How much is too much?
Assessing the non-linear relationship between debt and sovereign creditworthiness

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Objective: Better understand the complex relationship between economic fundamentals and sovereign ratings by using statistical learning methods
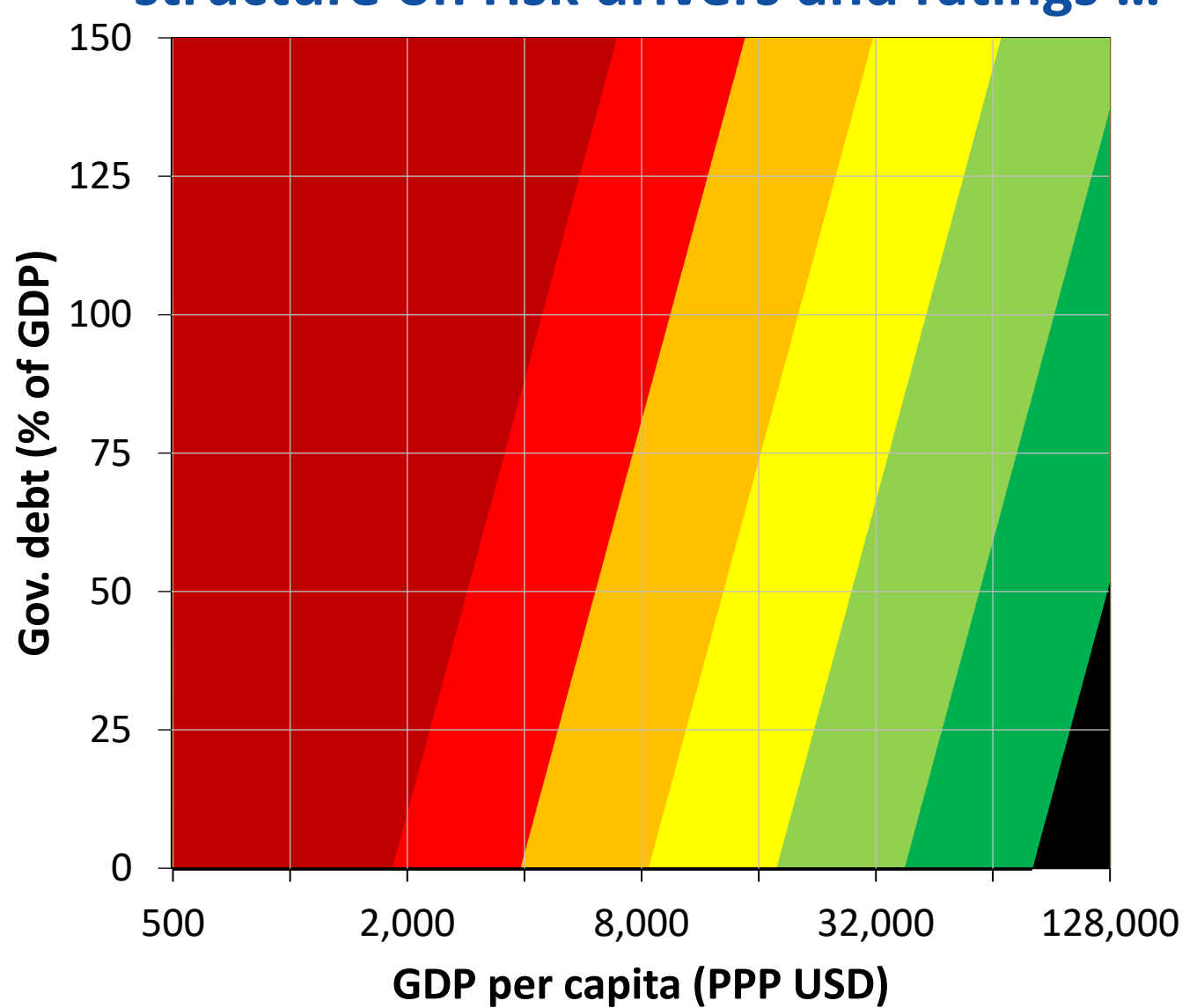
Assuming the simplest linear relation between sovereign creditworthiness and its drivers is an often used simplification
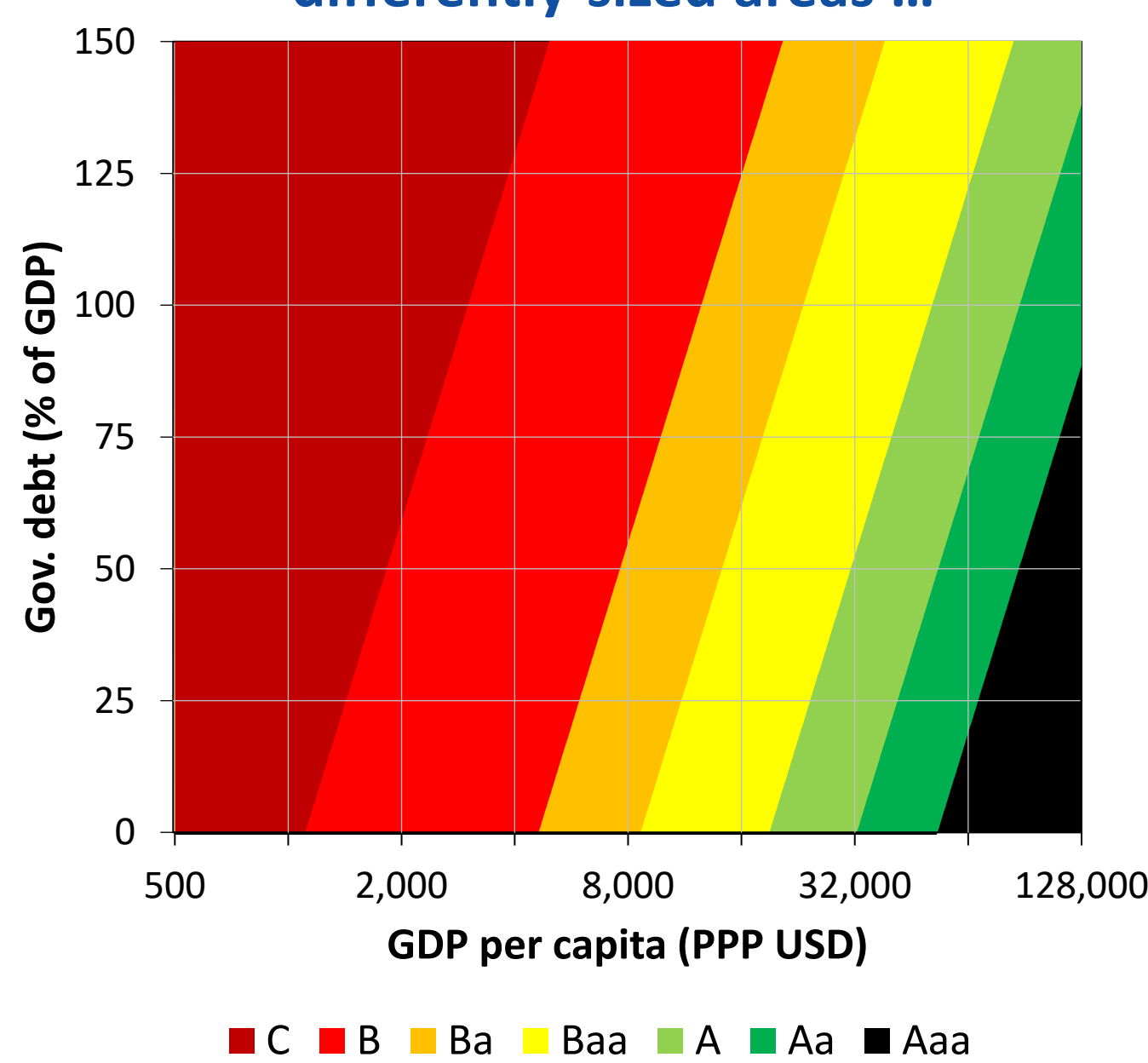
