Risk Management in the Middle of a Financial Crisis: Interest Rate, Commodity, and Credit Risk

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Risk Analysis Services, Southern Company

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Department of Risk Management and Insurance
Georgia State University
Overview

• A word on the Financial Crisis
• Quick Orientation: Southern Company – our business, our strength
• Enterprise Risk Management at Southern
• R/A/S, the Risk Analysis Services group, reports to Director, Enterprise Risk Management
• As part of ERM function, provides quantitative support
• Disclaimer: this presentation is personal opinion, not corporate policy or position
• Applied Examples
• Q&A
What’s a Good Stress Test These Days?

- Well aware of the early 70s. But there has been a regime change. Today is different.

- Oops, though thankfully not a perfect match.
It’s a New World

Source: WSJ, Dec 2008
...and another Version
“Reactions of the Wall Street slump”

The Economist, Nov 23, 1929

“IT’S an ill wind that blows nobody any good.”

“A prolonged upward movement, the extent of which is illustrated by some graphs which we print in a later column, has been built up over a series of years on the amazing and unexampled prosperity of America. But some two years ago the speculative movement seemed to lose all touch with reality; and in spite of occasionally vigorous but more often half-hearted, measures by the banking authorities of the United States, speculative fever spread throughout the nation and carried prices, mainly with the aid of borrowed money, to fantastic heights.”
Georgia Power versus Bank of America/JP Morgan

Current comparison of secondary trading of bonds maturing 2018

<table>
<thead>
<tr>
<th>Yield</th>
<th>Bank of America</th>
<th>JP Morgan</th>
<th>Georgia Power</th>
</tr>
</thead>
<tbody>
<tr>
<td>9%</td>
<td>8.20%</td>
<td>5.95%</td>
<td>5.13%</td>
</tr>
<tr>
<td>6%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0%</td>
<td></td>
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<td></td>
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</tbody>
</table>

Bank of America Yield: 8.20%
JP Morgan Yield: 5.95%
Georgia Power Yield: 5.13%
Georgia Power versus Bank of America
Secondary Market Trades

BAC 10 Year
GPC 10 Year

4/30/08 6/30/08 8/30/08 10/30/08 12/30/08 2/28/09
Origin of the Crisis: Housing – Flat from 1947 to 1996. Then Unprecedented Growth

Not the case that real housing values have generally increased in the US throughout history. The recent run-up in housing values was exceptional.

US Real Home Price Index, 1890-2008

Source: Robert Shiller, The Subprime Solution. [http://www.irrationalexuberance.com/Fig2.1Shiller.xls](http://www.irrationalexuberance.com/Fig2.1Shiller.xls)

Projection: Citi, “A View of the US Subprime Crisis” Sep 26, 2008
Bond Markets Dried Up...Completely

- “Extreme aversion to risk dominated the week and as such, all issuers remained on the sidelines. Looking forward, we expect that potential borrowers will continue to monitor tone and will look for stability in spreads before entering the market”
- **Monday, Sept 15 through Friday Sept 19:** Total Investment Grade Bond Offerings across United States:

<table>
<thead>
<tr>
<th>Issuer</th>
<th>Issue Ratings</th>
<th>Amount ($mm)</th>
<th>Tenor</th>
<th>Reoffer Spread (bp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fixed Rate Total</td>
<td></td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Floating Rate Total</td>
<td></td>
<td>$0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Issuance</td>
<td></td>
<td>$0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Bloomberg and Citi.

- The following week, an issuance came to market but failed (Sep 22). Tuesday of that week, Caterpillar (A2/A) paid 320bps above 5 year Treasury. A month earlier CAT raised 5 year money at +175.

Source: Citi, 9/19/8 Capital Markets Weekly
The week ending September 19, 2008 was the first week since Dec. 1989 when there was not a single investment-grade debt offering.
Financial Crises … Not Uncommon

Corporate Spreads Since 1990

- Savings & Loans Crisis / Bailout Mid-1980s
- Junk bond market closed (UAL LBO 1989)
- Drexel Burnham bankruptcy filing 2/13/90
- Credit Rallies as Recession Ends
- Mexican Currency/Debt Crisis
- Orange County Bankruptcy
- Mortgage Market
- Credit Rallies as Recession Ends
- Asian Currency/Debt Crisis
- Russian Default
- LTCM Bailout
- Corporate Governance Sept. 11, 2001
- Dot-Com Bubble Ends
- Credit Rallies as Recession Ends

Fed Policy:
- Ease
- Tighten
- Ease
- Tighten
- Ease
- Tighten
- Ease

S&P 500 Price Performance, Quarter-on-Quarter.

