BCC Bilateral Assistance & Capacity Building for Central Banks

البنك المركزي التونسي
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Workshop 1: Macroeconomic and financial modelling

The Predictive Power of the Yield Curve: Evidence from Tunisia

Chokri KHALFAOUI

This version incorporates several comments made by Mr. Marko Mlikota during the conference

INTRODUCTION

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The strong relationship between the slope of the yield curve and future economic conditions was clearly shown when the US yield curve inverted in May 2019, correctly predicting the recession that followed in March 2020.

U.S Treasury yield curve spreads

Source: Federal Reserve Economic Database, Data as o November 14, 2022.

INTRODUCTION

LITERATURE REVIEW

The yield curve's shape is explained by several key theories (Kumar et al. 2021), including :

- **Expectations Theory:**
Yield curve reflects investors' expectations of **future interest rates**.

- **Liquidity Premium Theory:**
Investors prefer **short-term bonds** due to lower price risk and greater liquidity, leading to a premium on long-term bonds.

- **Market Segmentation Theory**:
Yield curve shape is influenced by **demand** for bonds of different maturities, as investors have preferences for **specific maturities** (short, intermediate, long).

INTRODUCTION

LITERATURE REVIEW

Predictive Power of the Yield Curve: Empirical Studies

- **Mishkin (1990a, 1990b) & Estrella and Hardouvelis (1991):**
  - Inverted yield curve = Higher risk of recession

- **Bordo & Haubrich (2004):**
  - **Monetary policy credibility** influences the yield curve's ability to predict economic growth or recession.

- **Estrella (2005):**
  - Yield curve remains a **useful predictor** of output and inflation.

INTRODUCTION

LITERATURE REVIEW

- **Benzoni et al. (2018):**
  - **Monetary policy easing** flattens the yield curve, increasing recession risk.
  - **Risk premia's role** varies by source—lower inflation risk premium = higher recession risk.

- **Lacopini et al. (2024):**
  - Introduced TVP-QR-NS to analyze the U.S. term structure of interest rates.
  - Found **increased dispersion** in yield curve factors across quantiles post-recession.

INTRODUCTION

RESEARCH GOAL

"The primary objective of this study is to assess the predictive validity of the yield curve within the context of the illiquid and shallow Tunisian Treasury bond market"

METHODOLOGY

THE TUNISIAN CONTEXT

1. Tunisian Treasury Bond Market:

- **1989**: Introduction of **BTCs** (short-term Treasury bonds).
- **1997**: Major reforms; introduction of **BTA** (Treasury Bonds) & **BTCT** (Treasury Bills).
- **2006**: Launch of **Zero-Coupon Treasury Bonds** and new role for **Primary Dealers (SVTs)**.

2. Tunisian Sovereign Yield Curve:

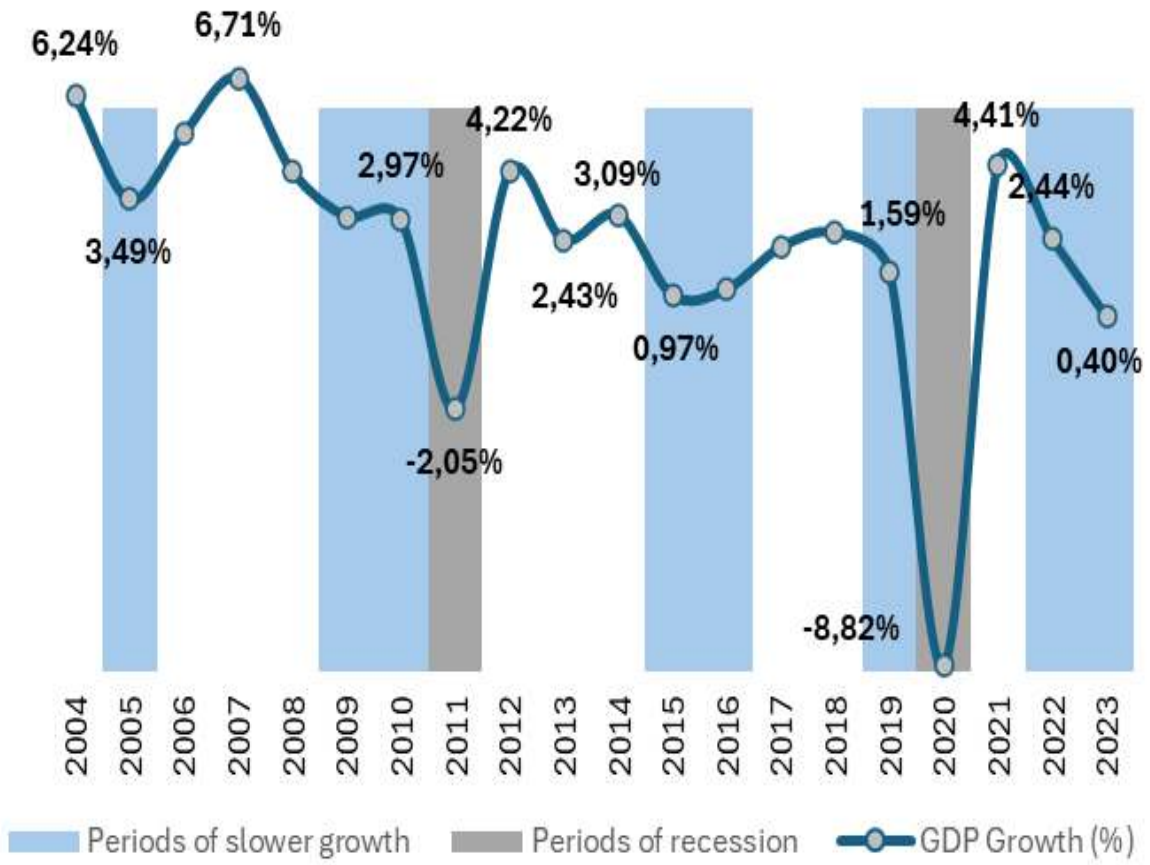
- **2005**: First yield curve by CMF (Financial market council) , based on primary market data (linear interpolation).
- **2016**: Second yield curve by Tunisie Clearing, zero-coupon model, repo, OTC, primary data.
- **2017**: Current curve using **Nelson-Siegel model**, incorporating data from money market, primary, and secondary markets.