Instead, this paper allows for an endogenous structure and derives the debt thresholds associated with rating changes from the data
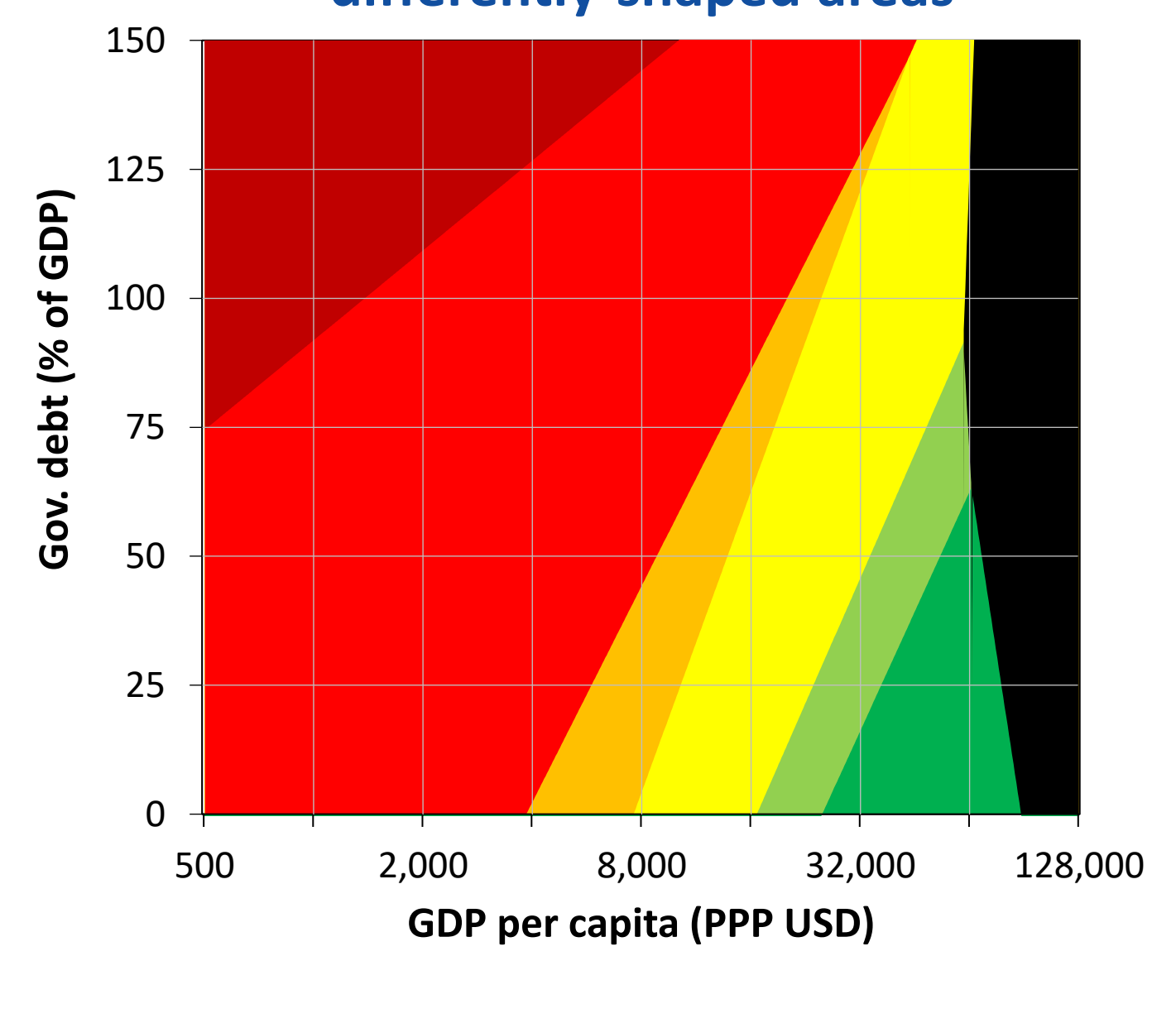
OLS imposes a stringent, regular structure on risk drivers and ratings …

