Axioma
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Factor Risk Models and Optimization

QWAFAFEW New York

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Axioma, Inc.

Some basic Axioma Facts

- Axioma started as an optimization company in 1998 and became a Risk Model provider in 2006, after acquiring IP from GS/PACE
- Axioma has 52 risk models in daily production, corresponding to:
  - 6 Single country models
  - 5 Regional models
  - 1 Global and 1 Global x-US model
- All models released daily, 5 hours before the market opens
- All models with 12+ years of daily history, US goes back to 1982
- All models include fundamental, statistical, short term and medium term horizon variants
- Leading firms have already fully converted to Axioma

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1. Frequency of data: Daily

- Which frequency of historical data should be used:
  - Daily vs Weekly vs Monthly

- **Challenges:**
  - Availability of clean historical daily data (globally)
  - Market synchronicity (Japan is closed when US is open)
  - Auto-correlation
  - Treatment of outliers

- **Benefit**:
  - More data points in a shorter time frame: accuracy and responsiveness
  - **Dynamic Volatility Adjustment**: Use daily data to re-weigh observations depending on the volatility regime
  - Specific risk model with more explanatory power
  - **Returns timing adjustment** to deal with market asyncronicity

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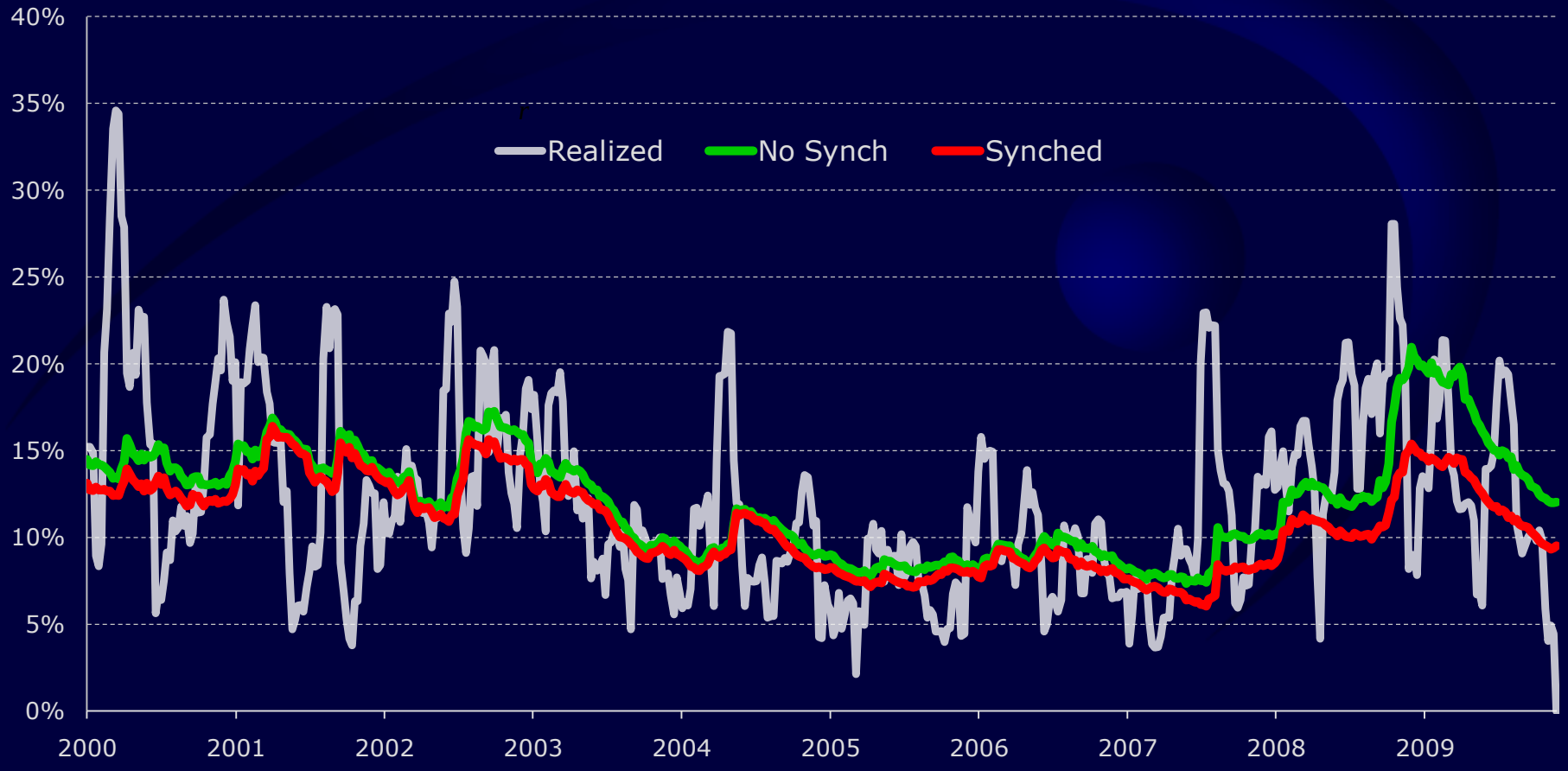
Axioma's Returns Timing