METHODOLOGY

THE TUNISIAN CONTEXT

3. Tunisia's Economic Growth (2004-2023):

- **2004-2008**: Peak growth, 6.71% in 2007.
- **2011**: Sharp downturn, -2.05% due to the 2009 financial crisis.
- **2012-2019**: Recovery with moderate growth, peaking at 4.22% in 2012.
- **2020**: Severe contraction, -8.82% due to COVID-19.
- **2021**: Rebound to 4.41% growth.
- **2023**: Growth slowed to 0.40%.



METHODOLOGY

EMPIRICAL INVESTIGATION

Our empirical investigation employs :

- **Data Source:** Treasury bills and bonds, with data from the Ministry of Finance (MOF), Central Bank of Tunisia (CBT), and Tunisie Clearing (TC).
- **Timeframe:** Monthly data from 2004 to 2023.
- **Markets Analyzed:** Primary and secondary markets, including open market operations conducted by the CBT.

Issues in Emerging Bond Markets (Makushkin, 2021):

- **Low Transaction Volume**: Due to low activity in the secondary market.
- **Distorted Yield Rates**: Aberrant rates observed in transactions involving companies within the same group.

METHODOLOGY

EMPIRICAL INVESTIGATION

To rectify the identified shortcomings :

1- construct the term structure of yields by averaging yields over a month

Our analysis specifically targeted fixed maturities of 1, 2, 3, 4, 5, 6, 7, 8, and 10 years.

2- Cubic spline interpolation

We utilized a cubic spline interpolation technique to interpolate the missing yield points.

3- Non-parametric Kernel smoothing

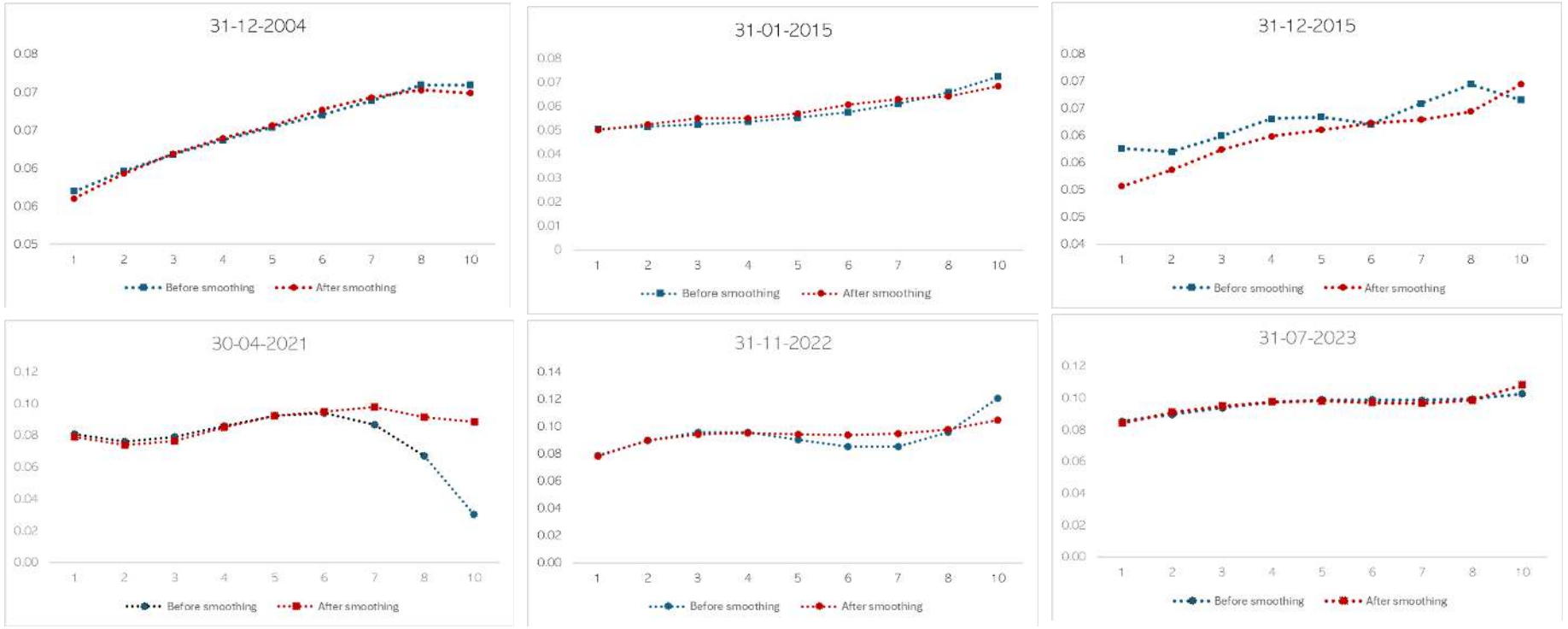
used to smooth out data and reveal underlying patterns without assuming a specific functional form for the data distribution

