

# Regime Type and Heavy Indebtedness: A Quantile Regression Analysis

Yong Kyun Kim

The University of North Carolina at Chapel Hill

ykkim@email.unc.edu

## Abstract

Do democracies tend to be less heavily indebted to foreign lenders than autocracies? OLS regression analysis gives only an incomplete answer at best, and is often misleading. First, typical measures of indebtedness include outliers to which OLS is sensitive. More importantly, the debt levels might differ across regime types not only in terms of the central tendency (mean or median) but also at various quantiles along the entire distributions. In other words, typical democracies may or may not accumulate less debt than typical autocracies; but heavy-borrowing democracies do accumulate significantly less debt than heavy-borrowing autocracies. Quantile regression analysis is used to capture this difference in heavy indebtedness across regime types.

## Questions and Problems

Just as the mean gives an incomplete picture of a single distribution, so the regression curve gives a corresponding incomplete picture for a set of distributions (Mosteller and Tukey 1977, p. 266).

That said, there is no reason to limit our understanding of causal effects to changes in the means of such distributions (Braumoeller 2006, p. 270).

## Questions

- Do democracies accumulate less external debt than autocracies? (central tendency)
- Do democracies tend to be less heavily indebted than autocracies? (upper tail behavior)

## Problems with OLS

- Measures of indebtedness (debt to GDP ratio) have outliers;  $\hat{\beta}_{OLS}$  (conditional mean difference) is sensitive to those outliers; it might over- or underestimate the difference in the typical debt levels across regime types
- Regime type might also affect the distributions of external debt level; specifically, democratic leaders are more constrained than their autocratic counterparts in how much they can accumulate foreign debt, and hence, the distribution of debt level tends to be more condensed for democracies than for autocracies; then,  $\hat{\beta}_{OLS}$  might fail to capture the difference in the extent of heavy indebtedness between democracies and autocracies
- OLS provides only an incomplete picture at best; it is often misleading

