Monetary Policy and the Yield Curve

Vladislav Abramov[1] Konstantin Styrin[1,2] Alexander Tishin[1]

abramovvv01@mail.cbr.ru *styrinka@mail.cbr.ru* *tishinav@mail.cbr.ru*

[1]Bank of Russia [2]New Economic School

Motivation

1. In general, monetary policy announcements contain very diverse information (Jarocinski, 2021):
   - Decision about the current rate ($r \uparrow \Rightarrow i_{\text{short-term}} \uparrow$, S&P500 $\downarrow$)
   - Delphic forward guidance – forecast about a future course of policy rates ($r \uparrow \Rightarrow i_{\text{long-term}} \uparrow$, S&P500 $\uparrow$)
   - Odyssean forward guidance – commitment to a future course of policy rates ($r \uparrow \Rightarrow i_{\text{long-term}} \uparrow$, S&P500 $\downarrow$)
   - Large scale asset purchases (US and EU cases)

$\rightarrow$ Monetary policy is a multidimensional object, which is important to account for.

2. However, the transmission of monetary policy in Russia usually do not considered from this multidimensionality standpoint (Pestova & Bannikova, 2021; Tishin, 2019).
3. As a result some puzzling effects (ex. price puzzle) usually found on Russian data, may be attributed, among other things, to insufficient consideration of the multidimensionality of policy.

Motivation

4. We do not know works accessing the transmission of monetary policy in Russia to the whole yield curve, given the multifaceted character of modern monetary policy.
5. Yet, it is important as different tools at the Bank of Russia disposal have distinct effects on different parts of the curve.
6. A better understanding of the yield curve movements and the reasons behind them could help with a more efficient implementation of monetary policy.

This paper

1. How financial markets react to central bank policy announcements within the same day (Gürkaynak et al., 2005; Swanson, 2021)

This paper

1. How financial markets react to central bank policy announcements within the same day (Gürkaynak et al., 2005; Swanson, 2021)
   - Does the decomposition of shocks make sense for the Russian economy?
   - How do different types of monetary policy affect the yield curve?

This paper

1. How financial markets react to central bank policy announcements within the same day (Gürkaynak et al., 2005; Swanson, 2021)
   - Does the decomposition of shocks make sense for the Russian economy?
   - How do different types of monetary policy affect the yield curve?

2. Estimates (multidimensional) monetary policy transmission into the whole yield curve (Leombroni et al., 2021)
   - From 3 months OFZ to 15 years OFZ
   - Additionally investigate impact on FX and stock markets

This paper

1. How financial markets react to central bank policy announcements within the same day (Gürkaynak et al., 2005; Swanson, 2021)
   - Does the decomposition of shocks make sense for the Russian economy?
   - How do different types of monetary policy affect the yield curve?

2. Estimates (multidimensional) monetary policy transmission into the whole yield curve (Leombroni et al., 2021)
   - From 3 months OFZ to 15 years OFZ
   - Additionally investigate impact on FX and stock markets

3. Uses the unique OTC and markets data
   - Use contracts from OTC money market (interest rate swaps) to extract monetary policy surprises
   - Use stock-tradable instruments (OFZ) to study the impact

Preview of the results

- Demonstrate the presence of at least 2 components of monetary policy Formal tests
- Indeed, in response to **target shock**,
  - short-term rates increase
  - the ruble appreciates
  - stock index insignificantly responds
- In response to **path shock**,
  - long-term rates increase
  - the ruble depreciates
  - stock market index decreases
- Target shock explains much variance of interest rate for the whole yield curve
- Path shock explains much variance of FX and stock market indices

Our approach

Employ event-study analysis (sub-index *t* is for monetary policy announcements)

- Extract **two** monetary policy shocks using principal component analysis (PCA)

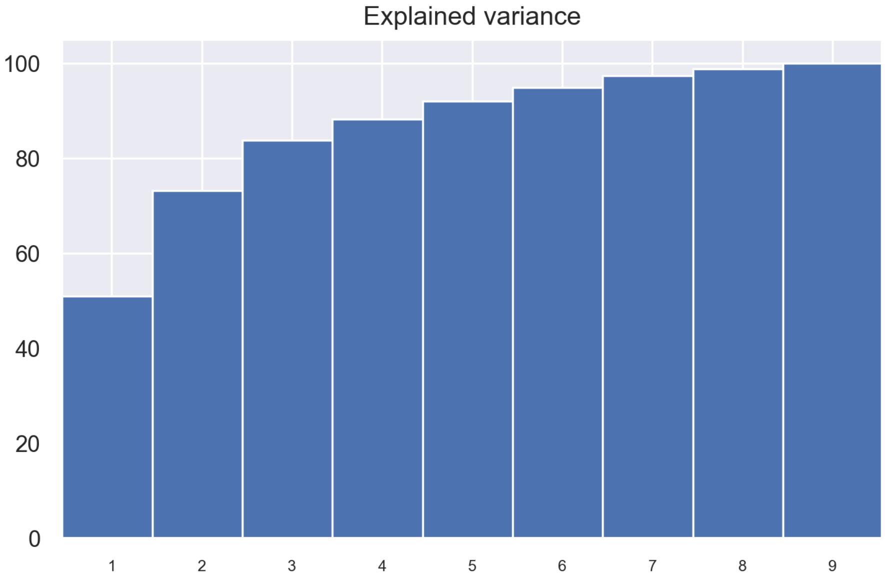
- **Target shock** – “key (target) rate”
- **Path shock** – “future path of policy”