METHODOLOGY

EMPIRICAL INVESTIGATION

Impact of Non-Parametric Kernel Smoothing on Yield Trends

The graphs illustrate how the Non-Parametric Kernel method effectively enhanced the yield curves for various maturities



METHODOLOGY

EMPIRICAL INVESTIGATION

Time Varying-Quantile Regression -Nelson-Siegel Model (TV-QR-NS)

The model is expressed as:

$$\boldsymbol{y(t,\tau)} = \boldsymbol{\beta_0(t)} + \boldsymbol{\beta_1(t)}\left(\frac{\mathbf{1}-\boldsymbol{e^{-\lambda\tau}}}{\boldsymbol{\lambda\tau}}\right) + \boldsymbol{\beta_2(t)}\left(\frac{\mathbf{1}-\boldsymbol{e^{-\lambda\tau}}}{\boldsymbol{\lambda\tau}} - \boldsymbol{e^{-\lambda\tau}}\right)$$

Where:

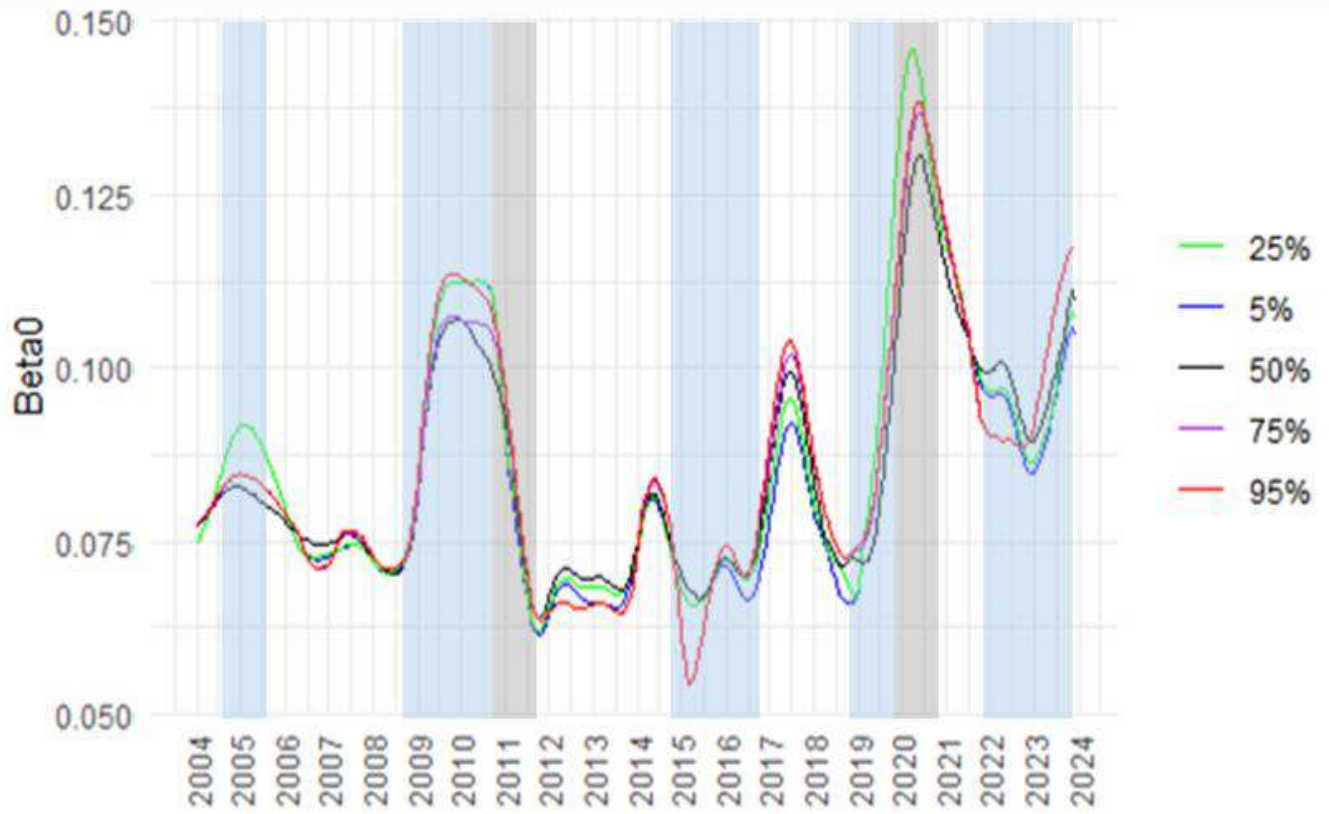
- λ is predetermined based on the current yield curve.
- $\boldsymbol{\tau}$ represent the maturity
- $\beta_0(t)$, $\beta_1(t)$ and $\beta_2(t)$vary over time to account for the dynamic structure of the yield curve.
- $\boldsymbol{y(t,\tau)}$ denote the yield $\boldsymbol{t}$ and maturity $\boldsymbol{\tau}$