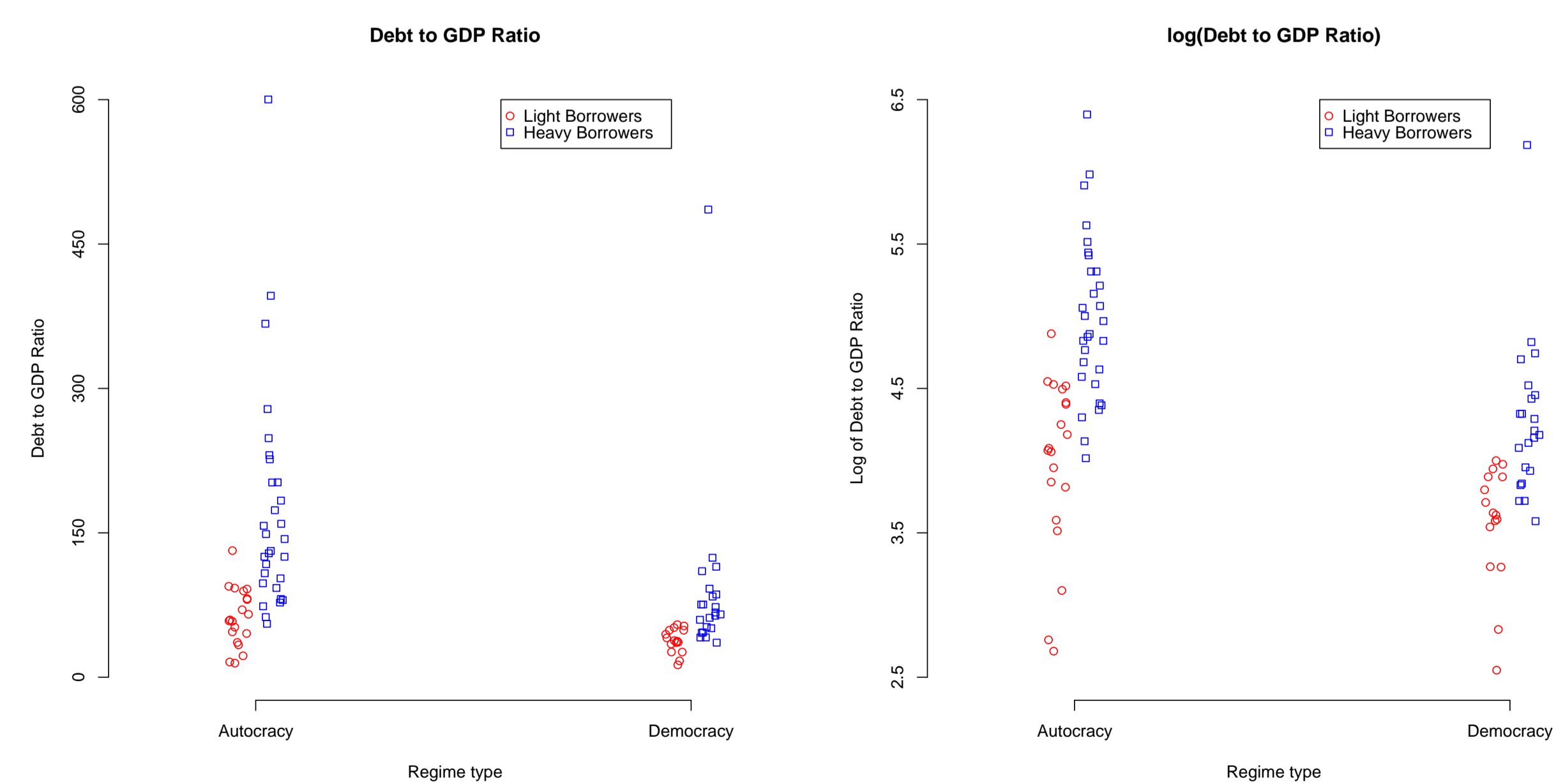


Figure 1: Regime type and (log of) debt to GDP ratio by previous debt levels

## Quantile Regression

- 0.5 quantile (or median) regression is more robust to outliers than OLS
- Upper tail quantiles (such as 0.75, 0.9, 0.95 quantiles) regressions can shed light on the differences in overborrowing tendencies between groups (e.g., are heavy-borrowing autocracies more heavily indebted than heavy-borrowing democracies?)
- A collection of quantile regressions at various quantiles provides a better picture of how effects of x on y varies along the entire distribution
- q quantile (or  $q \times 100^{th}$  percentile) regression estimator  $\hat{\beta}_q$  minimizes the asymmetric absolute loss function with respect to  $\beta_q$ :

$$\sum_{i: y_i \geq \mathbf{x}'_i \beta} q |y_i - \mathbf{x}'_i \beta_q| + \sum_{i: y_i < \mathbf{x}'_i \beta} (1-q) |y_i - \mathbf{x}'_i \beta_q|$$

- Linear programming methods are used to compute  $\hat{\beta}_q$
- Bootstrap procedure is used to calculate standard errors

## Data and Model Specification

- Sample: 87 developing countries
- Dependent variable: Total external debt to GDP ratio (and its logarithmic transformation), averaged from 1990 to 2003 (from IMF *Global Development Finance*)
- Independent variable: Democracy indicator coded 1 if average Polity score over the same period is greater than 3, coded 0 otherwise
- The model fits linear quantile regressions at various quantiles:

$$\text{Quant}_q(y_i | \mathbf{x}'_i) = \mathbf{x}'_i \beta_q$$

- x includes 1) debt level in the 80's; 2) GDP per capita; 3) GDP growth; 4) trade openness; 5) Log of GDP; 6) regional dummies (Eastern Europe, Latin America, Sub-Saharan Africa, and Asia as an omitted category) as well as the Democracy indicator