- Estimate $\Delta y_t = \beta_0 + \beta_1 \text{Target shock}_t + \beta_2 \text{Path shock}_t + \epsilon_t$
- Δy_t are OFZ (different maturities), FX, stock market indices

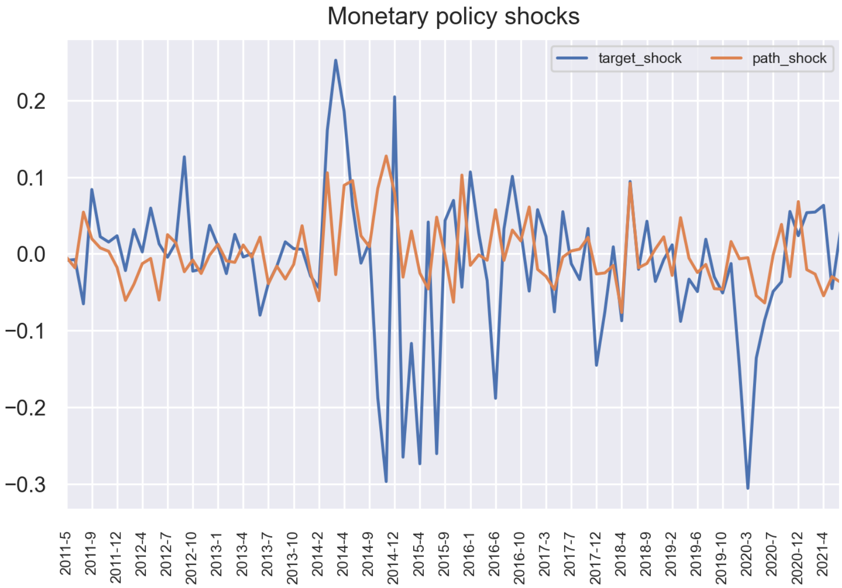
Data

- Monetary policy events from May, 2011 to July, 2021 – 90 policy meetings
- Calculate *daily* surprises Details
- Remove ‘outliers’ with help of 5-95 winsorization.
- Dataset for PCA: Interest rate swaps (OTC) plus futures Details
- Fit the term structure of interest rates using the Nelson-Siegel model Details

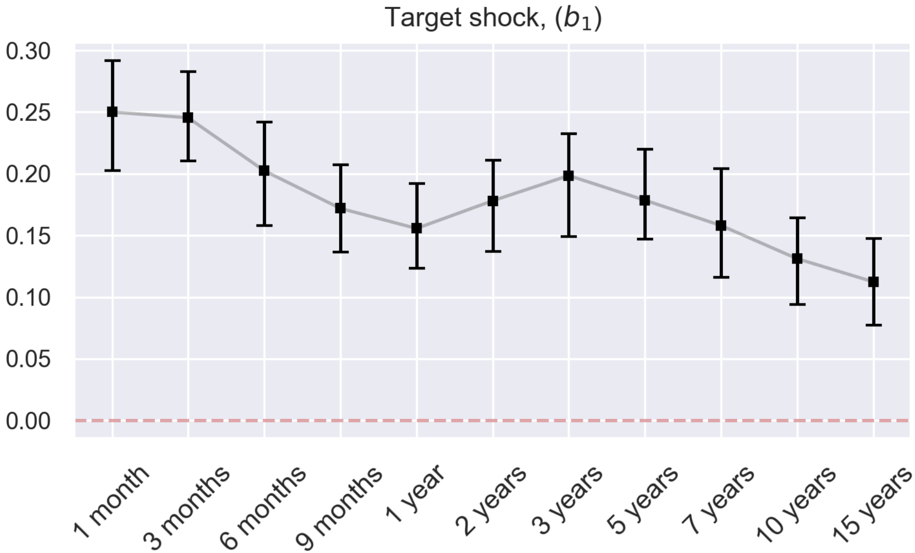
Explained variance (PCA)