RESULTS

TIME VARYING QUANTILE REGRESSION

Time Varying Quantile Regression for Nelson-Siegel Parameters β_0

- National events and global crises, particularly the COVID-19 pandemic, had a pronounced impact on interest rates.
- A sharp rise in the level (β_0) followed both the 2008 crisis and the COVID-19 pandemic, indicating long-term rate sensitivity to economic uncertainty and stimulus actions.
- Divergence among quantiles reflects heightened uncertainty in investor expectations regarding future economic conditions.



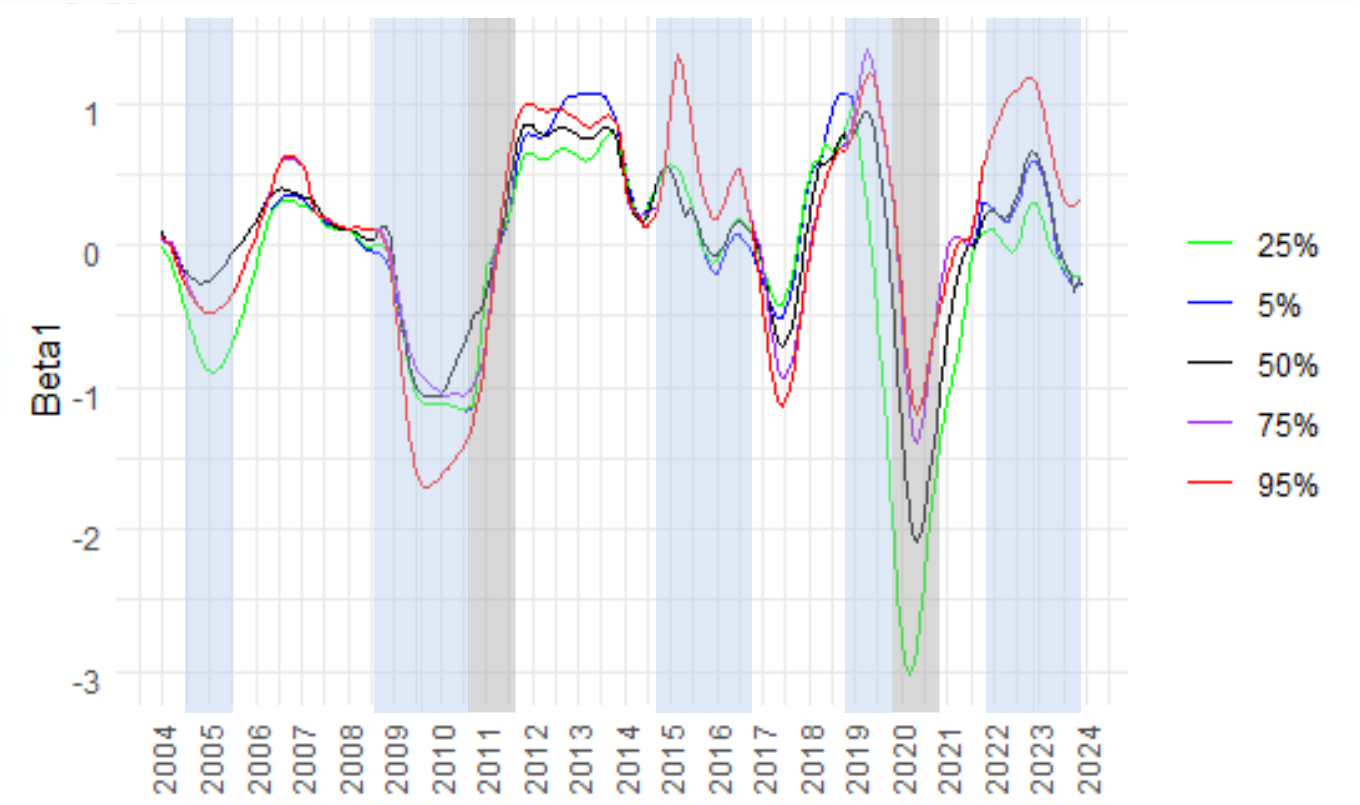
RESULTS

TIME VARYING QUANTILE REGRESSION

Time Varying Quantile Regression for Nelson-Siegel Parameters β_1

- **Significant fluctuations during economic crises**: β_1 exhibited severe changes during the 2008 financial crisis, the Tunisian revolution of 2011 and the COVID-19 pandemic, reflecting the influence of political and economic uncertainty on market expectations.