## Results

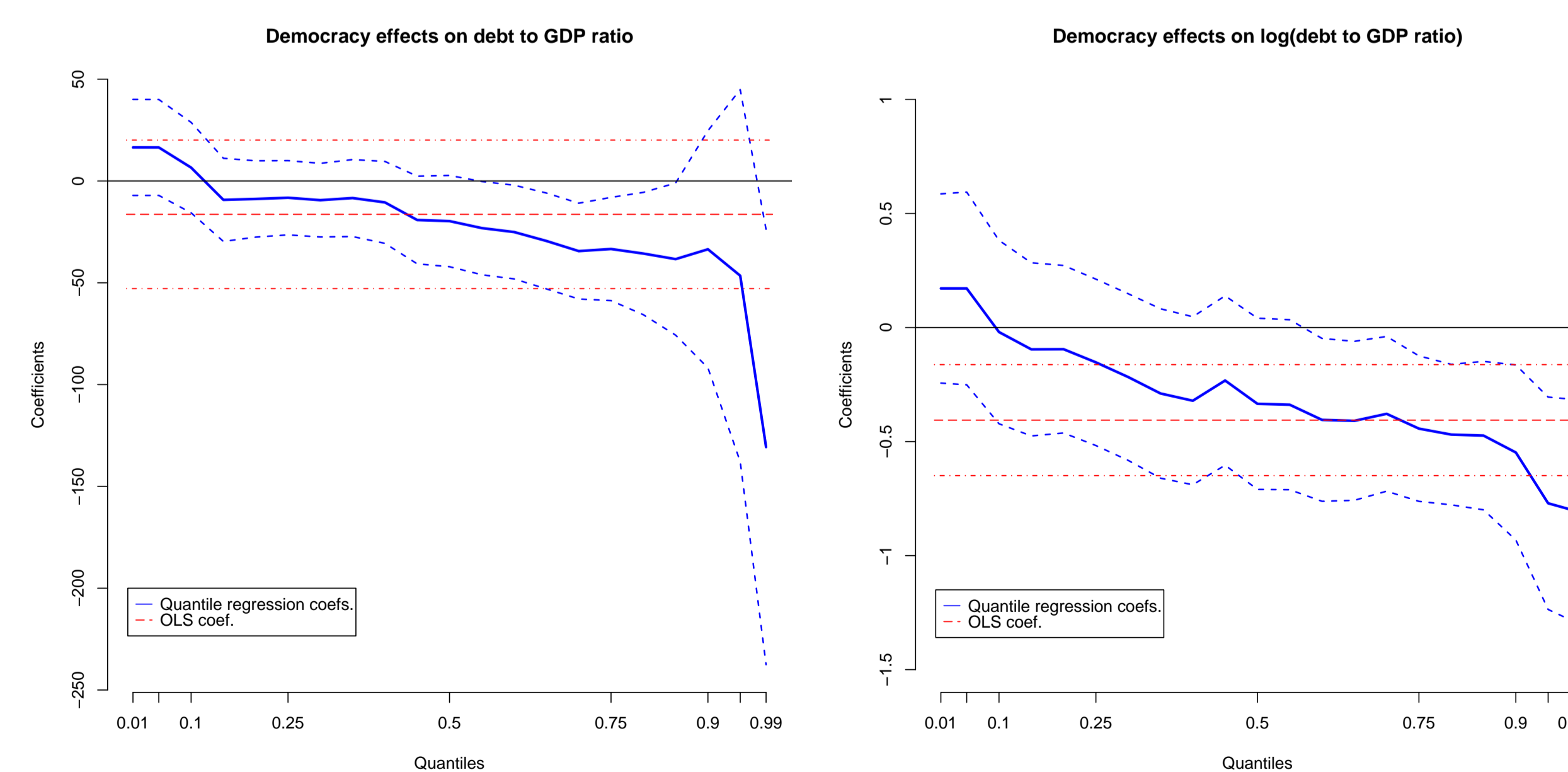


Figure 2: Democracy effects on (log of) debt to GDP ratio at various quantiles

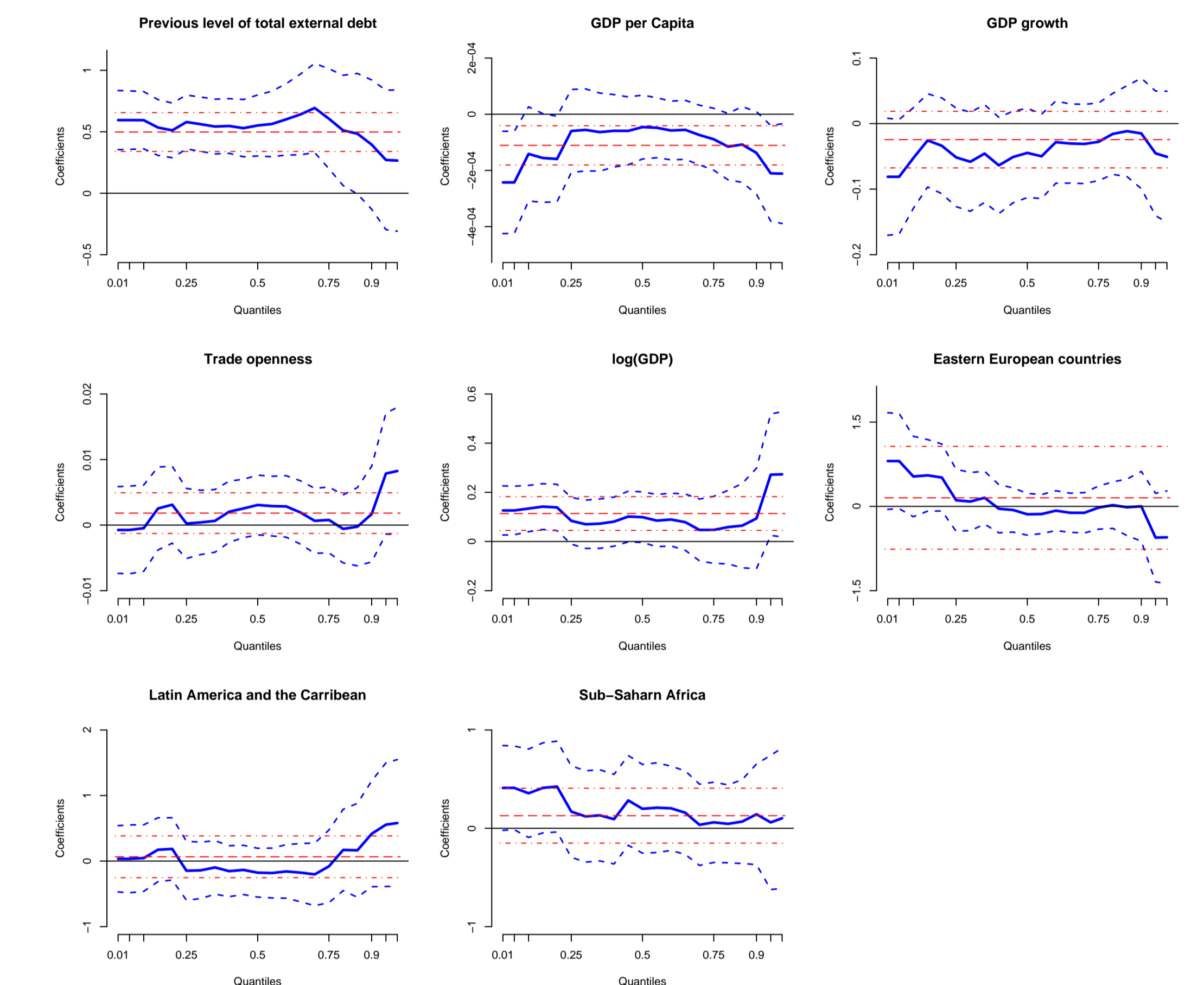


Figure 3: Quantile regression coefficients of other covariates

## Discussion

### Findings

- Being sensitive to outliers,  $\hat{\beta}_{OLS}$  seems to overestimate Democracy's negative effect on log(debt to GDP ratio);  $\hat{\beta}_{OLS}$  is significantly negative while  $\hat{\beta}_{median}$  is, albeit signed negative, not significant at 0.05 level
- $\hat{\beta}_q$ 's are positive, though not significant, at lower quantiles and become increasingly negative at upper quantiles;  $\hat{\beta}_q$ 's at 0.6 quantile or higher are consistently significantly negative

### Discussions

- Do democracies accumulate less external debt than autocracies? Yes, in the *mean* sense, but not in the *median* sense
- Do democracies tend to be less heavily indebted than autocracies? Yes, indeed, the *real* difference across regime types resides in the upper tail; heavy-borrowing democracies accumulate significantly less debt than heavy-borrowing autocracies; And this difference tends to be more evident at higher quantiles
- $\hat{\beta}_{OLS}$  cannot reveal this difference and misleadingly attributes it to a difference in the typical (mean) debt levels across regime types
- Quantile regression can be valuable when we are interested not only in changes in the central tendency of the variable but also in changes in its entire distribution