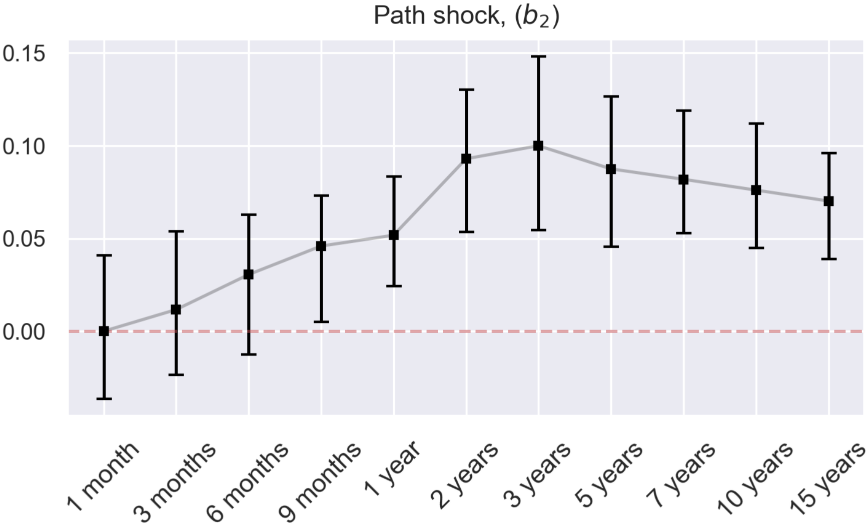
Estimated and rotated monetary policy shocks



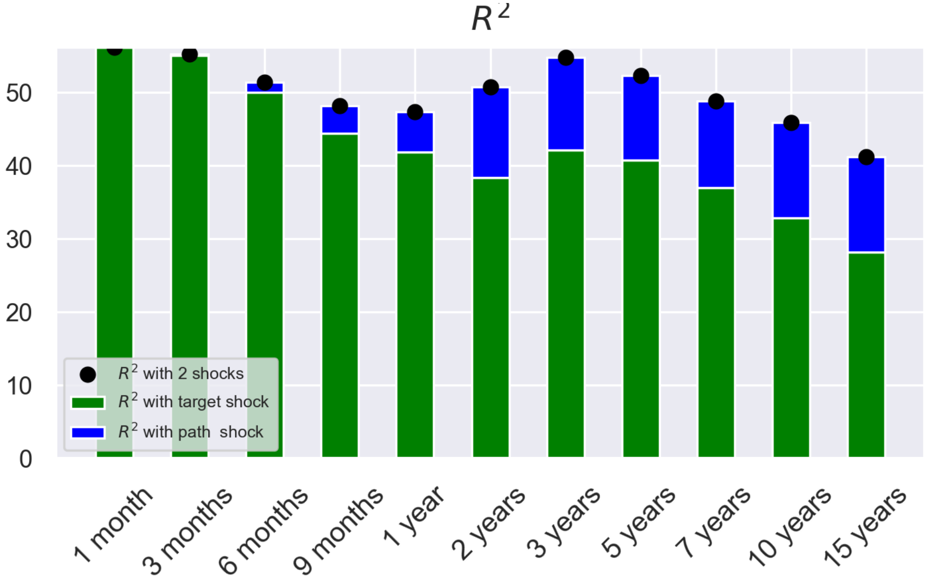
Estimated coefficients for Target shock for the Yield curve



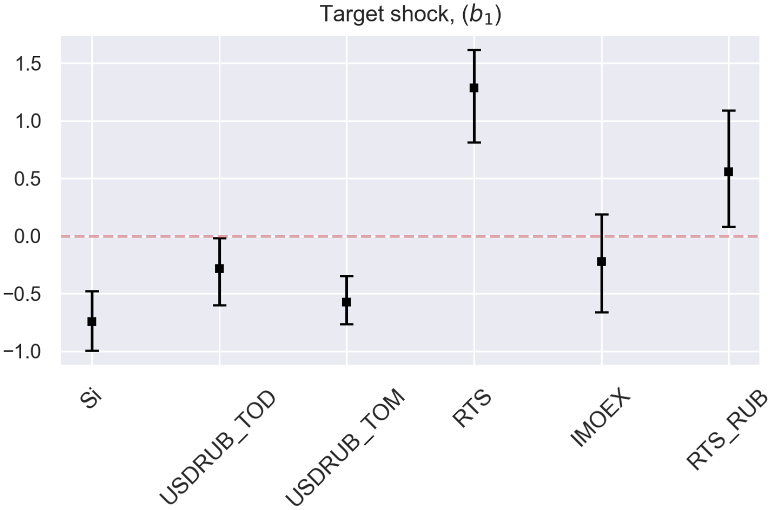
Estimated coefficients for Path shock for the Yield curve



