Non-Linear Cyclical Effects in Credit Rating Migrations: A Markov Switching Continuous Time Framework

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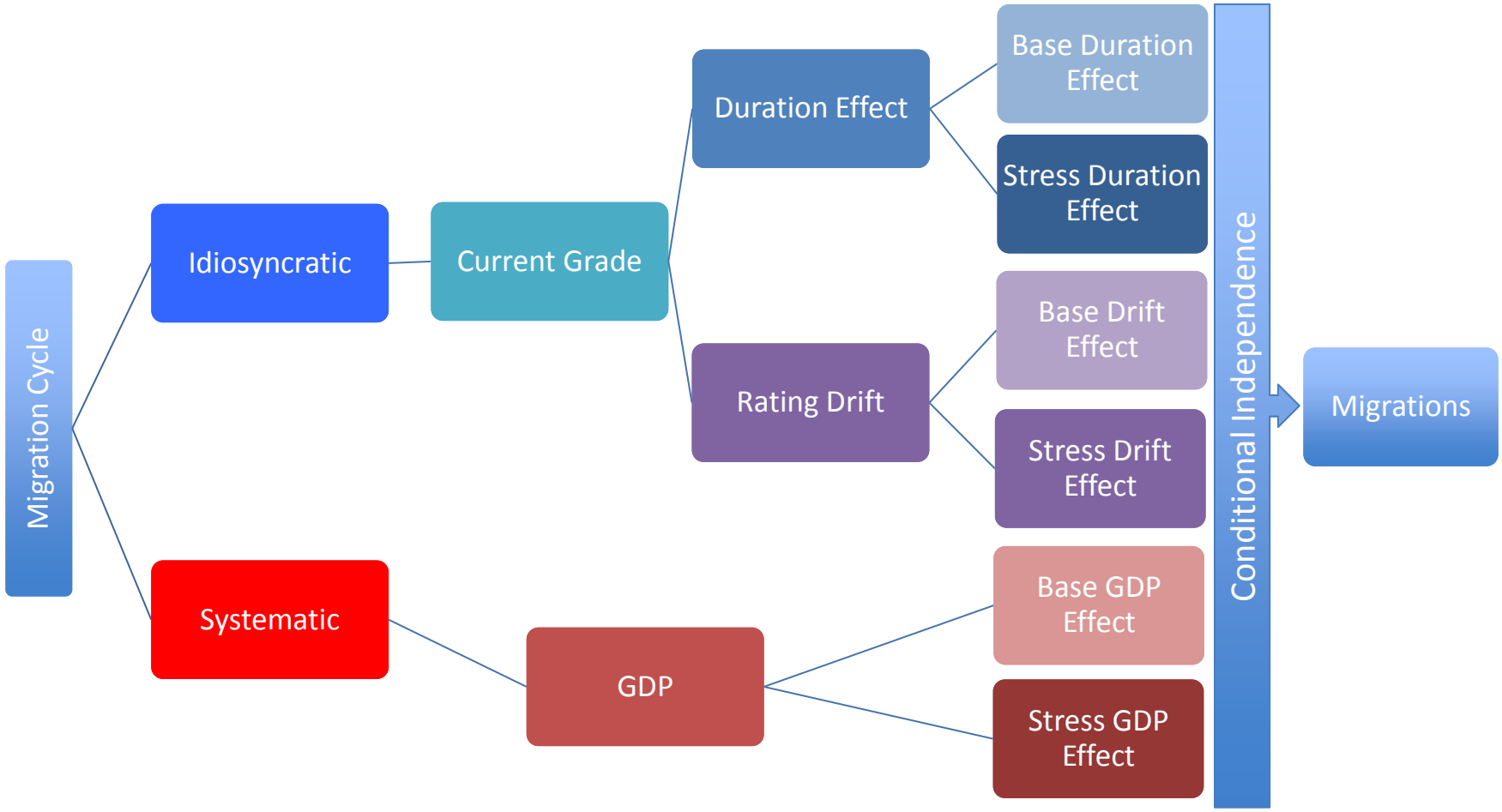
Overview