Predicted vs. Realized Active Factor Risk, Asia-Pacific benchmarked against all countries



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2. Update Frequency: Daily

- How frequently should all risk model components be updated?
  - Daily vs Weekly vs Monthly
- **Challenges:**
  - Round the clock global operation to provide timely updates as markets open and close
  - Avoid excessive risk-model induced turnover
- **Benefits**:
  - Risk updates available as events occur
  - Avoid beginning of month "crowding"
  - Trade on up-to-date risk information
  - 24-6 Risk Service

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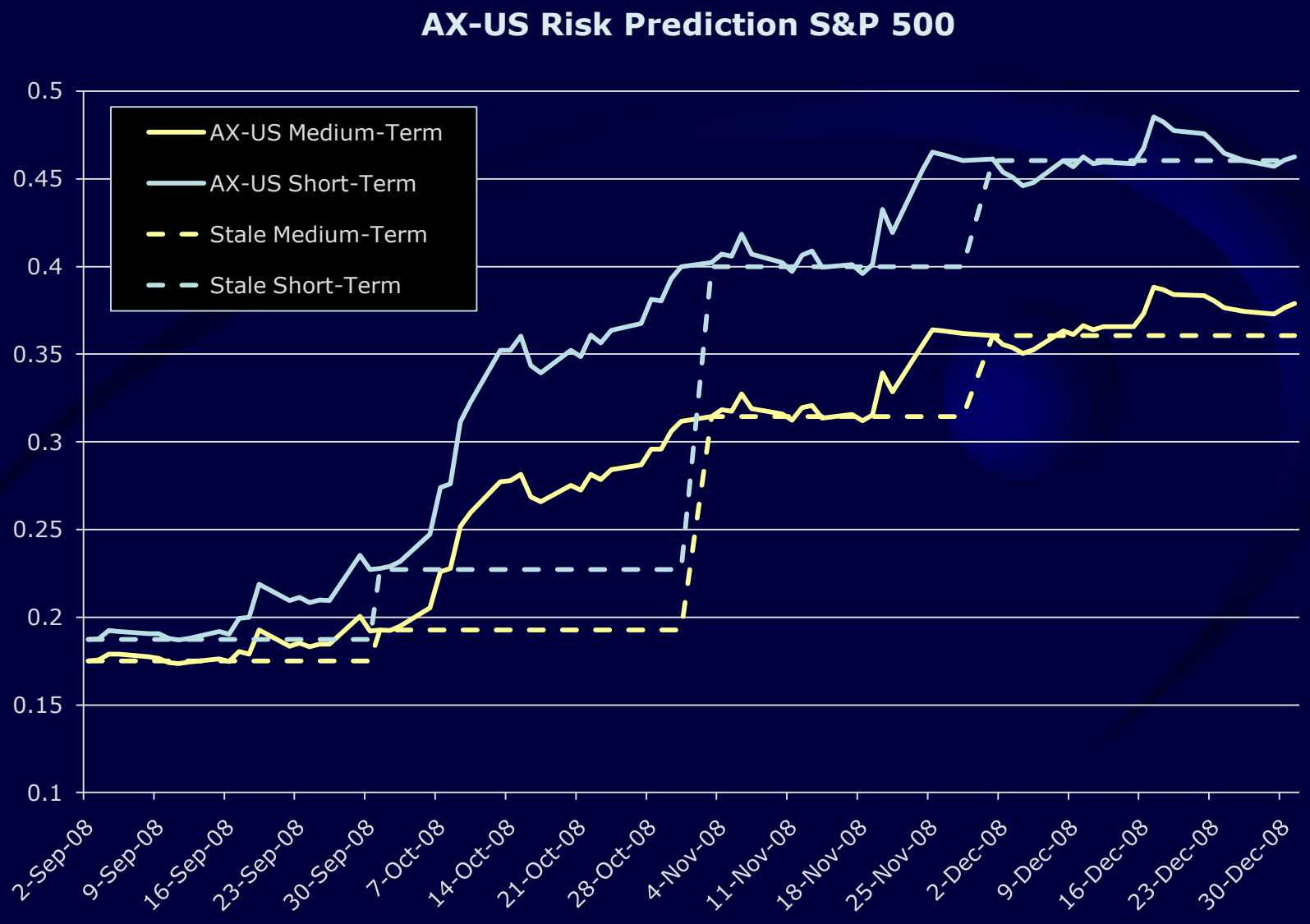
Daily versus Monthly Re-Estimation