- **Asymmetric reactions among market segments**: Quantile analysis revealed differing responses to economic events, suggesting diverse expectations among investors.

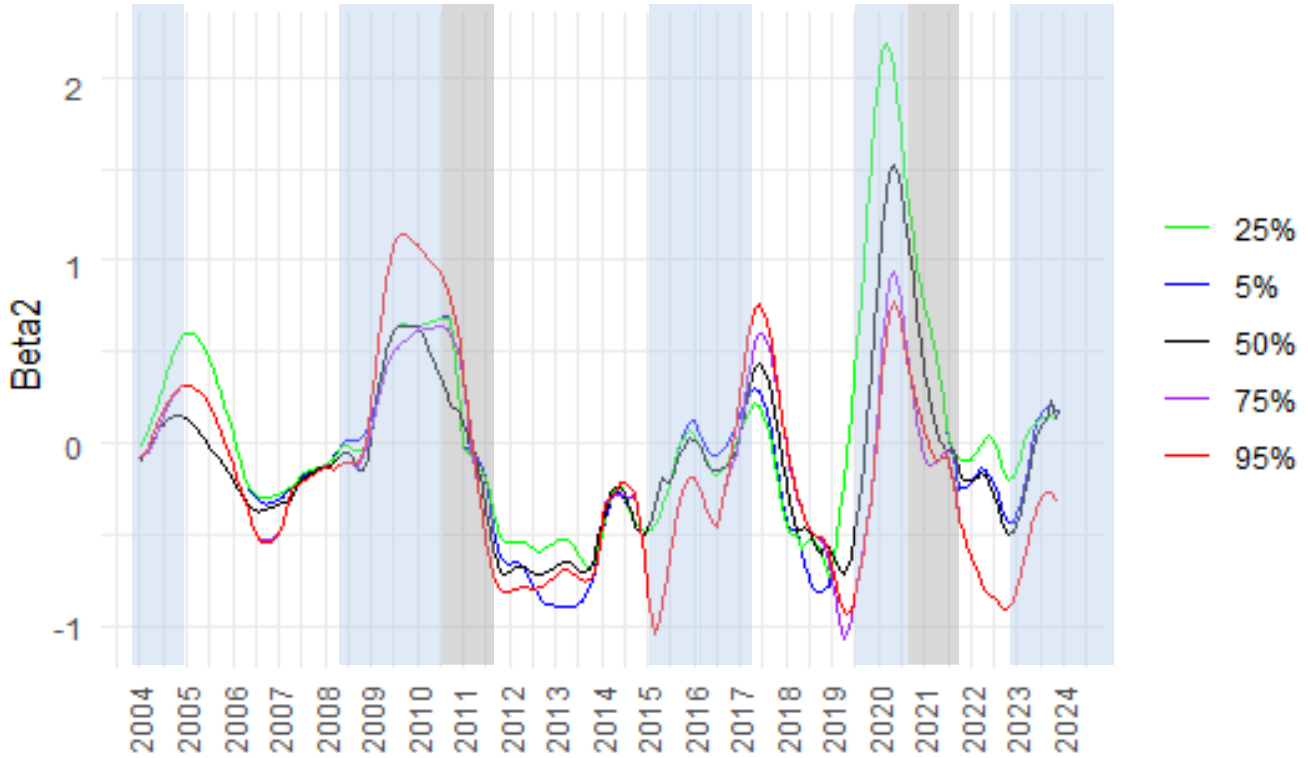


RESULTS

TIME VARYING QUANTILE REGRESSION

Time Varying Quantile Regression for Nelson-Siegel Parameters β_2

- **Significant changes during crises**: The parameter declined sharply during the 2008 financial crisis and the COVID-19 pandemic, suggesting potential yield curve inversions and economic downturns.
- **Asymmetric reactions among market segments**: The dispersion among quantiles during crises indicates varying expectations among market participants regarding medium-term economic prospects.
- **Influence of policies and events**: Both domestic and international factors, including monetary policies and political events, have contributed to the volatility of the parameter.