… ordered logit allows for differently-sized areas …

… sequential logit also allows for differently-shaped areas
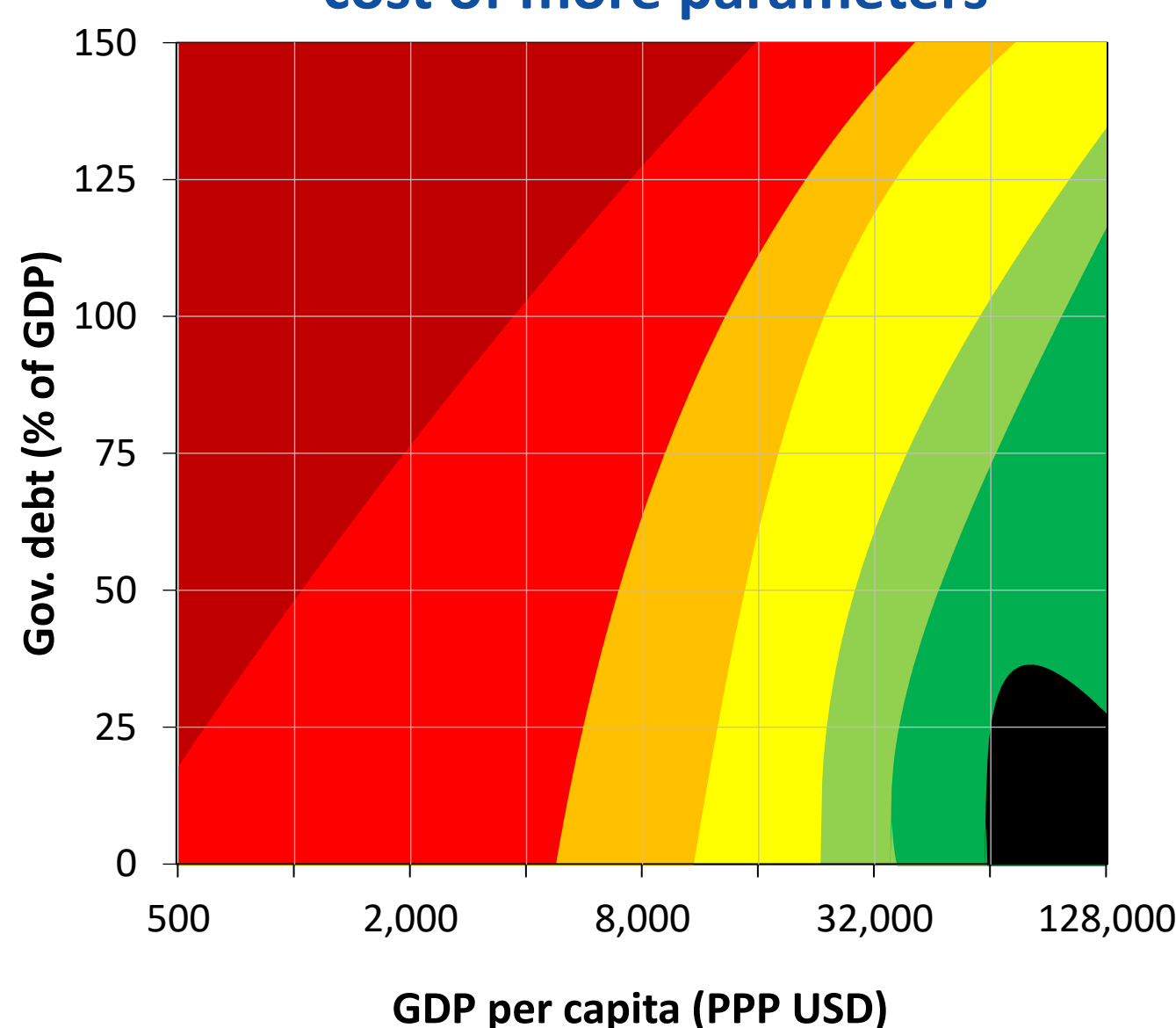

