

Master's Thesis Conference

Modelling the Yield Curve in the United States and the Euro Area

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October 25, 2024

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2 Methodology

- The Nelson Siegel Model
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- Data
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What happened in 2022?

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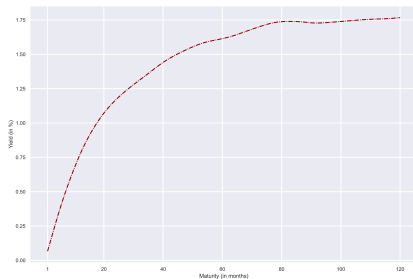


Figure: US Treasury Yield Curve, January 2022

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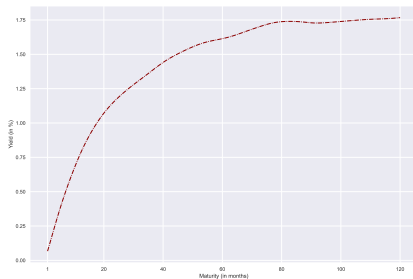


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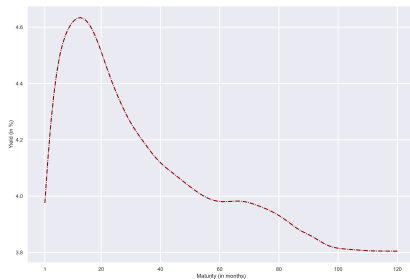


Figure: US Treasury Yield Curve, December 2022

The Yield Curve and the Macroeconomy

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- Yields are central for the transmission of monetary policy — especially considering unconventional monetary policy tools such as QE and Forward Guidance (see: Gürkaynak, Sack, and Swanson (2005), Gürkaynak and Wright (2012), Altavilla et al. (2019), and Swanson (2021))

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- Yields are also highly relevant for fiscal policy (public debt)
- An inversion of the yield curve has (historically) been a very accurate predictor of recessions

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- 2 Step 2: Identification via an SVAR using short-run zero-restrictions

Nelson Siegel Model

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Following the representation of Diebold and Li (2006), the yield curve is assumed to be represented by the Nelson and Siegel (1987) three factor model

$$y_t(\tau) = L_t + S_t \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} \right) + C_t \left(\frac{1 - e^{-\lambda\tau}}{\lambda\tau} - e^{-\lambda\tau} \right) + \varepsilon_t \quad (1)$$

