Affine term structure models: forecasting the Colombian yield curve

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Section 1

The term structure

The term structure of interest rates

Term structure (TS): relates interest rates γ with investment time horizons τ.

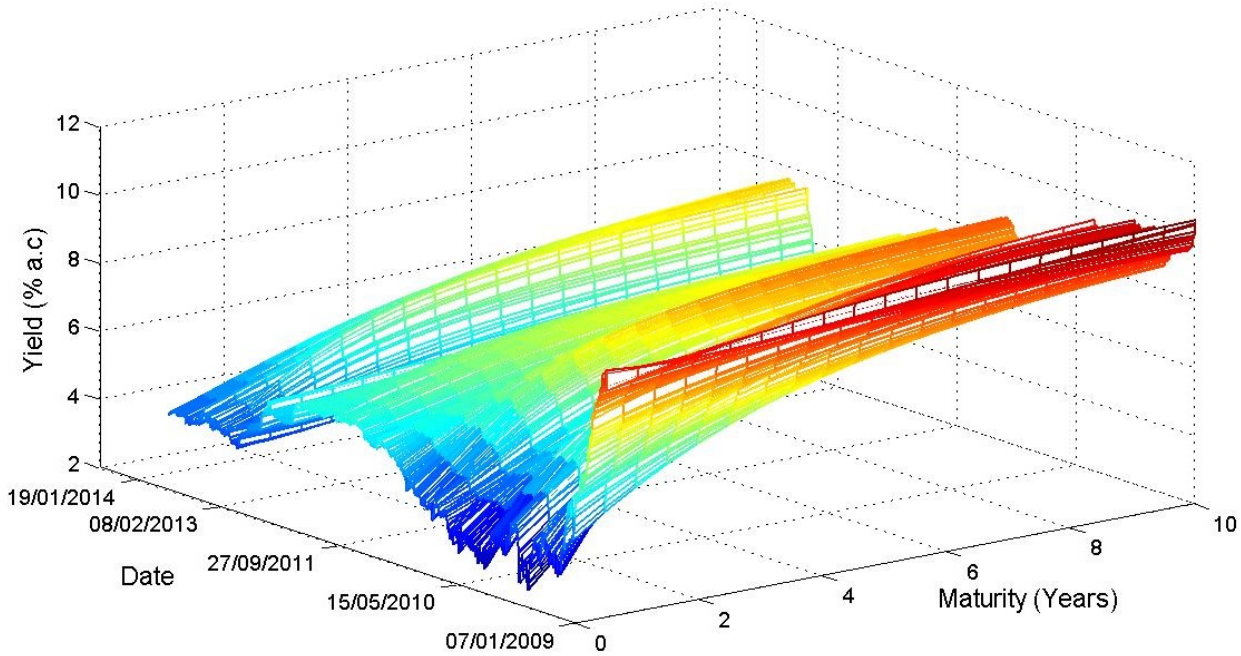

Figure 1: Colombian yield curve

Why understand the term structure?

The TS can be used for:

- Pricing financial instruments.
- Aiding decisions from investors and policymakers.
- Extracting information about the estates of the economy and the financial market.

Section 2

The Colombian setting

The usual approach in Colombia

Most agents adjust yield curves daily.

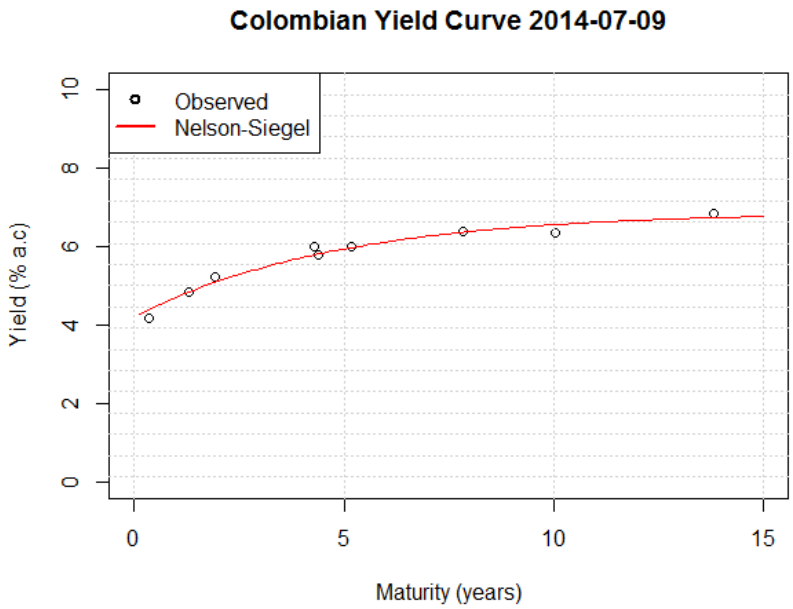

Figure 2: Nelson-Siegel example.

- Continuous curves are fit to observed yields.
- Common methods:
  - Nelson-Siegel
  - Cubic splines

Why is it not enough?

Curve-fitting and interpolation have limitations:

- No information about the TS dynamics.
- No theoretical support.
- Observable yields change frequently in developing markets.
- Past data is discarded.

Section 3

Affine term structure models

Model outline

- Every yield γ_τ is an affine function of a state vector $X(t)$:

$$\gamma_\tau(t) = A(\tau) + B(\tau)^\top X(t) \tag{1}$$

- The state vector follows an affine diffusion process under the risk-neutral probability measure Q:

$$dX(t) = \mu^Q(X)dt + \sigma(X)dW^Q(t) \tag{2}$$

W^Q: N-dimensional standard brownian motion.

Advantages and difficulties of ATSMs

Advantages:

- Desirable theoretical properties.
- Tractability.
- They model the factors that drive yield changes.
- Panel data is used.

Difficulties:

- Estimation is not straightforward.
- Cross-sectional fit is not as good.

Preceding research

- **1996** • Duffie & Kan present ATSMs and their advantages.
- **2002** • Dai & Singleton classify ATSMs and outline restrictions on parameters.
- **2008** • Restrepo-Tobón & Botero-Ramírez implement two one-factor models in Colombia with good results.
- **2010** • Ait-Sahalia & Kimmel estimate ATSMs using closed-form likelihood expansions.

Applications

Some applications include:

- Yield forecasts.
- Derivative pricing.
- Decomposition of the yield curve.
- Interpretation.

Section 4

Our project

Objectives

General To evaluate the performance of various ATSMs in forecasting the Colombian TS.

Specific

- Understand the theory and implementation of ATSMs.
- Replicate empirical applications for the Colombian market.
- Implement various ATSMs using Colombian yield data.
- Test and compare the forecast accuracy of the models.

Methodology

Data Yields taken from the Nelson-Siegel curve with the parameters published by *Infovalmer* from 2009 to 2014.

Estimation Maximum likelihood using the closed-form expansions from Ait-Sahalia & Kimmel .

Comparison Models will be ranked by their mean squared forecast error.

Schedule

Activity	Time range
Literature review	Jan. 26 - Feb. 28
Implementation.	Mar 1 - Mar 31.
Tests of forecast accuracy.	Apr 1 - May 28

Table 1: Project schedule

Report / Presentation	Deadline
Proposal report	Feb. 13th.
Proposal presentation	Feb. 27th.
Progress report	10th week.
Final report	May 29th.
Final presentation	19th week.

Table 2: Course deadlines

Section 5

References

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Thanks for your attention!