■ C ■ B ■ Ba ■ Baa ■ A ■ Aa ■ Aaa

Using logit to separate rating classes

✓ Each debt threshold is estimated separately
✓ The estimation is controlling for public finances, economic performance, external performance and institutional quality
✓ The control variables are first regressed on GDP per capita and government debt => debt thresholds also capture the indirect effects of GDP per capita and debt
✓ A country performing worse on the control variables than suggested by its GDP per capita and government debt, will face more restrictive thresholds, or alternatively, a penalty on its debt (adjusted debt)

Orthogonal control variables help to separate rating classes and visualise results

Imposing less structure markedly improves the model performance, which confirms the non-linear relationship between fundamentals and ratings
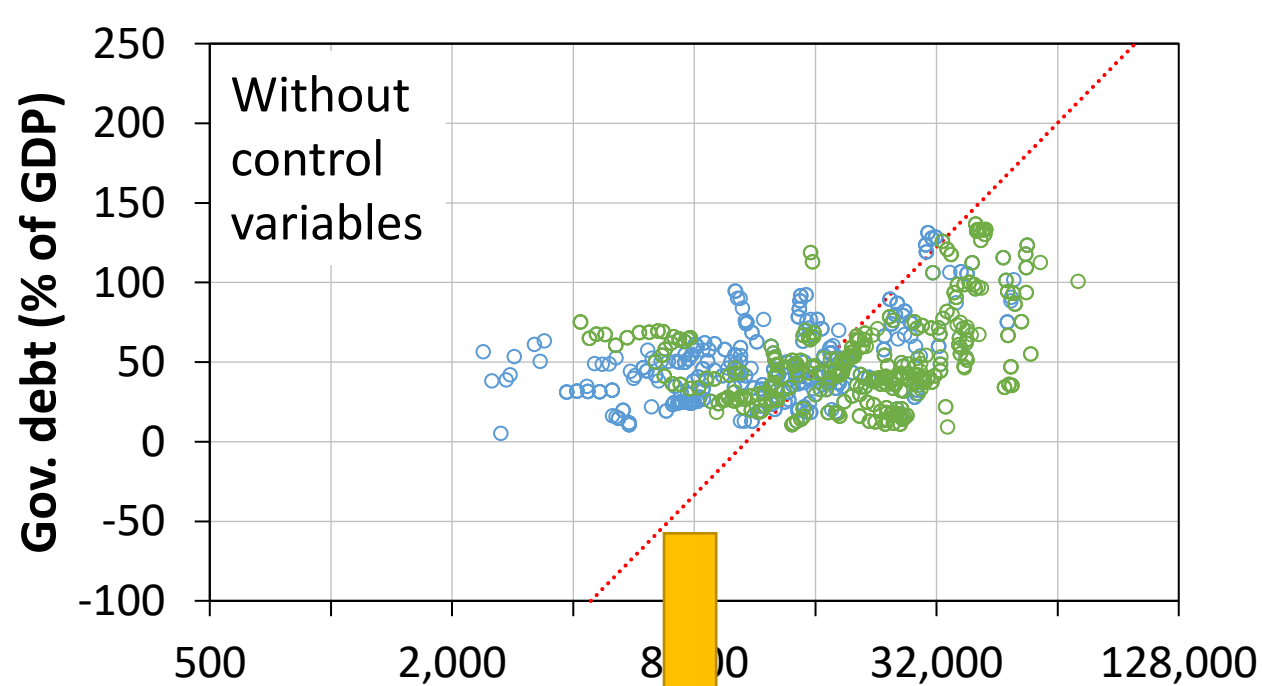
Share of correctly predicted ratings	OLS	Ordered logit	Sequential logit
Linear regressions	52%	55%	63%
Quadratic regressions	55%	59%	69%