Nelson Siegel Model

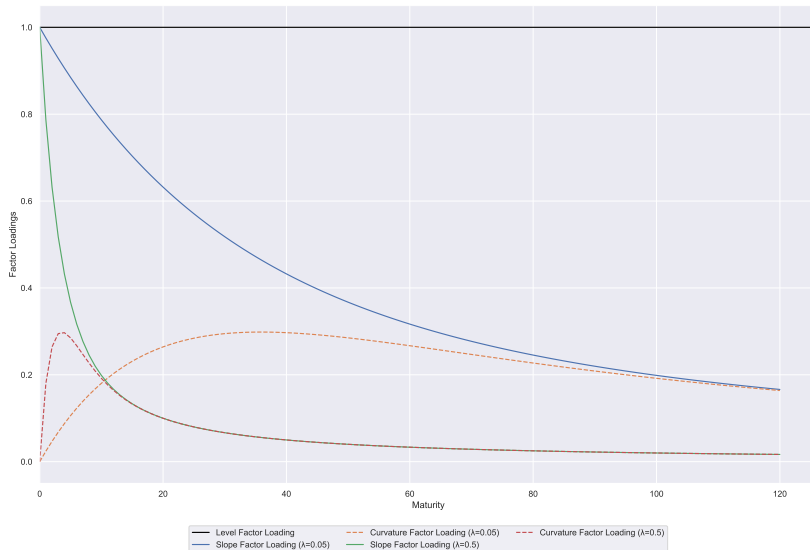


Figure: Exemplary Nelson-Siegel Factor Loadings

Nelson Siegel Model

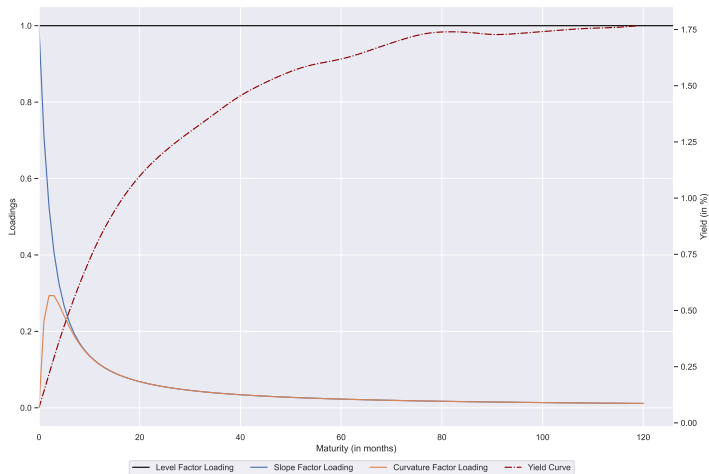


Figure: Actual Nelson-Siegel Factor Loadings as of January 2022, US

$$\mathbf{Y}_t = [IP_t, \pi_t, i_t, FS_t, L_t, S_t, C_t, M_t]$$

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$$\mathbf{B}_0 \mathbf{Y}_t = \mathbf{B}_p \mathbf{Y}_{t-p} + \boldsymbol{\omega}_t, \boldsymbol{\omega}_t \sim \mathcal{N}(0, \mathbf{I})$$

$$\underbrace{\mathbf{B}_0^{-1} \mathbf{B}_0}_{\mathbf{I}} \mathbf{Y}_t = \underbrace{\mathbf{B}_0^{-1} \mathbf{B}_p}_{\mathbf{A}_p} \mathbf{Y}_{t-p} + \underbrace{\mathbf{B}_0^{-1} \boldsymbol{\omega}_t}_{\boldsymbol{\varepsilon}_t} \quad (3)$$

Cholesky Decomposition

$$\begin{bmatrix} u_t^{IP} \\ u_t^{\pi_t} \\ u_t^{i_t} \\ u_t^{FS_t} \\ u_t^{L_t} \\ u_t^{S_t} \\ u_t^{C_t} \\ u_t^{M_t} \end{bmatrix} = \begin{bmatrix} b_0^{11} & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ b_0^{21} & b_0^{22} & 0 & 0 & 0 & 0 & 0 & 0 \\ b_0^{31} & b_0^{32} & b_0^{33} & 0 & 0 & 0 & 0 & 0 \\ b_0^{41} & b_0^{42} & b_0^{43} & b_0^{44} & 0 & 0 & 0 & 0 \\ b_0^{51} & b_0^{52} & b_0^{53} & b_0^{54} & b_0^{55} & 0 & 0 & 0 \\ b_0^{61} & b_0^{62} & b_0^{63} & b_0^{64} & b_0^{65} & b_0^{66} & 0 & 0 \\ b_0^{71} & b_0^{72} & b_0^{73} & b_0^{74} & b_0^{75} & b_0^{76} & b_0^{77} & 0 \\ b_0^{81} & b_0^{82} & b_0^{83} & b_0^{84} & b_0^{85} & b_0^{86} & b_0^{87} & b_0^{88} \end{bmatrix} \begin{bmatrix} w_t^{IP} \\ w_t^{\pi_t} \\ w_t^{i_t} \\ w_t^{FS_t} \\ w_t^{L_t} \\ w_t^{S_t} \\ w_t^{C_t} \\ w_t^{M_t} \end{bmatrix} \quad (4)$$

Data US

- Sample: January 1976 – December 2022
- Industrial Production (FRED: INDPRO)
- CPI (FRED: CPIAUCSL)
- Federal Funds Effective Rate (FRED: DFF)
- S&P 500 (Yahoo Finance: ^GSPC)
- Excess Bond Premium (EBP)¹
- β factors based on yields data provided by Liu and Wu (2021))²

¹source: Fed Note Data

²source: Liu-Wu Yield Data

Data EA

- Sample: October 2004 – September 2022
- Industrial Production (FRED: EA19PRINTO01GYSAM)
- Inflation (FRED: CPHPTT01EZM659N)
- 3M Interbank Rate (FRED: IR3TIB01EZM156N)
- Eurostoxx 50 (Yahho Finance: ^STOXX50E)
- Credit Risk EA³
- β factors based on yields data provided by the ECB⁴

³source: Banque de France

⁴source: dataset “All years - AAA”