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3. Types of Risk Models: Fundamental and Statistical

- Which types of Risk Models should be offered?
  - Fundamental vs Statistical vs Macro

- **Challenges:**
  - Expertise in various model construction techniques
  - Multiple models have to be integrated into software, and allowed to be used together to provide multiple views of risk

- **Benefits:**
  - Different views of risk available from one provider in one package, using consistent historical databases
  - Statistical models are more reactive and more relevant in times of crises
  - Fundamental models look for long-term trends and provide intuitive explanations for Portfolio Managers

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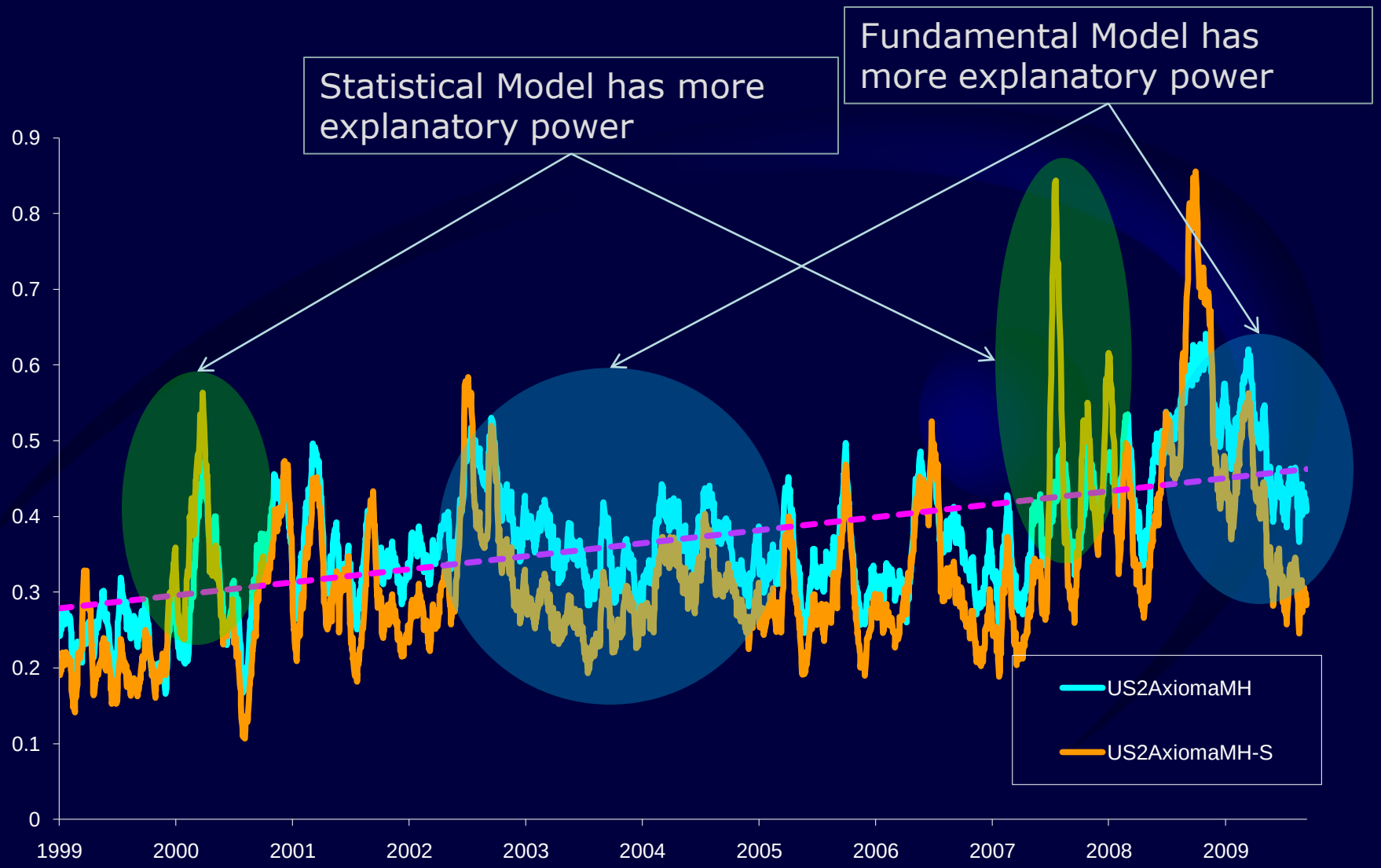
Model Explanatory Power - US



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4. Factor Structure: Industry Standard and Transparent

- What should be the factor structure of the risk model?
  - Complex Factor Structure vs Industry Standard/Transparent

- **Challenges:**
  - Are more factors better?
  - Are more complex factors better?
  - How can we make sure we match clients' factors with risk model factors?

- **Benefits:**
  - Common reporting paradigm (GICS), customized to deal with market idiosyncrasies
  - Consistent style factor structure across geographies
  - Ability to easily match style factors to alpha factors
  - Additional style factors have very low explanatory power