- **A Markov Switching Framework for Rating Migrations**
  - Different parameters during benign and stress economic periods
  - Switching between stress/non-stress periods endogenous
  - Log-Logistic survival model using continuous time
  - Rating Drift & Duration Dependence Effects
- **Implication for Credit Risk Stress Testing**
  - RWA
  - Marked-to-Market (MtM) Losses
- **Conclusion**
- **Q&A**

Statistical Model

Modeling the Transition Matrix

- **How the model works**



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Econometric Specification

- **Statistical Framework**
  - **Log-logistic survival model** with firm specific (*i*) and calendar time (*q*) effects

$$\log(t_i) = \alpha + \beta X_q + \gamma Drift_i + \alpha + \beta X_q + \gamma Drift_i + \varepsilon + u_i,$$

$$u_i \sim \text{Logistic}(0, \gamma_i)$$

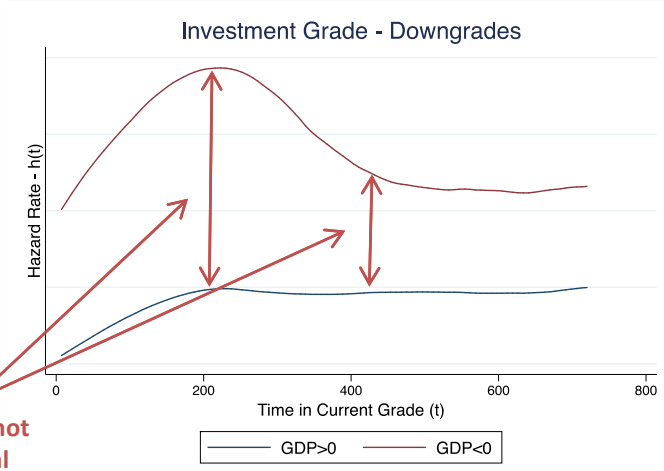
  -
  - **Correction** to grade *k* baseline Fixed Effects **during periods of stress (*s*)**
    - Correction is applied at the rating grade level
    - The time series of regime indicators follows a **2 state time homogeneous Markov Switching** model with transition probabilities

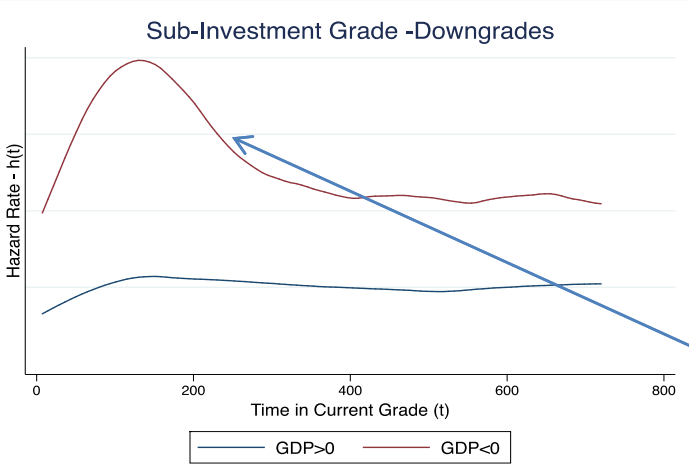
$$\xi_{12} = \Pr(S_q = 2 \mid S_{q-1} = 1), \qquad \xi_{21} = \Pr(S_q = 1 \mid S_{q-1} = 2)$$

  - **Grade *k* Random Effects** for each quarter *q* ($\eta_{k|q}$) to capture migration noise