RESULTS

IMPULSE RESPONSE FUNCTIONS RESULTS

IRF result for (β_0 , inflation , IPI)

1- Reaction of Inflation to β_0 Shock

The IRF shows a positive response of the inflation rate following a positive shock in β_0.

2- Reaction of IPI to β_0 Shock

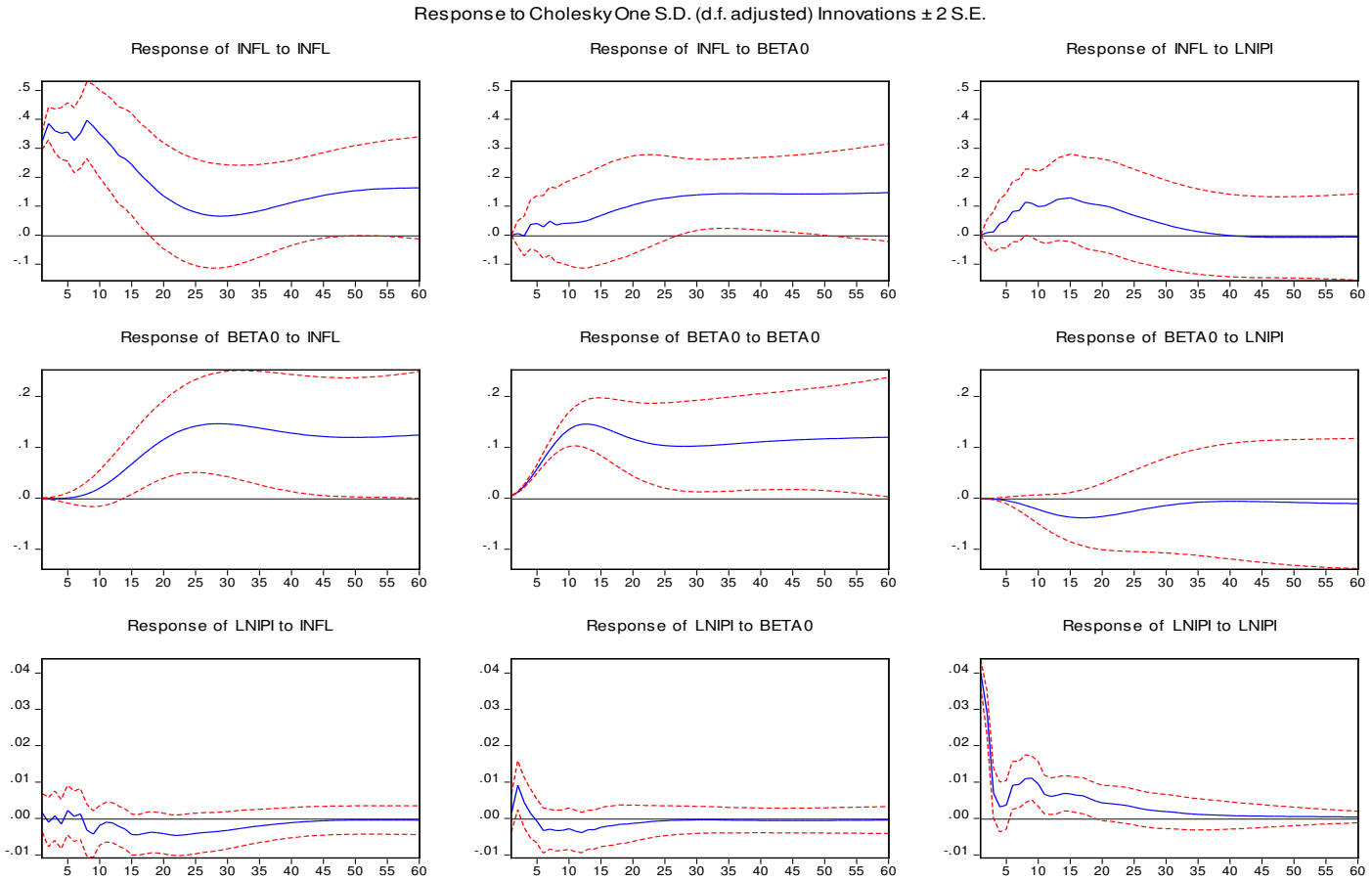
The IPI shows a slightly negative reaction following a positive shock to β_0.

3- Reaction of β_0 to IPI Shock

β_0 reacts negatively to a positive shock in the IPI.

4- Reaction of β_0 to Inflation Shock

β_0 reacts positively to a positive shock in the inflation rate.