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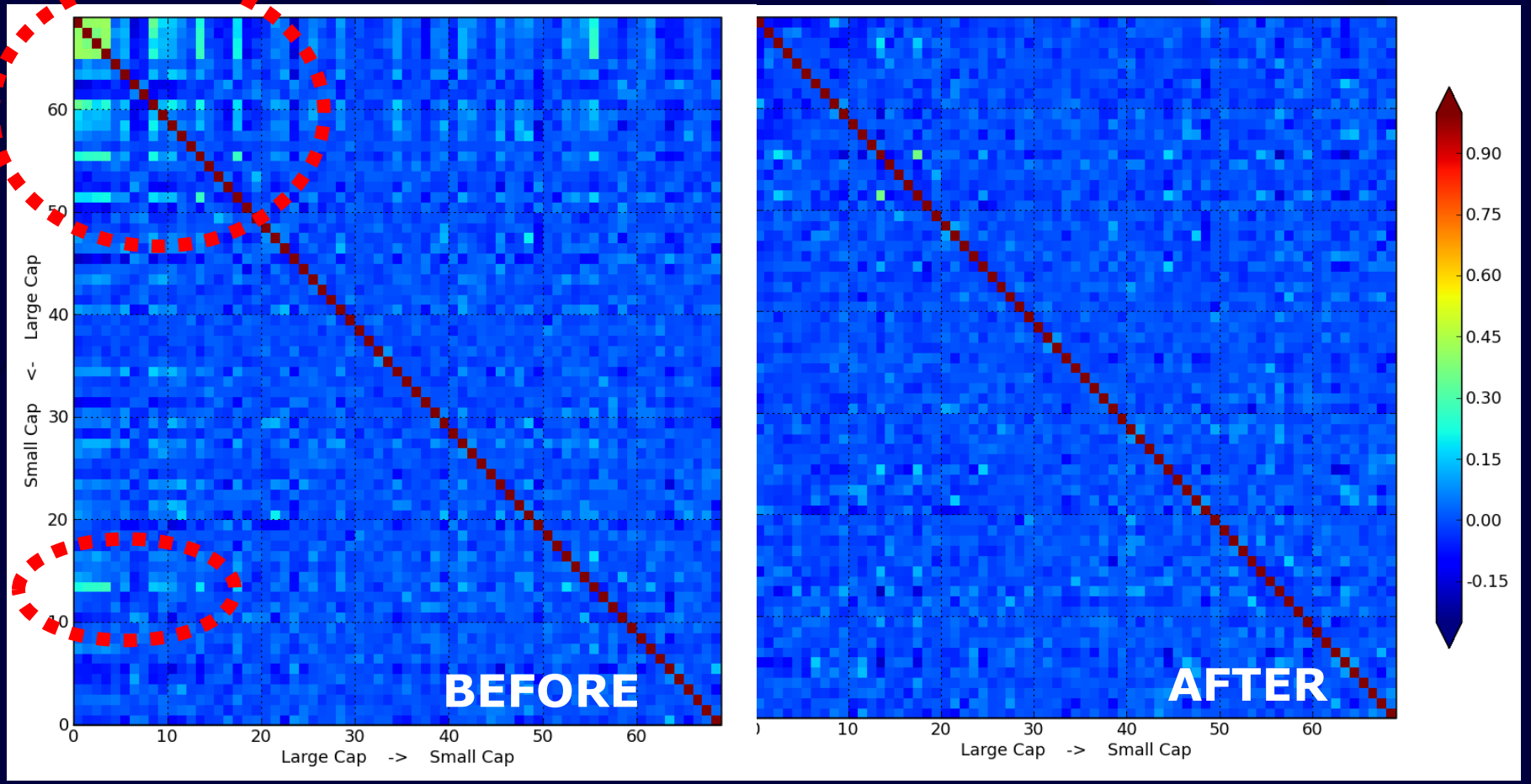
AX-CA Industry Factors

- Using GICS® *Industry Groups* or *Sectors* as industry factors, stock specific returns within *Metals & Mining* still show a lot of cross-correlation not captured by model factors



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5. Risk Models and Optimization: Full integration

- **Challenges**:
  - Interaction of Risk Models and Optimizers leads to risk underestimation
  - Risk model factors, alpha factors and constraint mis-alignment is a pervasive problem that also leads to underperformance
  - Adding your own alpha factors to the risk model does not cure the problem altogether but it helps
  - Constraints have an effect too, look at implied alpha vs alpha

- **Benefits:**
  - Axioma's Alpha Alignment Factor is designed to fix these issues, it is the orthogonal part of implied alpha
  - Addition of the AAF is fully integrated into our software
  - The AAF helps push the efficiency frontier, literally