Duration Effect

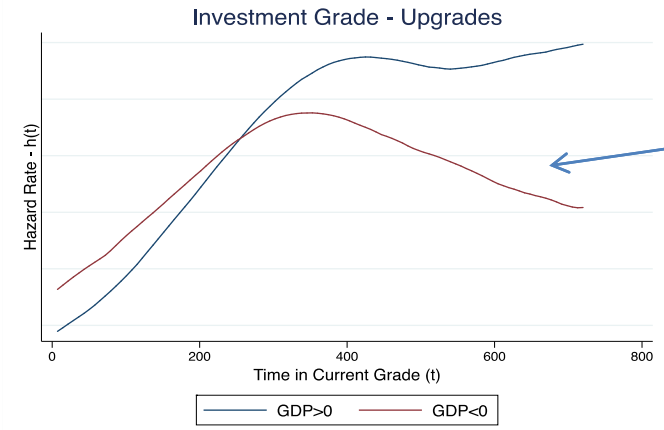
- **Why log-logistic form?**

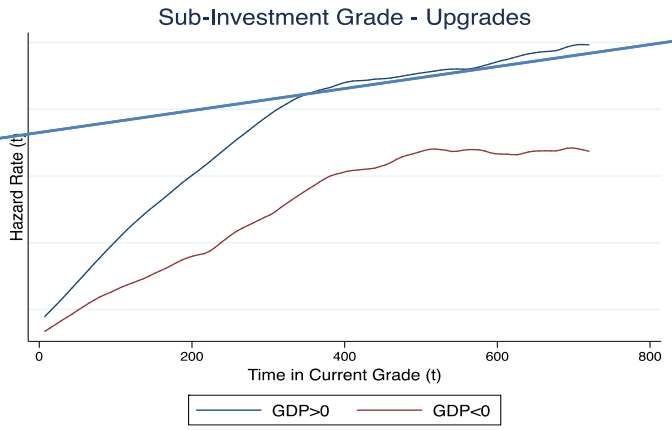




GDP Effect not proportional

Hazard rate is not always monotonically increasing/decreasing





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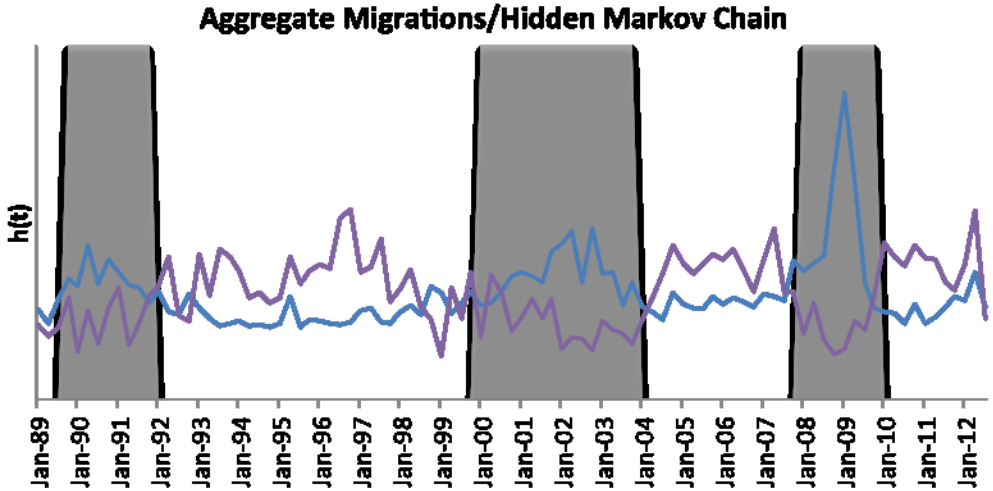
Estimates

Migration Cycle Regimes

- **Regimes are clearly separated and very persistent**
  - The state of the hidden Markov Chain closely follows the peaks in aggregate downgrades



  - Markov Chain Transition Matrix suggest an expected duration of ~16 quarters for regime 1 and ~11 quarters for regime 2