R^2 for the Yield curve

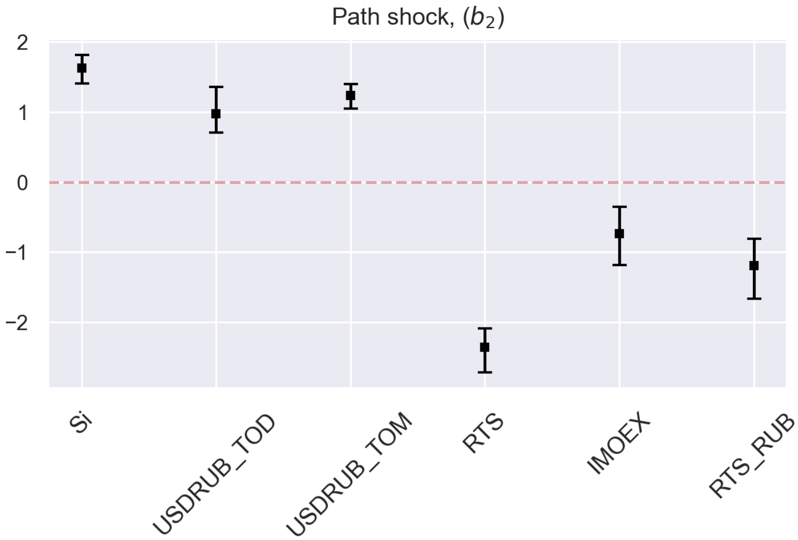


Estimated coefficients for Target shock for FX and Stock indices[1]

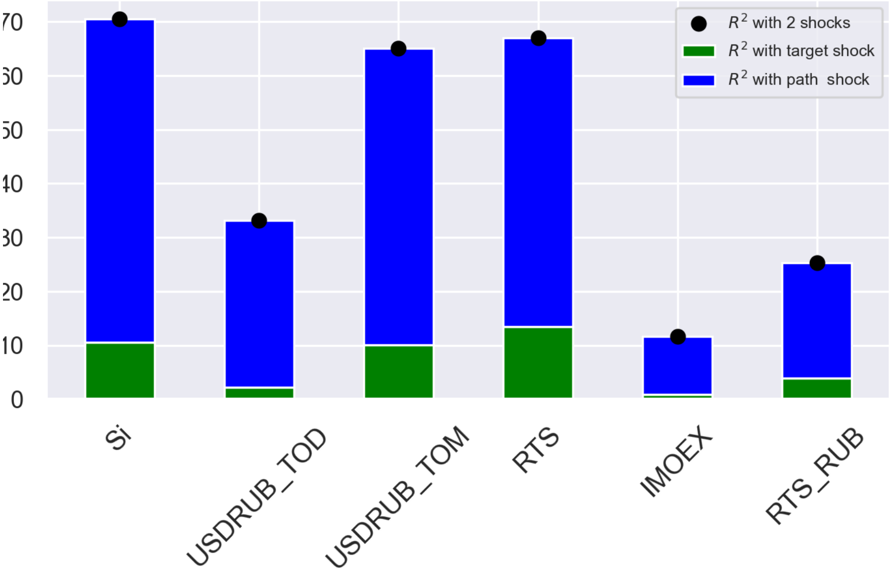


[1] Remember: RTS $\approx \frac{\text{IMOEX}}{USDRUB}$

Estimated coefficients for Path shock for FX and Stock indices



R^2 for FX and Stock indices



What else we do?

- Rolling window estimation:
  - Take the same Target and Path shocks (estimated on the whole sample)
  - Re-estimate: $\Delta y_t = \beta_0^F + \beta_1^F \text{Target shock}_t + \beta_2^F \text{Path shock}_t + \epsilon_t^F$ for each 40 points
  - Helps understand the importance of each shock
  - Detects potential outliers and structural breaks Results

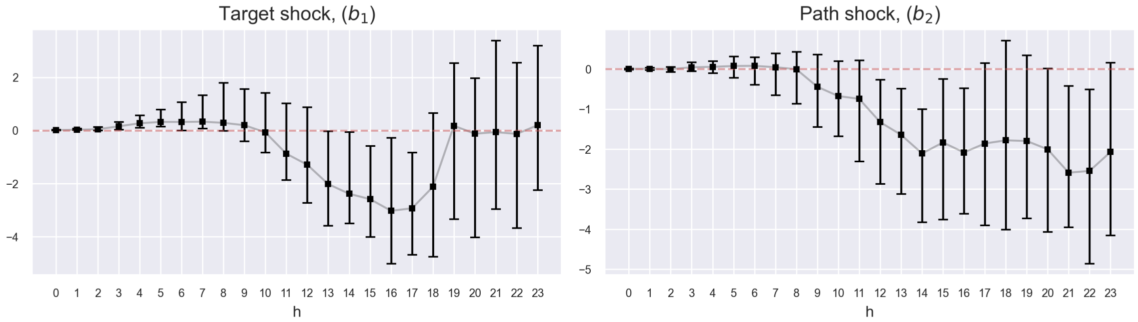
- Local projections (daily):
  - $\Delta y_{t+h} = \beta_0 + \beta_1 \text{Target shock}_t + \beta_2 \text{Path shock}_t + \epsilon_t$
  - Check the effects of monetary policy decision on the following days
  - A kind of robustness test Results