Source: Citi
...though this Particular Crisis Clearly Stands Out

Difference between 3 month Libor and Treasury bill yields (TED)

Source: Moody’s Economy.com, Sep 23 2008 Presentation, “When Will It End?”, and MLXport data
Premiere Utility Franchises
Putting customers first

Customers

Constructive Regulation
Healthy Capital Spending

High Reliability
Low Prices
High Customer Satisfaction

Named #1 Electric Utility
8 years in a row
by the American Customer Satisfaction Index

Rates at least 15% below the National Average

2007 Fossil and Hydro Peak Season EFOR - 1.6%
(industry average = 6.3%)

Southern Company Transmission Reliability Sustained Duration 1997 - 2007

Southern Company Transmission Reliability Sustained Frequency 1997 - 2007

Duration of outages
Frequency of outages
Financial Strength and Integrity
Our dividend has provided outstanding value...

**A strong and balanced return** - SO dividends have contributed **6.1%** to an average annual return of **15.2%** over each 10-year period in the past 20 years.

Source: Bloomberg total shareholder return data for calendar years 1988-2007, compounded daily over each 10-year holding period. Peer companies are electric utilities with 60% of historical earnings from regulated electric utility operations, at least $1.2B in total revenue, have 10 years of historical return data available, and whose average annual TSR contribution from reinvested dividends over the period was at least 5%

*Disclaimer: Bloomberg adjusts the historical Southern Company stock prices prior to the spin of Mirant based on Mirant value at the time of the spin.*
...and stable income for investors

241 consecutive quarters of dividend payments

(increased 4% in April 2007)

Targeting a payout ratio of approximately 70%
Strong Performance in Uncertain Economies

During past 4 recessions, SO has outperformed the market

Jan 1980 to Jul 1980: 26.4% Southern TSR, 8.8% S&P 500 TSR
Jul 1981 to Nov 1982: 50.2% Southern TSR, 10.0% S&P 500 TSR
Mar 2001 to Nov 2001: 30.5% Southern TSR, 2.5% S&P 500 TSR
Average: 30.8% Southern TSR, 2.5% S&P 500 TSR

Source: Bloomberg, Total Return based on monthly calculations as of last trading day prior to recession start and end dates.

Bloomberg adjusts the historical Southern Company stock prices prior to the spin of Mirant based on Mirant value at the time of the spin.
ERM : Risk Oversight Governance Structure at Southern

<table>
<thead>
<tr>
<th>Southern Company Board of Directors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audit Committee</td>
</tr>
<tr>
<td>Finance Committee</td>
</tr>
<tr>
<td>CEO and CFO/CRO</td>
</tr>
</tbody>
</table>

**Ethics and Compliance Council**
- Discuss Ethics and Compliance Program issues
- Discuss improvements that should be considered

**Southern Disclosure Committee**
- Consolidate Southern System Disclosure Committee results
- Determine which items are required disclosures

**Southern Company ROC**
- Establish risk policies and principles
- Establish risk appetite
- Understand and monitor risk and management programs
- Integrate risk with strategy

**Executive Management Committees**

<table>
<thead>
<tr>
<th>Risk Advisory and Controls Committee</th>
<th>Business Assurance Council</th>
<th>Subsidiary/Functional Risk Oversight Groups*</th>
</tr>
</thead>
</table>
| • Provide oversight of risk management procedures and controls
  • Provide oversight and management of financial risks
  • Establish guidelines for risk quantification
  • Monitor risks to Financial Plan
| • Review and oversee Southern Company's system-wide program for Protection, Preparation, and Response
  • Recommend priorities, policies and procedures to ensure business continuity
  • Ensure Business Assurance Agreements are developed for critical facilities, applications and processes |
| *Oversee risk management practices and risk control
  *Oversee compliance functions at the entity and functional units
  *Oversee development of risk profile and mitigation activities |

<table>
<thead>
<tr>
<th>Business Unit / Organization Risk Management</th>
</tr>
</thead>
</table>
| • Identify risk and develop mitigation plans
  • Monitor all risks                        |
| • Compliance with SOX/404, Ethics and other requirements |

* The ERM function coordinates with the SEC Reporting, Business Controls, Business Assurance, Internal Auditing and Compliance functions
ERM: Southern Company Risk Profile (illustrative only)