$$P_S = \begin{bmatrix} 0.935 & 0.065 \\ 0.09 & 0.91 \end{bmatrix}$$

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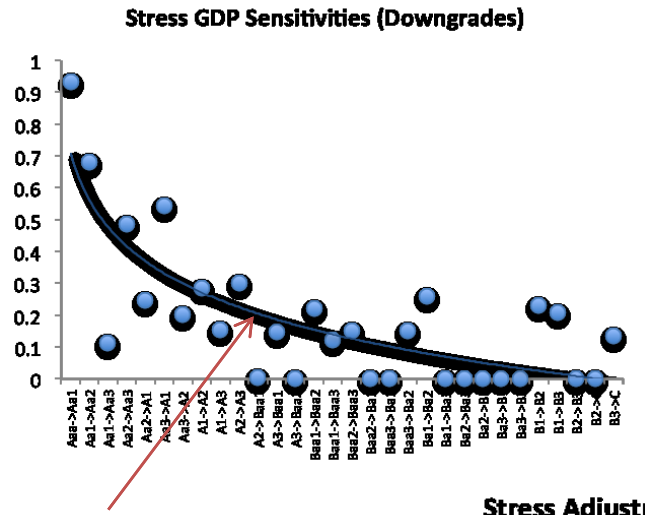
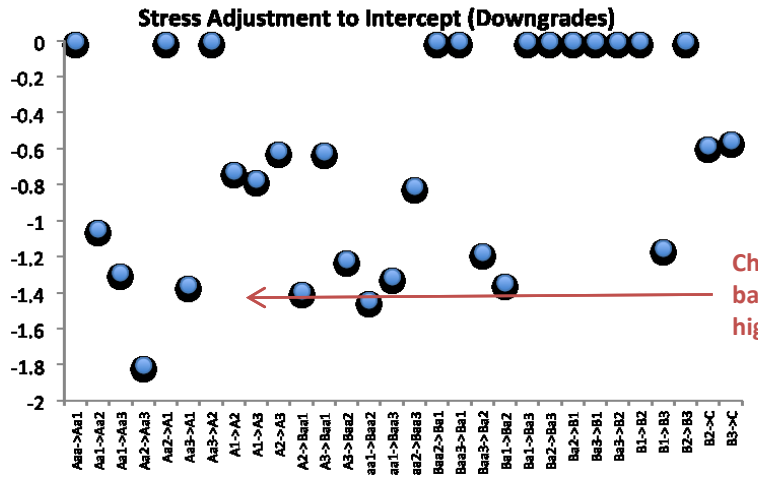
Switching Parameter Estimates

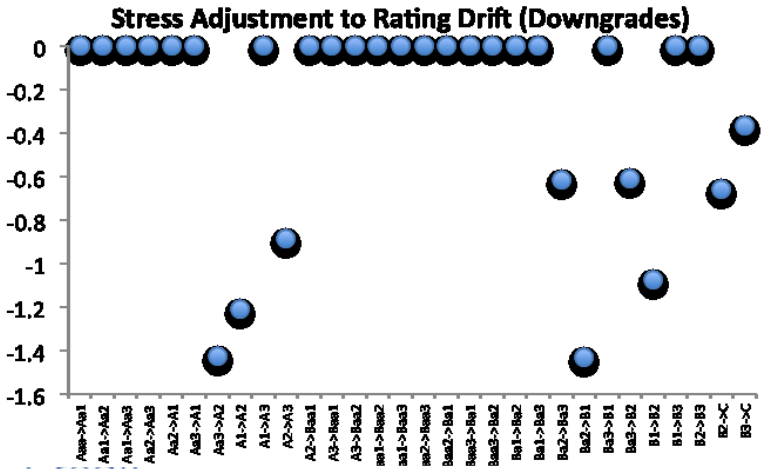
- **Significant differences in parameter estimates for Downgrades**