RESULTS

IMPULSE RESPONSE FUNCTIONS RESULTS

IRF result for (β_1 , inflation , IPI)

1- Reaction of Inflation to β_1 Shock

The inflation rate exhibits a negative response following a positive shock to $\boldsymbol{\beta_1}$, peaking at around the 25th month.

2- Reaction of IPI to β_1 Shock

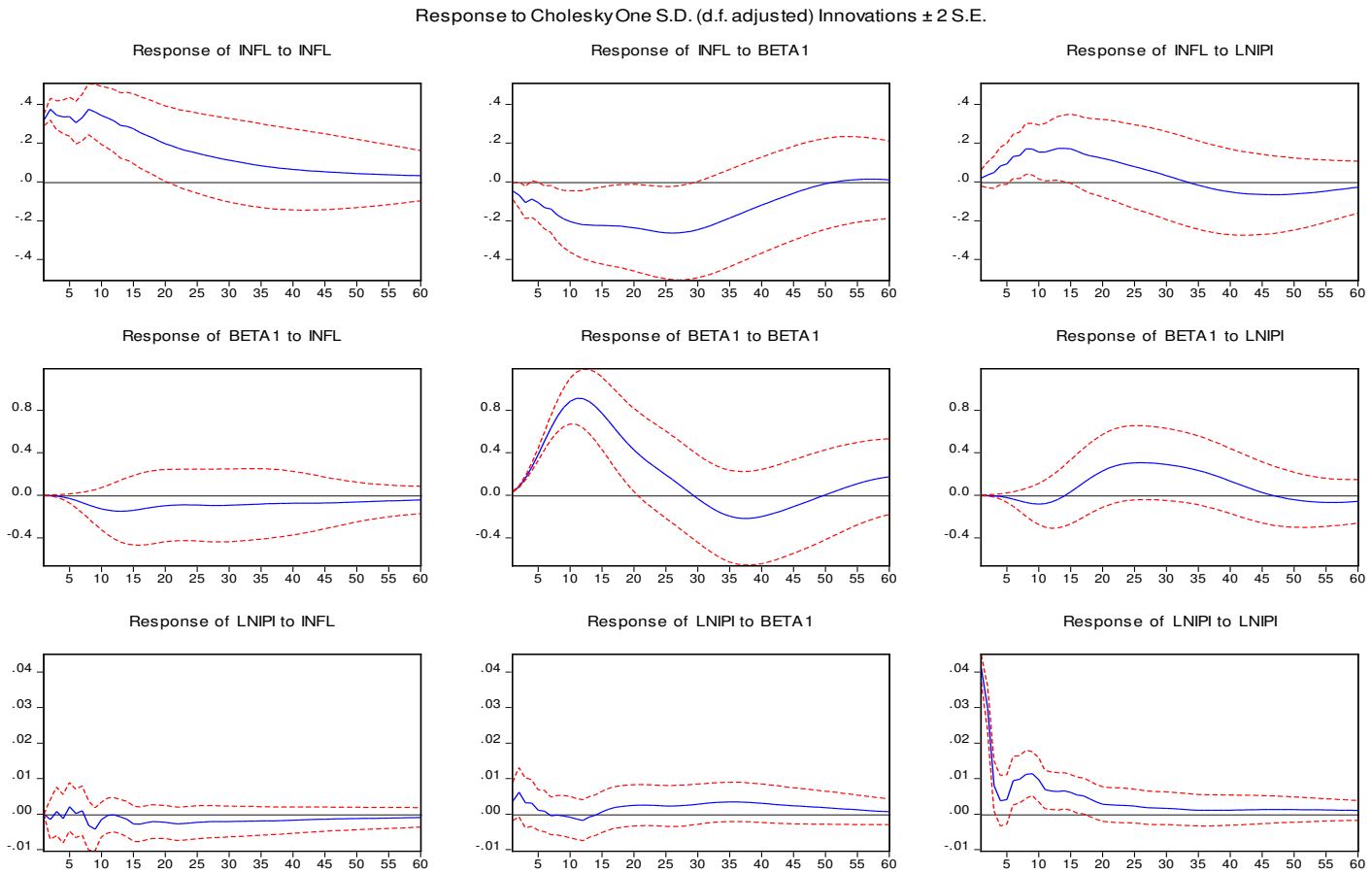
The response of the IPI to a positive shock in β_1 is shown to be insignificant.

3- Reaction of β_1 to IPI Shock

$\boldsymbol{\beta_1}$ reacts positively following a positive shock to the IPI.

4- Reaction of β_1 to Inflation Shock

The response of the $\boldsymbol{\beta_1}$ to a negative shock in the inflation rate is reported as insignificant.



RESULTS

IMPULSE RESPONSE FUNCTIONS RESULTS

IRF result for (β_2 , inflation , IPI)

1- Reaction of Inflation to β_2 Shock

The inflation rate responds positively after a positive shock to β_2.