<table>
<thead>
<tr>
<th>Risk responsibility</th>
<th>Accountability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Council member / Key executive</td>
<td>1. Risk # 1</td>
</tr>
<tr>
<td>Responsible officer</td>
<td>2. Risk # 2</td>
</tr>
<tr>
<td></td>
<td>3. Risk # 3</td>
</tr>
<tr>
<td></td>
<td>4. Risk # 4</td>
</tr>
<tr>
<td></td>
<td>5. Risk # 5</td>
</tr>
<tr>
<td></td>
<td>6. Risk # 6</td>
</tr>
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<td>7. ...</td>
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<td>8. ...</td>
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<td>9. ...</td>
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<td></td>
<td>10. ...</td>
</tr>
<tr>
<td></td>
<td>11. ...</td>
</tr>
</tbody>
</table>

**Risk**

1. Risk # 1
2. Risk # 2
3. Risk # 3
4. Risk # 4
5. Risk # 5
6. Risk # 6
7. ...
8. ...
9. ...
10. ...
11. ...

**Materiality of impact**

**Likelihood**

- **Risk responsibility**
  - Management Council member / Key executive
  - Responsible officer
What RAS Does: Structured Products – LIBOR Market

• Well understood: issuance of plain vanilla corporate bonds typically at fixed rates, floating rates, or fixed + callable post lockout period
• Structured bond deal: floating rate depends on relative movements of 3 month LIBOR forwards, potential for large savings
• Well known that forward markets exhibit a “bias” known as the market price of risk. Visible in crude oil, heating oil, natural gas, electricity… and:

• The LIBOR market: the bias appears fairly systematic, steepest on the short end. Potential to monetize
• Index to replicate this trading Strategy: buy 3ML 4 quarters fwd, sell 3 months from now. Keep rolling this position. Total return is the index performance

Source: counterparty
**The Deal:** how are payoffs structured >>

**The Question:** Should RAS recommend we enter into this structure?

1) How much risk, 2) how much return, 3) what is the relative value distribution compared to other products

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### Indicative pricing – 1 year fixed

<table>
<thead>
<tr>
<th>Maturity</th>
<th>10y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupon (Year 1)</td>
<td>2.71%</td>
</tr>
<tr>
<td>Coupon (Year 2-10)</td>
<td>2.71% + (Strike – Index Performance)</td>
</tr>
<tr>
<td>Index performance</td>
<td>(Index at period end / Index at trade date) – 1</td>
</tr>
<tr>
<td>Strike</td>
<td>1.50% for the third semiannual coupon, increasing by 0.50% per coupon thereafter</td>
</tr>
<tr>
<td>Coupon cap</td>
<td>10.50%</td>
</tr>
<tr>
<td>Coupon floor</td>
<td>1.00%</td>
</tr>
<tr>
<td>Index</td>
<td>[Bloomberg ticker]</td>
</tr>
<tr>
<td>Historical IRR</td>
<td>3.20%</td>
</tr>
<tr>
<td>Historical min/max IRR</td>
<td>1.22% / 5.48%</td>
</tr>
</tbody>
</table>

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*Strike price evolves deterministically, key is index stochastics and performance*
Structured Bond Risk Analytics – Historical View

- Historical risk analysis: what level of performance would we see had we entered this structure at any point in the past
- Structured Note outperforms floating rated debt by 272 basis points on average, historically single highest IRR is 5.48%, lowest is 1.22%
- On every $100MM face value, historical expected savings over floating is a nominal $27.2MM over 10 years, or about $23MM NPV
Structured Bond Risk Analytics – Simulation

- **Used simulation to model risk in Structured Bonds**
- Weekly realized “Index Performance” follows a t-distribution with 6.95 degrees of freedom (fat tailed), semi-annual very close to 30 DF
- Index is not mean-reverting, cannot refute random walk (Geometric Brownian Motion), with low volatility – approximately 1.5% on average. Single highest volatility over 30 week realized period is < 2%
- Reason for low volatility is that 3M Libor 1 year out and 3M Libor 9 months out tend to be correlated
- Produced an “expected” risk analysis using estimated parameters
- Also produced stress analysis using “extreme value theory” (EVT) for the distribution of volatility (more vol, more coupon risk) and also a sharp drop off in index drift (leading to lower returns and therefore higher coupon payments)
Structured Bond Risk Analytics – “Expected” Simulation

- The Structured Bond has both a lower expected coupon and lower a risk profile.
- The expected IRR is 3.2% for FRB, 4.9% for the Floating Rate Note.
- 95% of the time FRB rates are below 4.2%, whereas only 18% of Floating rate notes are below 4.2%.
- The 95th percentile for a Floating Rate Note is 6.21%... To get to 6.21% on the FRB note you need a stress event that has close to zero likelihood.