Macroeconomic effect almost exponential decays across the rating scale



Change in level more balanced, but on average higher for investment grade



Rating Drift remains largely unaffected

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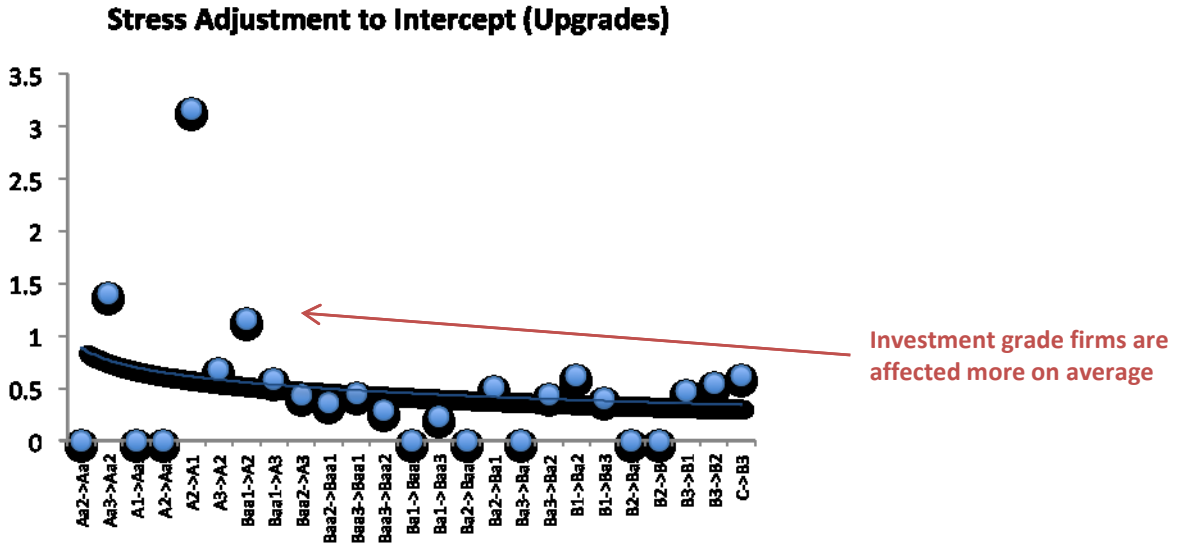
Switching Parameter Estimates

- **Regime dependence weaker for upgrades**
  - Strong evidence of level change
  - Sensitivity to GDP is very low
    - Indication that rating agencies are less inclined to upgrade firms even in benign periods
    - No evidence of different behavior during periods of stress
  - Rating Drift effect is very strong
    - No evidence of effect increase during periods of stress