More

Macro data

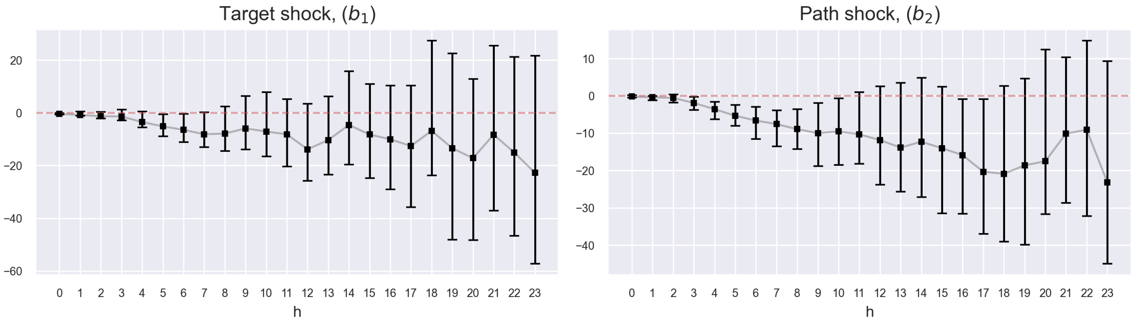
- Switch from event-study to monthly data
- Attribute a surprise to the month when it occurred
  - How to match surprises on monthly data:
    - ★ One HF surprise corresponds to a monthly shock: $m_t = s_t$
    - ★ Weigh according to # days left in the month when announcement took place: $m_t = \frac{d}{D} s_t$
    - ★ Redistribute monetary policy surprise for two months according to # days left in the month when announcement took place and the rest to the next month: $m_t = \frac{d}{D} s_t$ and $m_{t+1} = (1 - \frac{d}{D}) s_t$
- Do our shocks have effects on macro variables?
- $\Delta y_{t+h} = \beta_0 + \beta_1 \text{Target shock}_t + \beta_2 \text{Path shock}_t + \epsilon_t$

Monthly regressions: CPI response



$$\frac{y_{t+h}-y_{t-1}}{y_{t-1}} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Monthly regressions: USD/RUB response



$$\frac{y_{t+h} - y_{t-1}}{y_{t-1}} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Findings

- Variables react to both monetary policy shocks
- But the responses are very different

- Does the decomposition of shocks make sense for the Russian economy?
  - Likely yes, but with considerations

- How do different types of the monetary policy affect yield curve?
  - Target shock explains much of variation in the yield curve
  - Path shock explains FX and stock market indices
  - In rolling window OLS we see a ‘structural break’ in 2019 – this may be the effect of disappearing of volatile 2014-2015 from the rolling sample

What is next?

- Now, we have replicated GSS (2005) on Russian data
- Use intra-day data (in progress, waiting data from MOEX)
- More ambitious goals?
- Better understand the factors:
  - Delphic forward guidance
  - Odyssean forward guidance
- Measure monetary policy transmission to expectations (Baumeister, 2021)

Thank you for your attention!

Monetary Policy and the Yield Curve

Vladislav Abramov[1] Konstantin Styrin[1,2] Alexander Tishin[1]

abramovvv01@mail.cbr.ru *styrinka@mail.cbr.ru* *tishinav@mail.cbr.ru*

[1]Bank of Russia [2]New Economic School

Appendix

Nelson-Siegel Model

Nelson-Siegel Model

- For now, we use fitted values from Nelson-Siegel model, provided and published by Moscow exchange (on daily basis)

$$y_t(\tau) = \beta_{1,t} + \beta_{2,t}\left[\frac{1-\exp(-\lambda\tau)}{\lambda\tau}\right] + \beta_{3,t}\left[\frac{1-\exp(-\lambda\tau)}{\lambda\tau} - \exp(-\lambda\tau)\right]$$

- The following specification is from Diebold and Li, 2006
- For each observable OFZ issue and date (t)
- We have τ – maturity (e.g. 34.5 months)
- Yield to maturity, $y_t(\tau)$
- Estimate the following model for each date t

Back

Details about estimation

Surprises

- Calculate *daily* surprises
- For rates $s_{i,t} = i_t - i_{t-1}$, for others variables (FX, stock market indices $s_{i,t} = \frac{p_t - p_{t-1}}{p_{t-1}}$)
- We assume that
- $s_{i,t} = \alpha_{i,TS} \times \epsilon_t^{TS} + \alpha_{i,PS} \times \epsilon_t^{PS} + \zeta_{i,t}$
- Surprise *i* in time *t* is influenced by two structural shocks plus the error term
- Note that $\alpha_{i,TS}$ and $\alpha_{i,PS}$ also vary with *i* $\rightarrow$ different reaction of different surprises *i* to changes in structural shocks
- Implicit assumption: surprises are related only to structural shocks and uncorrelated with all other variables (HFI logic).