Index vol goes above 99.999th %ile in the EVT distribution for volatility.
Structured Bond Risk Analytics – “What-If” Simulation

Simulation reveals high sensitivity of IRR distributions to location in interest rate cycle

Key sidebar:
1. Probability of index underperformance in years 1 and 2 conditional on execution near center of easing cycle is 100% (realized data), and near 100% (simulation model)
2. Probabilities for executing “middle of the downslope” are better, though still requires a view of short term interest rates and market timing for years 1 and 2

1 % drop in index per year in FIRST two years, then GBM. Mean IRR incr by 245bps.

GBM, then 1% index drop per year in LAST two years. Mean coupon moves up by 20bps only
Structured Bond Takeaway

- Historical analysis, standard simulation: product is a “Go”
- Extreme Value Distribution for volatility: “Go”
- What-If simulation, reasonable probabilities of occurrence: product is “No Go”
- It’s not the volatility that kills the structure, it’s cycle-timing
IC@R : Interest Cost at Risk

Purpose

- Created a tool to calculate potential variability of interest cost and related coverage ratios
- Can be used to estimate total interest variability and/or potential variability versus the budget
- Captures all sources of interest variability
  - Short-term debt
  - Variable rate long-term debt
  - Planned issuances of fixed long-term debt
  - Tax exempt debt
  - *Includes effect of any hedge activities*
- Will be used for each of Southern’s Operating Companies as well as on a consolidated basis
@Risk Portfolio: Key Rate-Risk Drivers by Instrument

2009
Key Assumptions

- Key interest rates simulated
  - 1-month LIBOR, 3-month LIBOR
  - 30-year taxable debt
  - 30-year tax exempt debt
- Correlations among various rates based on historical relationships
- Financial Plans and issuance schedules used as the source of information about the portfolio
- Two buckets:
  - “@ Risk”: any outstanding and planned debt issuances that are currently exposed to changes in interest rates
  - “Not @ Risk”: any outstanding and planned debt issuances that are currently not exposed to changes in interest rates
Market-Based Interest Rate Risk Modeling

- The same model that is used by the market to price interest rate options is used to generate the cost @Risk at the 5\textsuperscript{th} and 95\textsuperscript{th} / 99\textsuperscript{th} percentiles
- Simulated 10,000 different rate environments (states of the world)
- Consistent with current forward markets and option implied volatility. Market expects rates to rise. Our models reflect this:

Market-Implied 3 Month LIBOR Rates through 2010
Example : Modeling Term Rates

- Georgia Power planned issuance Dec 2009, $250MM taxable
- We do not know the all-in rate for Dec 2009 today: this rate is uncertain until we issue. Model : keeps rate uncertain until Dec, then fixes for life of the bond
- We do this for every @-risk bond in Southern’s bond portfolio
Interest Cost at Risk (ICAR) : Total Southern Bond Portfolio

Southern Company total interest expense at risk: at budget and market rates
Southern Company Interest Cost @ Risk: Looking to 2010

- The total interest expense will not exceed budget in 2010 (A% certainty) based on current budget rates.
- By the same token: A% certain that 2010 total interest expense will be lower than budget.
Commodity Risk: Natural Gas

- Natural gas is one of the main sources of generation, accounting for 16% of Southern Company’s generation portfolio in terms of KWhs generated.
- Southern Company spent more than $6.8 Billion on fuel expenses in 2008.
- With volatilities ranging from 40% to 80%, natural gas is one of the most volatile commodities.
- Southern Company manages natural gas price risk utilizing a number of approaches including NYMEX natural gas future contracts.
Natural Gas: Historical Spot Price & Volatilities

Source: Bloomberg
Natural Gas: Forward Curves at Different Points in Time

Source: Bloomberg
Objective of Natural Gas Hedging Program

- Minimize volatility of cash flow spending on natural gas portfolio over time
- Define spending on natural gas portfolio as:

\[ C_{p,t} = S_t \times Q_{p,t} \]

- Cost of physical gas at time \( t \)
- Spot price of gas at time \( t \)
- Quantity of physical gas at time \( t \)

- Further define log change in cash flow as:

\[ CF_{p,n} = \ln\left(\frac{C_{p,t}}{C_{p,t-1}}\right) \]