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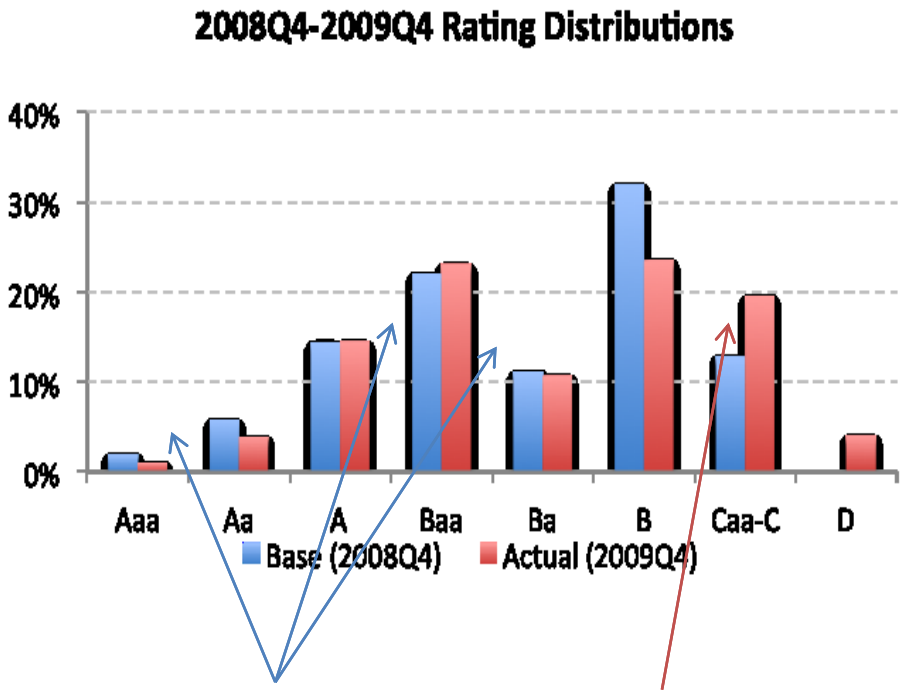
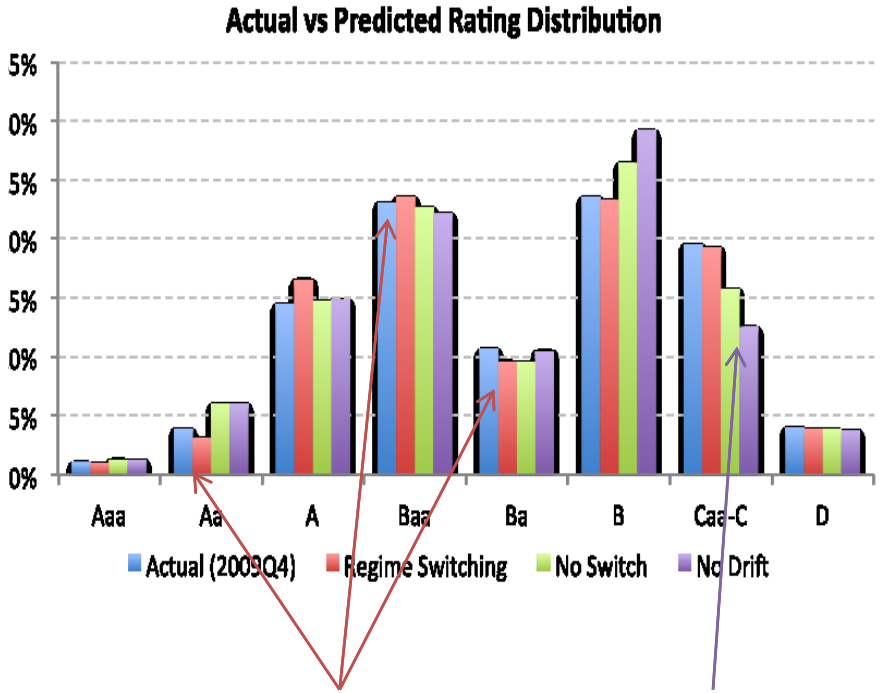
Implications for Stress Testing

Credit Portfolio Parameters

- **Credit Instruments**
  - Moody's portfolio as of 2008Q4 is used
  - Equal exposure of £100 for each firm in the portfolio
    - For a total of 2,665 firms, total exposure is £266,500
  - Exposures correspond to zero coupon bonds
  - Bond maturity set to 10 years
- **Credit Parameters**
  - 39% Recovery Rate
    - Based on Moody's 30-days post default trading prices for corporate bonds
  - For RWA purposes, Moody's long run TTC DRs are used
  - Actual time in current grade is used as of 2008Q4
- **Calculations**
  - Results based on 10,000 simulations
  - All results conditioned on being in regime 2 (stress period)

Portfolio Distribution





Rating distribution not overly sensitive to credit cycle (TTC Ratings)

Sharp migration of firms from B->Caa-C ratings (PiT elements in credit ratings)

Predicted and actual distributions are very close

In the absence of rating drift migrations from B->Caa-C are severely underestimated

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Risk Metrics

- **RWA**
  - RWAs closer for switching model as compared to non-switching model
  - RWA for the specification with no switching and no rating drift is the closest to the actual
    - Misleading result, since it is primarily driven by the over-prediction for B rated firms (Ba and B grades have the highest weighting in overall RWA)