Back

Principal Component Analysis

- $\mathcal{S} \in s_1, s_2, \dots, s_N$ – sorted by maturity a set of HF surprises
- Extract η_1 and η_2 – the first two principal components from $\mathcal{S}$
- Rotate η_1 and η_2 in a way:
- $s_1 = \alpha_0 + \alpha_1\eta_1 + \alpha_2\eta_2 + \nu_t$ and take $\hat{s}_1 =$ Target shock – take all that explain a surprise with the shortest maturity in the data
- $\eta_1 = \gamma_0 + \gamma_1\hat{s}_1 + \varepsilon_t$ and take $\hat{\varepsilon}_t =$ Path shock – find the orthogonal complement to $\hat{s}_1$
- So, target shock should explain the short part of the yield curve, i.e., changes in the current rates
- Path shock explains everything else (=orthogonal), i.e., the long part of the yield curve, forward guidance, central bank information, etc

Back

Data

- $\mathcal{S}$ (dataset for PCA):
  - 1 month OFZ yield (from NS); RTS (futures on USD-valued MOEX index); Si (futures on USD-RUB FX); Moscow Exchange Government Bond Index 1Y (RUGBICP1Y);
  - IRS[2] (1,3,5,7,10 years).

- Δy (variables for OLS):
  - OFZ yields from Nelson-Siegel model (3, 6, 9 months, 1, 3, 5, 7, 10, 12, 15 years);
  - Si (futures on USD-RUB FX); USDRUB (TOD – today and TOM – tomorrow USD-RUB FX); RTS (futures on USD-valued MOEX index); IMOEX (stock market index);

[2] A vanilla interest rate swap is an agreement between two counterparties to exchange cashflows (fixed vs floating) in the same currency. This agreement is often used by counterparties to change their fixed cashflows to floating or vice versa. The payments are made during the life of the swap in the frequency that is pre-established by the counterparties.

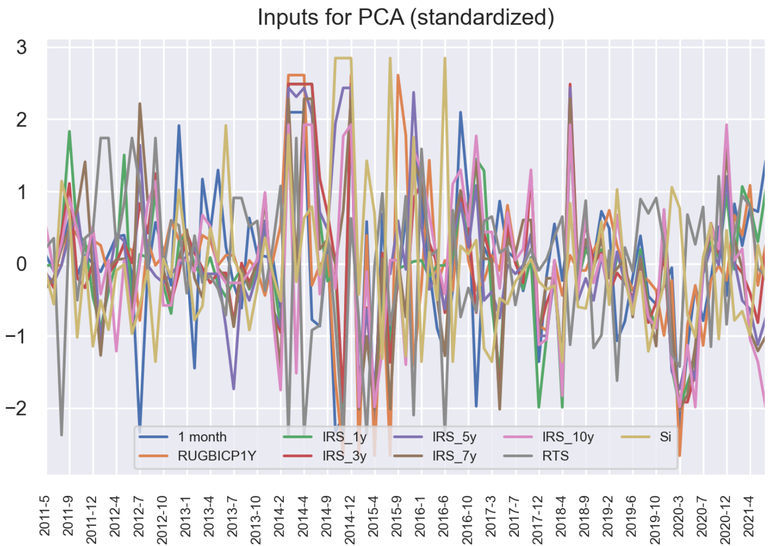
What else we do?

- Rolling window estimation[2]: Results
  - Take the same Target and Path shocks (estimated on the whole sample)
  - Take the rolling 40 subsequent points
  - Re-estimate: $\Delta y_t = \beta_0^F + \beta_1^F \text{Target shock}_t + \beta_2^F \text{Path shock}_t + \epsilon_t^F$ for each 40 points
  - Additionally estimate (also on rolling window)
  - $\Delta y_t = \beta_0^{R1} + \beta_1^{R1} \text{Target shock}_t + \epsilon_t^{R1}$
  - $\Delta y_t = \beta_0^{R2} + \beta_2^{R2} \text{Path shock}_t + \epsilon_t^{R2}$
  - Compare R^2 from the full OLS (sub-index ^{F}) and from two restricted (sub-indices ^{R1} and ^{R2}) regressions
  - Helps to understand the importance of each shock
  - Detects potential outliers and/or structural breaks
- Local projections[3] (daily): Results
  - $\Delta y_{t+h} = \beta_0 + \beta_1 \text{Target shock}_t + \beta_2 \text{Path shock}_t + \epsilon_t$
  - Check the effects of monetary policy decision on the following days
  - A kind of robustness test

