
<td>Caa2</td>
<td>1.74%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>MOUNTAIN ENTERPS CORP - CLA</td>
<td>6.13%</td>
<td>Caa3</td>
<td>5.12%</td>
<td>CONSTRUCTION</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>ACCO BRANDS CORP</td>
<td>1.01%</td>
<td>Caa1</td>
<td>1.12%</td>
<td>PRINTING</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>NAVISTAR INTERNATIONAL CORP</td>
<td>1.23%</td>
<td>Caa3</td>
<td>1.16%</td>
<td>AUTOMOTIVE</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>SANDRIDGE ENERGY INC</td>
<td>0.45%</td>
<td>B3</td>
<td>0.73%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>JABIL CIRCUIT INC</td>
<td>0.54%</td>
<td>B3</td>
<td>0.61%</td>
<td>ELECTRONIC PRODUCTS</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>BILL BARRETT CORP</td>
<td>0.96%</td>
<td>B3</td>
<td>0.78%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
<tr>
<td>NEWFIELD EXPLORATION CORP</td>
<td>0.20%</td>
<td>B1</td>
<td>0.26%</td>
<td>OIL, GAS &amp; COAL EXP/PROD</td>
<td></td>
<td>No change</td>
</tr>
</tbody>
</table>