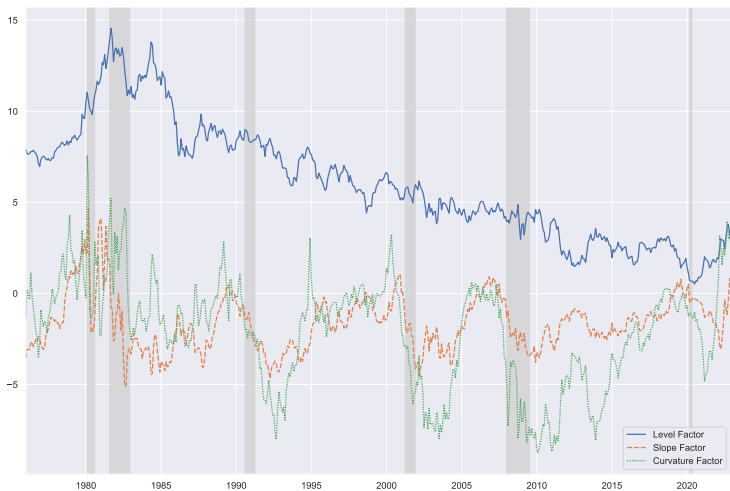


Figure: Estimated level, slope and curvature factor, US

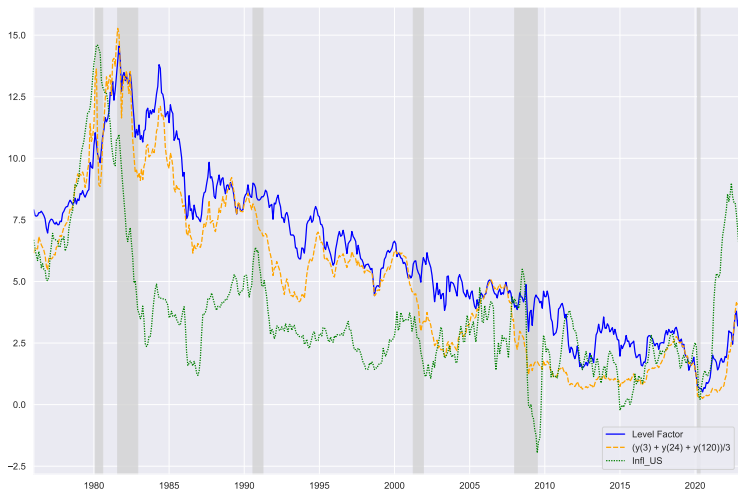


Figure: Level factor, empirical proxy and inflation, US

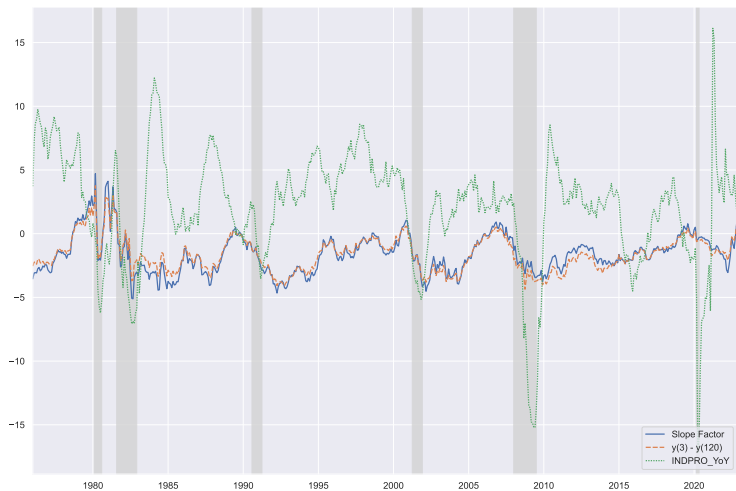


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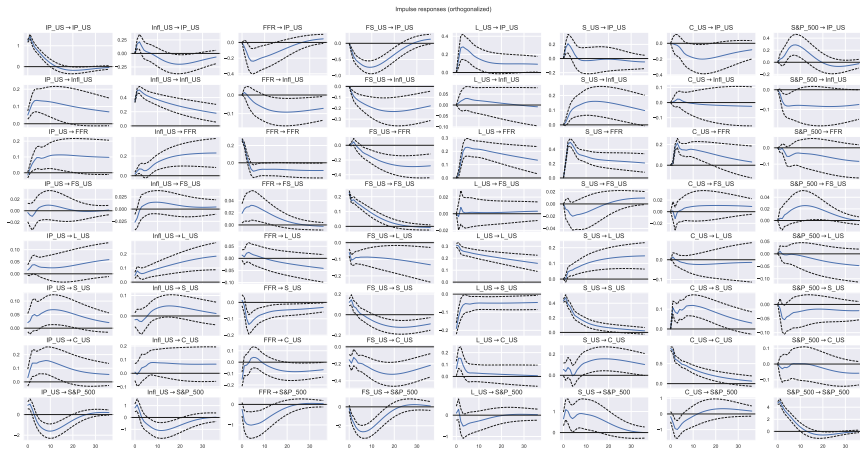