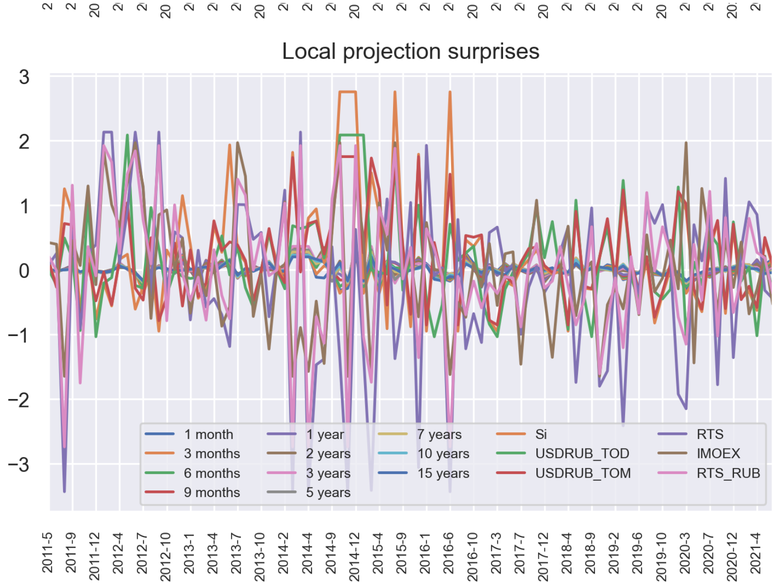
Back

[3] For each Δy

PCA: $\mathcal{S}$



Data for Δy



Formal test

Formal test for # of components (Cragg & Donald, 1997)

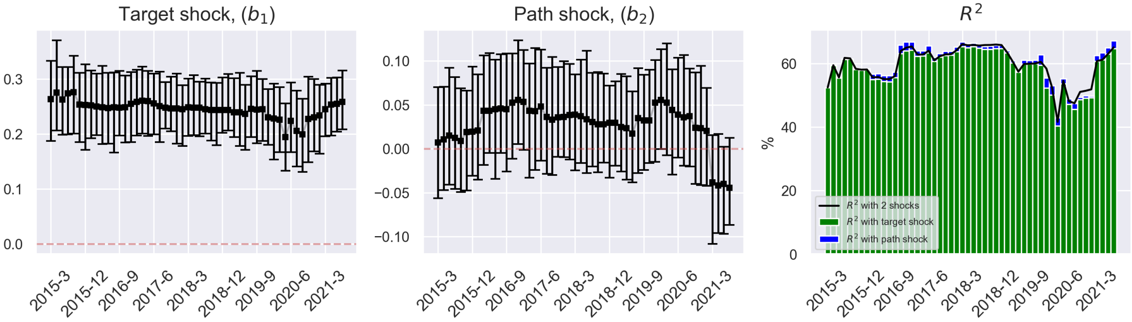
H_0: number of factors equals	degrees of freedom	Wald statistic	p -value
0	36	36	**0.00**
1	27	40	**0.01**
2	19	30	**0.60**

Back

Rolling window OLS

Δy: 3 month OFZ

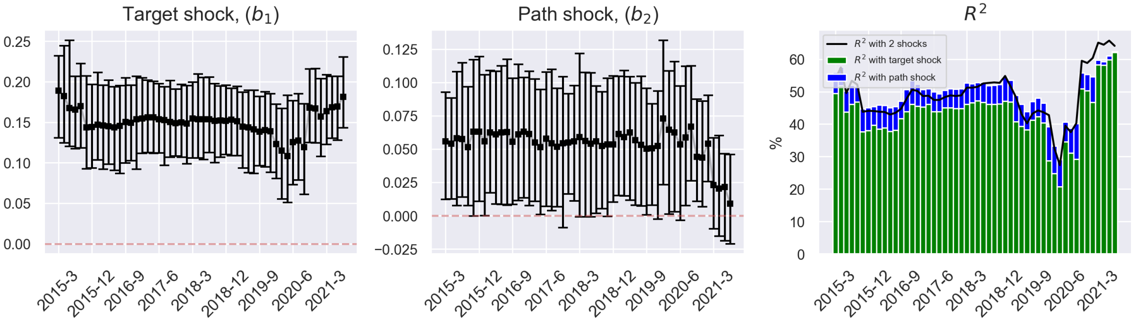
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 1 year OFZ