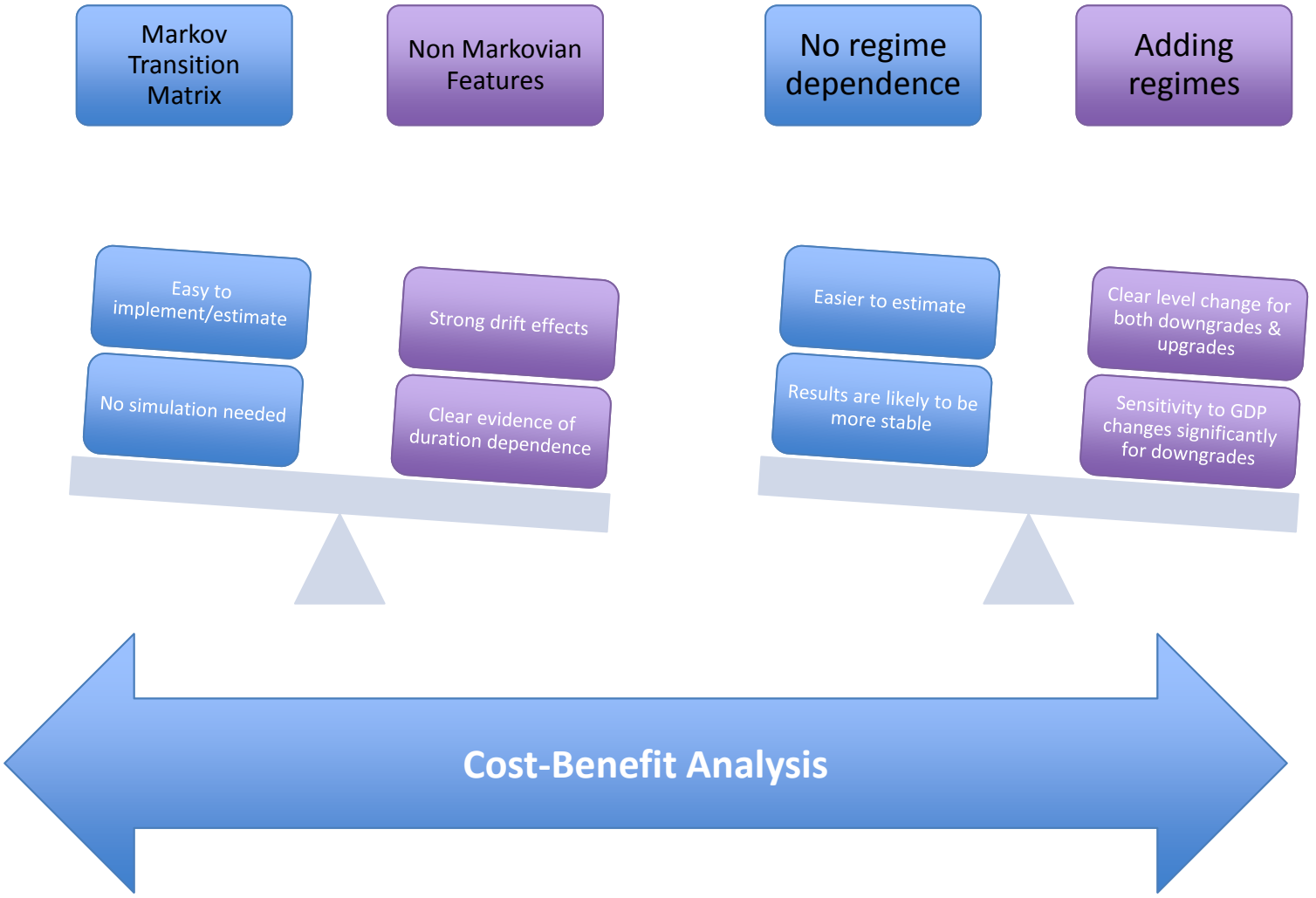
	Actual	Regime Switching	No Switch	No Drift
RWA	**25,012**	**24,861**	**24,834**	**25,087**
% Diff From Actual	-	-0.60%	-0.71%	0.30%

- **Marked-to-Market (MtM)**
  - Regime Switching model gives MtM portfolio value extremely close to actual
  - Ignoring Switching and Rating Drift can lead to 100bp error in MtM portfolio value

	Actual	Regime Switching	No Switch	No Drift
MtM (Excl Default)	**392,005**	**392,531**	**390,186**	**388,007**
% Diff From Actual	-	0.13%	-0.46%	-1.02%
MtM (Incl Default)	**374,046**	**374,437**	**372,341**	**370,319**
% Diff From Actual	-	0.10%	-0.46%	-1.00%

Conclusion

Key Take-Aways



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Questions

Q&A