Figure: Impulse Responses SVAR(6), US

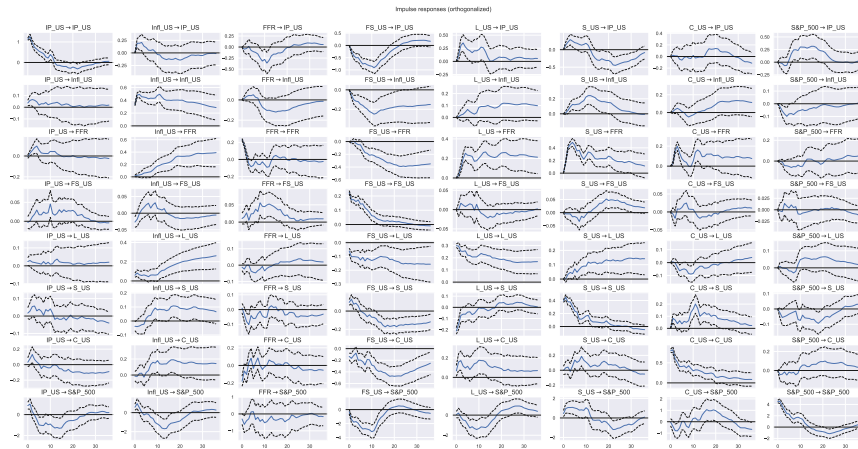


Figure: Impulse Responses SVAR(12), US

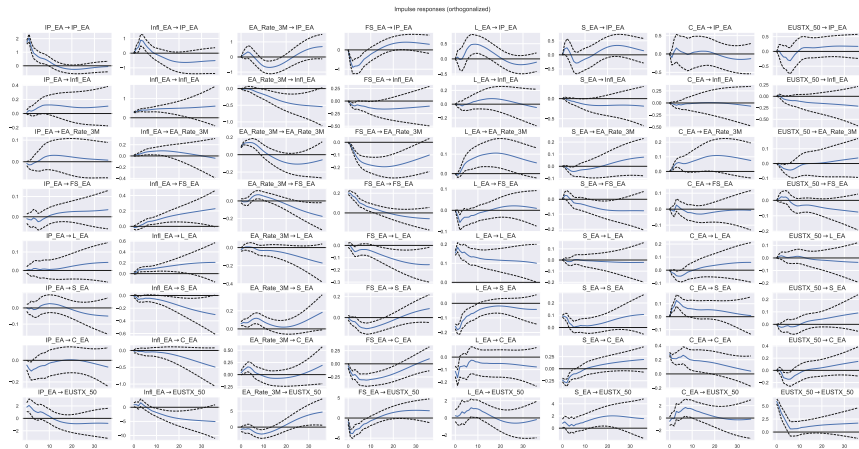


Figure: Impulse Responses SVAR(6), EA

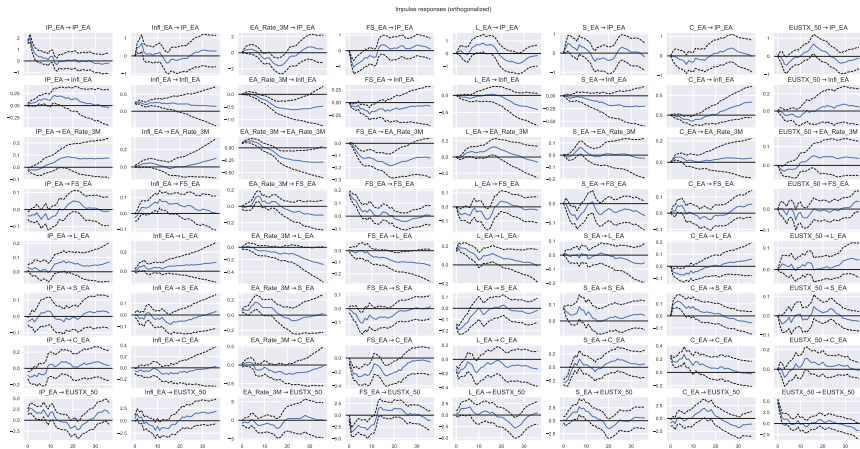


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- Inflation expectations (L_t) seem to become somewhat unanchored given an aggregate supply (π_t) or aggregate demand (IP_t) shock in both the US and the EA
- Slope Factor (S_t) is associated with an economic contraction only in the EA
- A monetary policy shock (i_t) induces a decrease in the level factor (L_t), underlining the high credibility and transparency of the Fed and ECB

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