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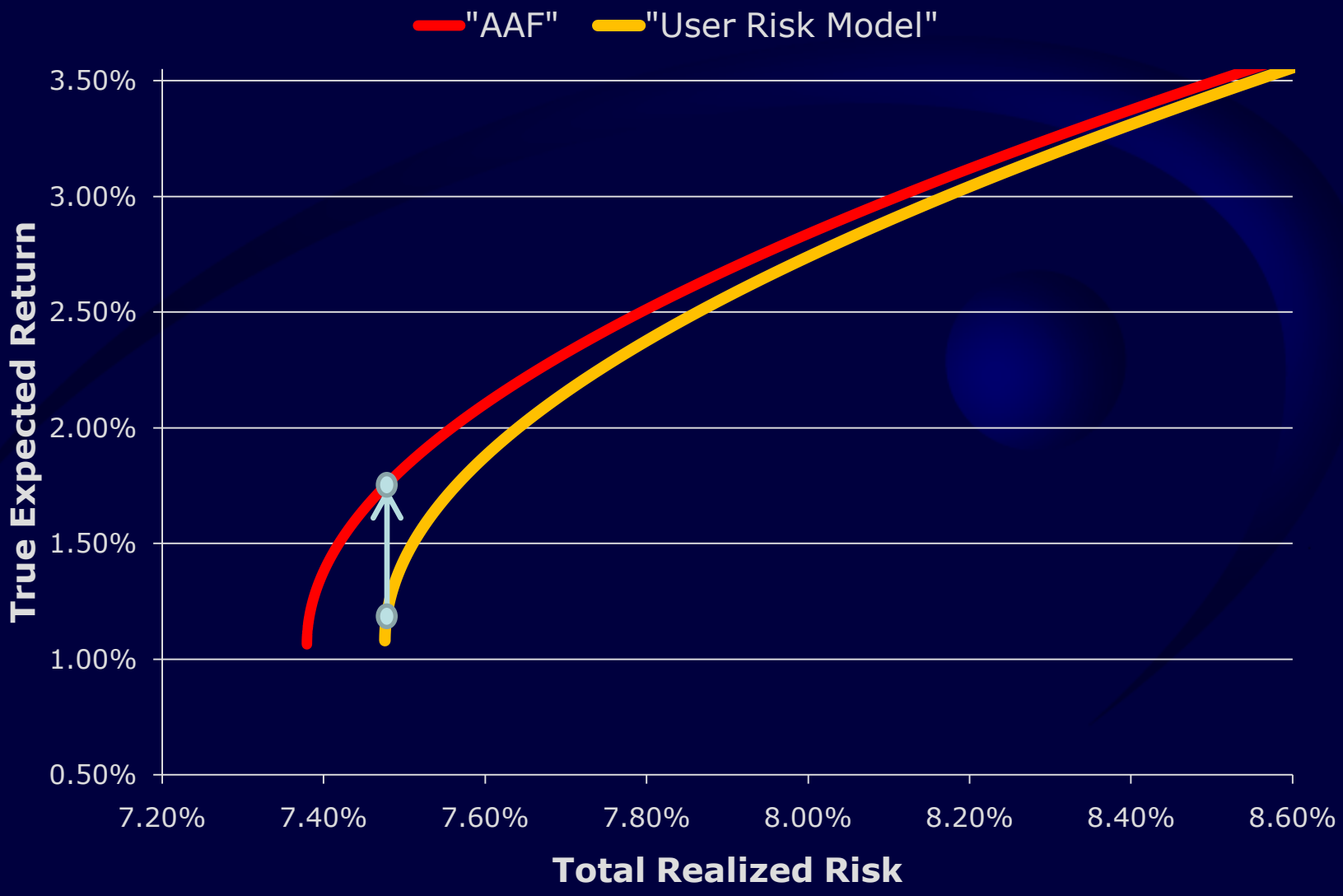
The AAF Pushes the Efficiency Frontier