2- Reaction of IPI to β_2 Shock

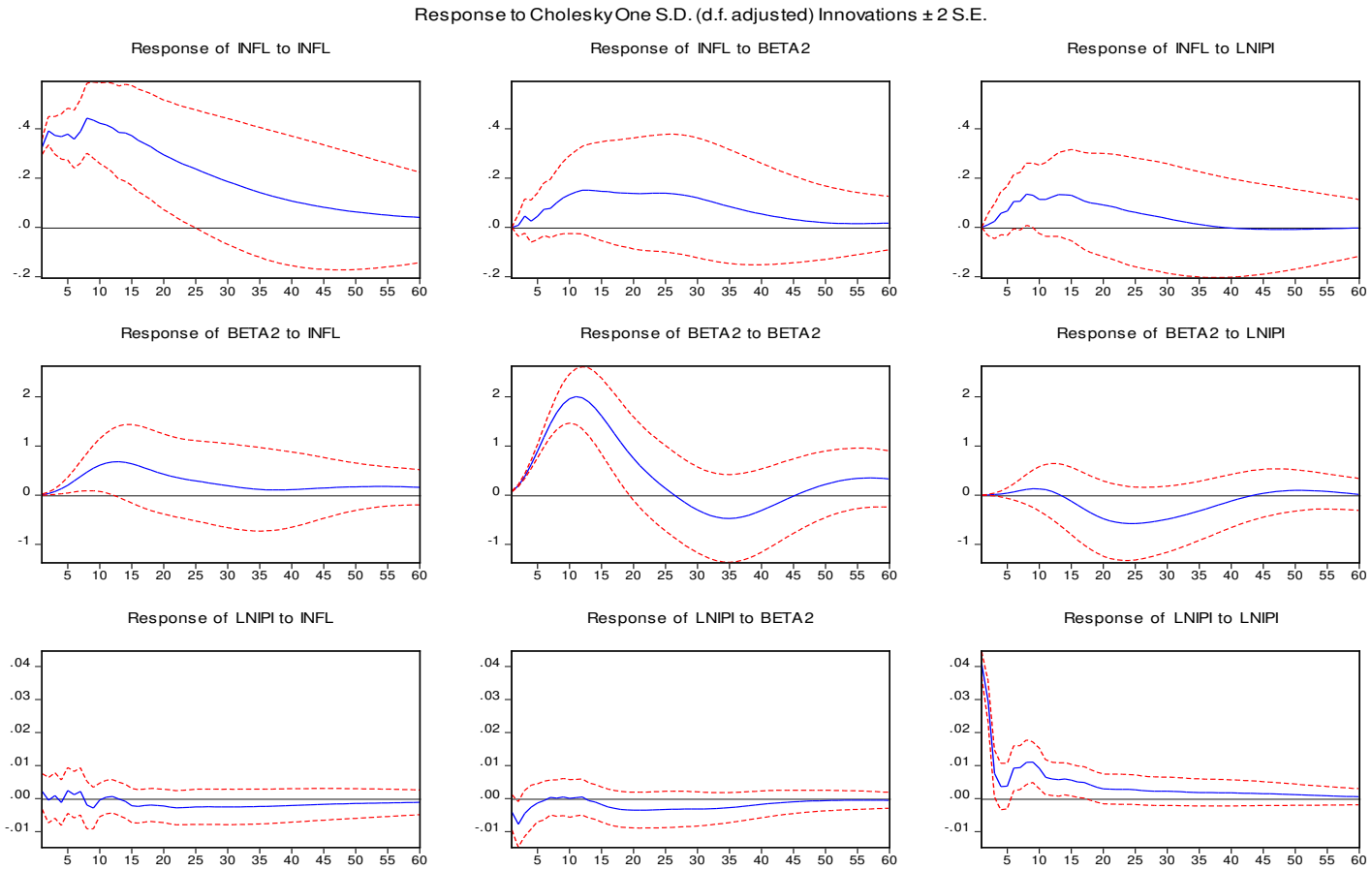
The response of the IPI to a positive shock in β_2 is slightly negative.

3- Reaction of β_2 to IPI Shock

β_2 reacts negatively following a positive shock to the IPI.

4- Reaction of β_2 to Inflation Shock

β_2 reacts positively to a positive shock in the inflation rate.



CONCLUSION

CONCLUSION

- This study examined the predictive power of the yield curve in the illiquid and shallow Tunisian sovereign bond market.
- Key findings show that yield curve parameters (β_0, β_1, β_2) are strongly influenced by market forecasts.
- The yield curve responds significantly to economic indicators such as inflation and industrial production.
- This research provides an initial step towards understanding the Tunisian yield curve and paves the way for further studies on its dynamics and predictive power within the Tunisian context.

THANK YOU

Chokri KHALFAOUI

chokri.khalfaoui@bct.gov.tn