- Objective: Minimize cash flow volatility:

\[ \sigma_{p,CF} = \sqrt{\frac{1}{N} \sum_{n=1}^{N} (CF_n - \overline{CF})^2} \]
Instrument: NYMEX future contracts

• Cost of financial gas:
  \[ C_{f,t} = h^* \times F_t \times Q_{f,t} \]
  \( C_{f,t} \) = Cost of financial gas at time \( t \)
  \( h^* \) = Optimal hedge ratio % (the proportion of the exposure that is hedged)
  \( F_t \) = NYMEX future price of gas at time \( t \)
  \( Q_{f,t} \) = Quantity of gas hedged at time \( t \)

• Hedged Profit/Loss:
  \[ PL_{hedged,t} = C_p,t - C_{f,t} \]
  \[ PL_{hedged,t} = S_t \times Q_{p,t} - h^* \times F_t \times Q_{f,t} \]

• Further assume:
  \[ Q = Q_{f,t} = Q_{p,t} \]

• Then:
  \[ PL_{hedged,t} = (S_t - F_t) \times h^* \times Q \]
.. Minimize Cash Flow Volatility by Choosing $h^*$

- Spending on hedged natural gas portfolio:
  \[ C_{\text{hedged}, t} = C_{p, t} - PL_{\text{hedged}, t} \]

- Hedged log change in cash flow:
  \[ CF_{\text{hedged}, n} = \ln\left( \frac{C_{\text{hedged}, t}}{C_{\text{hedged}, t-1}} \right) \]

- Minimize volatility of hedged cash flow by choice of $h^*$:
  \[ \sigma_{\text{hedged}, CF} = \sqrt{\frac{1}{N} \sum_{n=1}^{N} \left( CF_{\text{hedged}, n} - \bar{CF}_{\text{hedged}} \right)^2} \]
Hedging Spot Exposure with Multi-Year Staggered Financial Contracts: Marginal and Total Hedge Ratios

- Smooth hedging volumes rolled forward through time.
  For example, for a physical spot exposure in 2013, hedge 0% in 2009, 5% in 2010, 10% in 2011, 15% in 2012, and 30% in 2013. These are “marginal” hedge ratios.
- This implies a 60% hedged natural gas portfolio for physical spot deliveries in 2013. This is the total hedge ratio. See table below: highlighted hedge ratios are marginal.

<table>
<thead>
<tr>
<th>Spot Year</th>
<th>Hedge for Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Current</td>
</tr>
<tr>
<td>2009</td>
<td>2009</td>
</tr>
<tr>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>2010</td>
<td>2010</td>
</tr>
<tr>
<td></td>
<td>30%</td>
</tr>
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<td>30%</td>
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<tr>
<td></td>
<td>30%</td>
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<tr>
<td></td>
<td>30%</td>
</tr>
<tr>
<td>2014</td>
<td>2014</td>
</tr>
<tr>
<td></td>
<td>30%</td>
</tr>
</tbody>
</table>
Portfolio Hedge Results: Hedging Reduces Price Risk

- Cash flow volatility with unhedged portfolio: 53% (= price volatility, percent per year)
- Cash flow volatility with hedged portfolio: 29%
- Hedge Performance Metric: by how much does hedging reduce cash flow volatility, calculates as 1 - Risk(Hedged Portfolio) / Risk(Unhedged Portfolio) = 45% risk reduction. “Hedging cuts price risk in half”

Monthly Cash (Out)Flows, Hedged and Unhedged Gas Portfolio

Prices: realized
Volumes: stable
No assumptions concerning correlation or volatility
Strategies and their Risks: Making Money vs. Hedging

- Instruct the model to make as much money as possible, without knowing the future, and without being able to either short sell futures or engage in options trading.
- Result is a strong emphasis on buying NYMEX futures with longer time to delivery: after 3000 optimization paths, the optimal strategy is to buy zero volume for near-dated contracts and all volumes as far out as possible (i.e. $h_1 = h_2 = \ldots = h_4 = 0$, $h_5 = 100\%$). This is driven by backwardation in the futures market and rising spot prices. Assumes constant volume (actual=budget) to simplify.
Counterparty Credit Risk

- Counterparty default risk when Southern is deep in the money
- Mitigation Strategies
  - Management of risk limits
  - Monitoring counterparty CDS
  - Collateral for exposure above an agreed threshold

5 Year CDS

Source: Bloomberg
• Questions? Comments?

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