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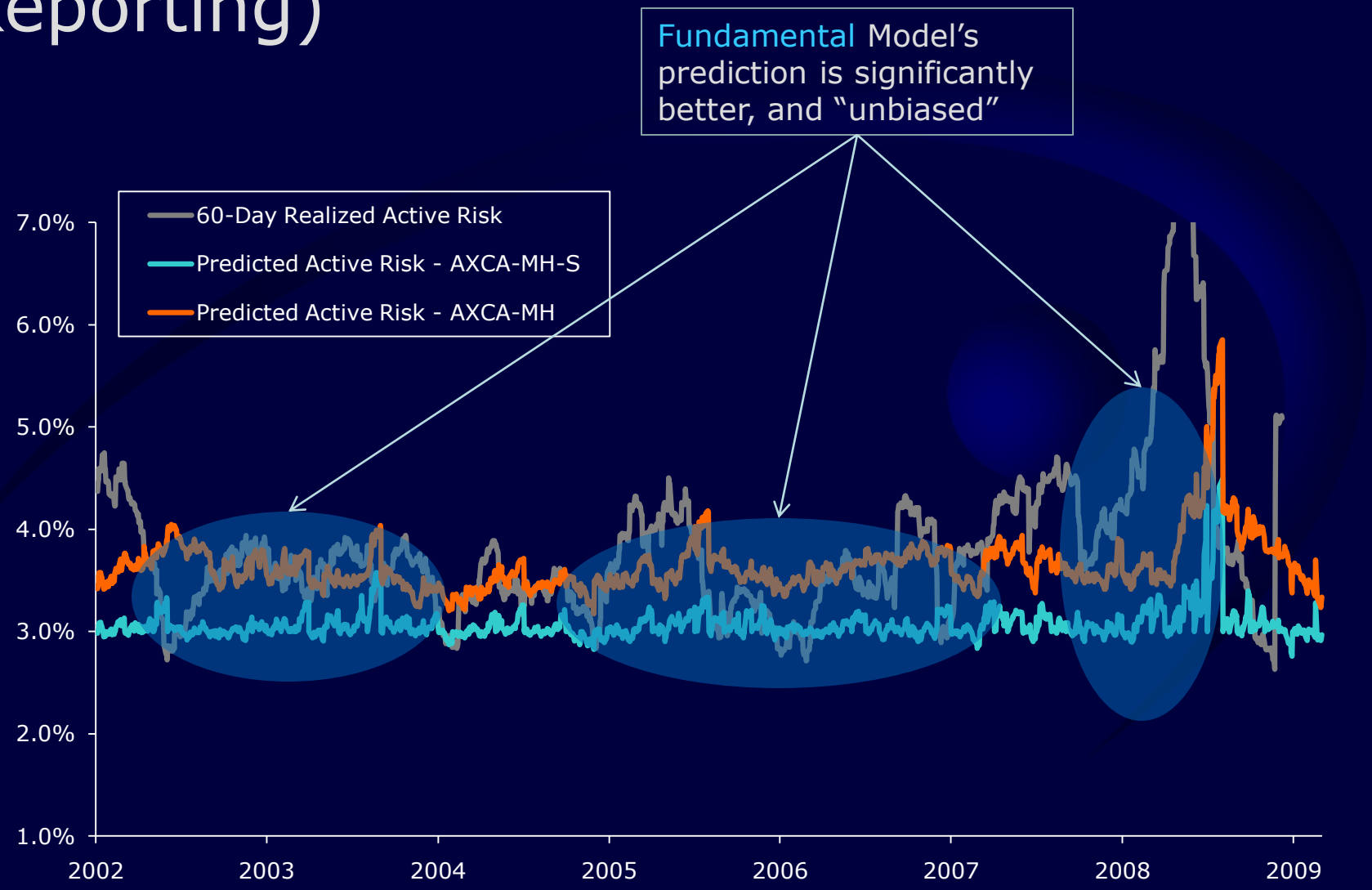
Statistical Backtest (Fundamental Reporting)