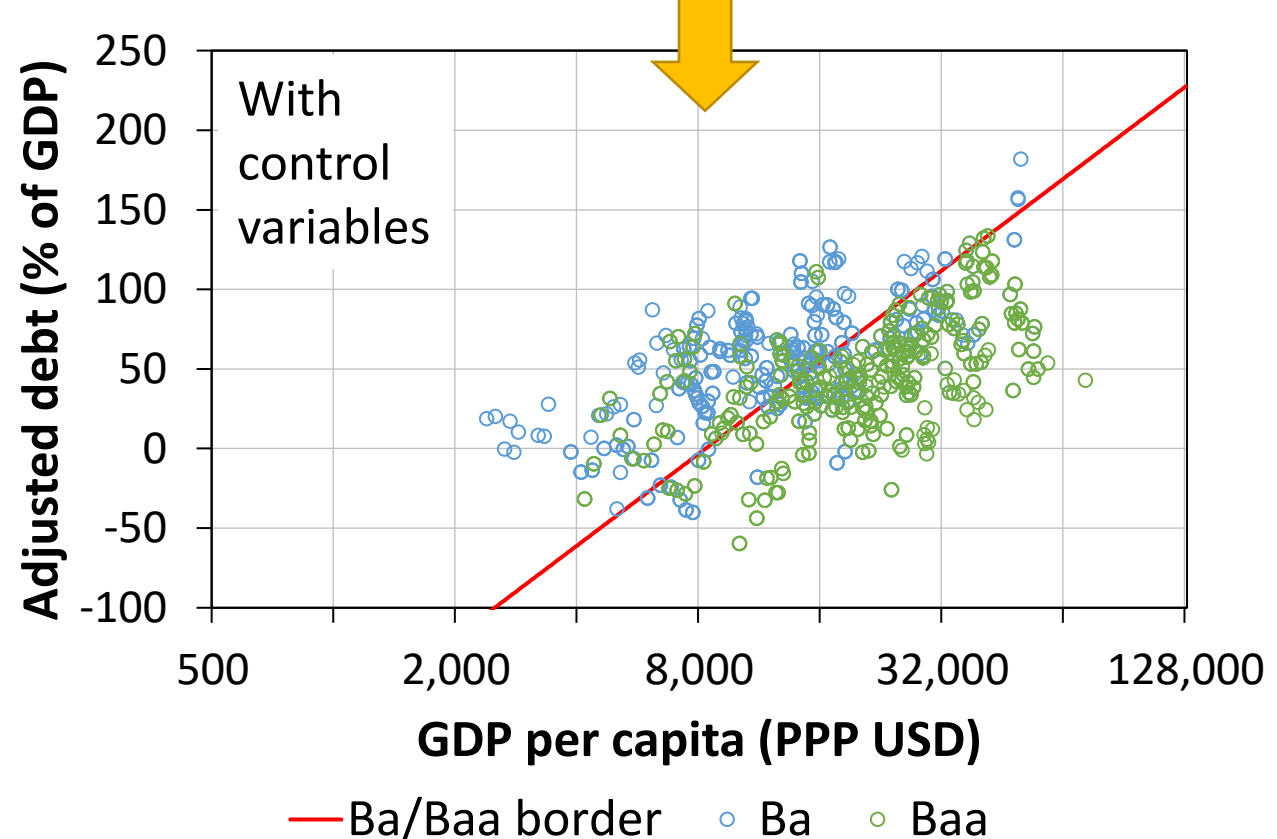**Quadratic terms for public finances can further improve the performance at the cost of more parameters**

The findings are confirmed by various robustness tests:

✓ Cross-validation to assess the degree of overfitting
✓ Gradually declining weights of more distant ratings
✓ Individual ratings (e.g. Baa1) instead of rating bands (e.g. Baa)
✓ Higher share of C-ratings (using EIB internal ratings)

! *Implications could be relevant beyond sovereign entities*

FINDINGS

★ The relation between economic fundamentals and ratings is highly non-linear
★ Imposing the simplest linear structure (OLS) pushes the quest for simplicity too far, results may not even be useful
★ "What drives ratings?" does not have a simple answer => any analysis of rating drivers only holds for part of the rating scale
★ The endogenous structure provides new insights:
  ★ The large area of Baa-ratings could reflect rating agencies' reluctance to downgrade below investment grade;
  ★ Ba- and A-ratings are rather "transitory" given their small areas
  ★ C-ratings are very different => perhaps too ambitious to cover by the same model