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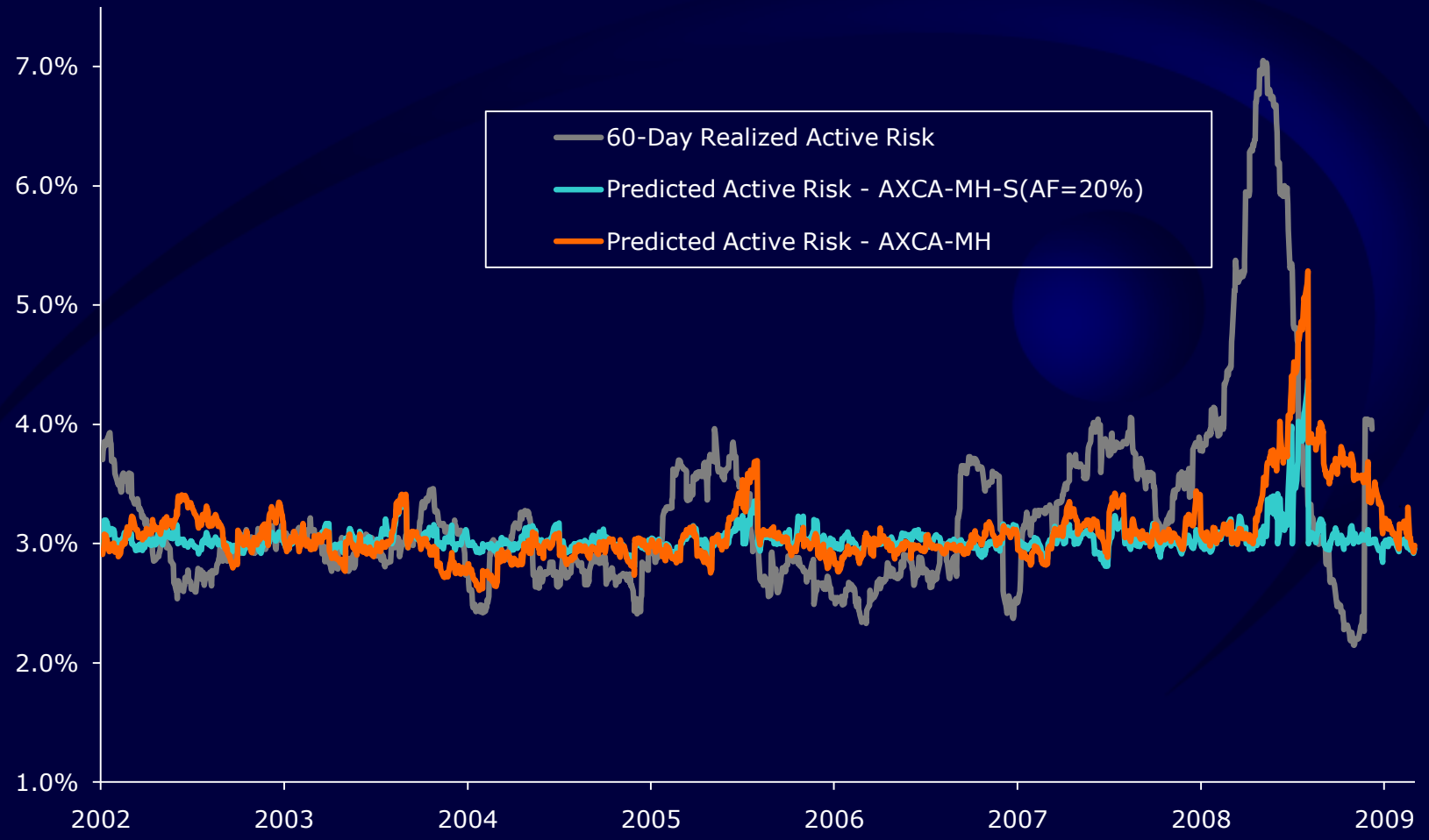
Statistical Backtest (Fundamental Reporting) (with the AAF)



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Conclusion

1. Use daily data, better predictions, more responsiveness
2. Update all risk model components daily, up-to-date information, flexibility for rebalancing
3. Have multiple models available, different views of risk are important in times of turbulence
4. Use a simple and transparent factor structure, the minor improvements in explanatory power are not worth the complexity
5. Link the risk models and the optimizer tightly, manage the alignment of your alpha factors, risk model factors and constraints

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