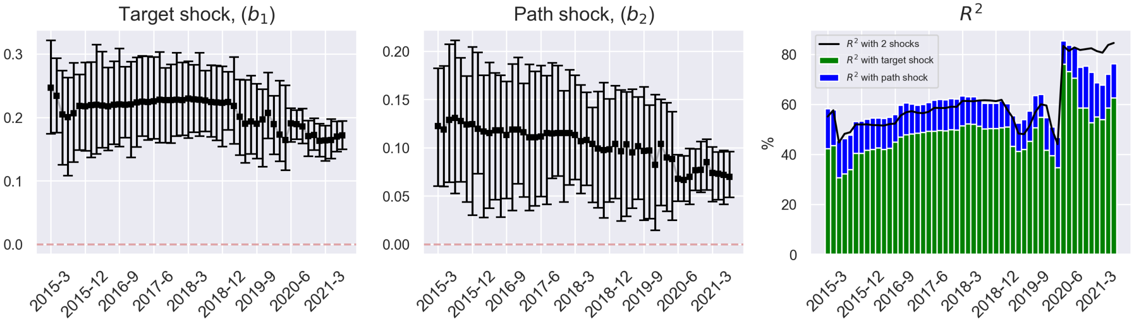
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 3 years OFZ

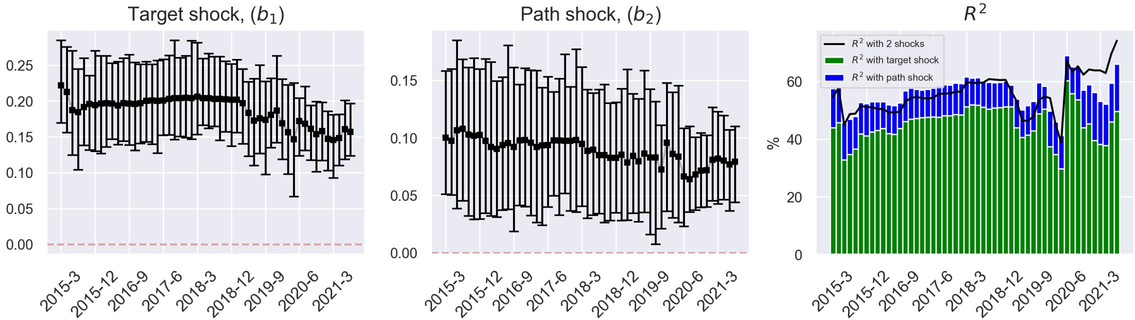
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 5 years OFZ

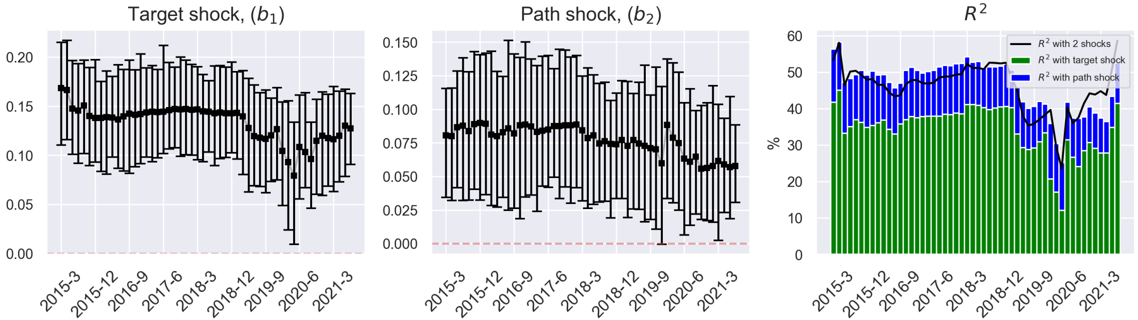
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 10 years OFZ

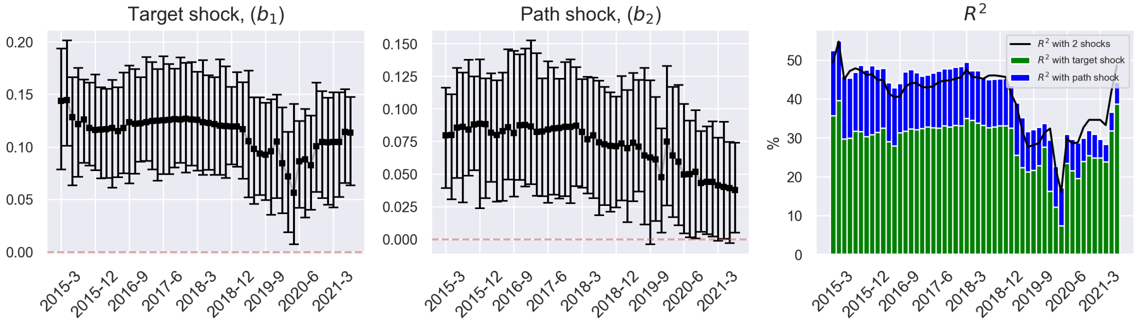
Rolling window OLS



$$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Δy: 15 years OFZ

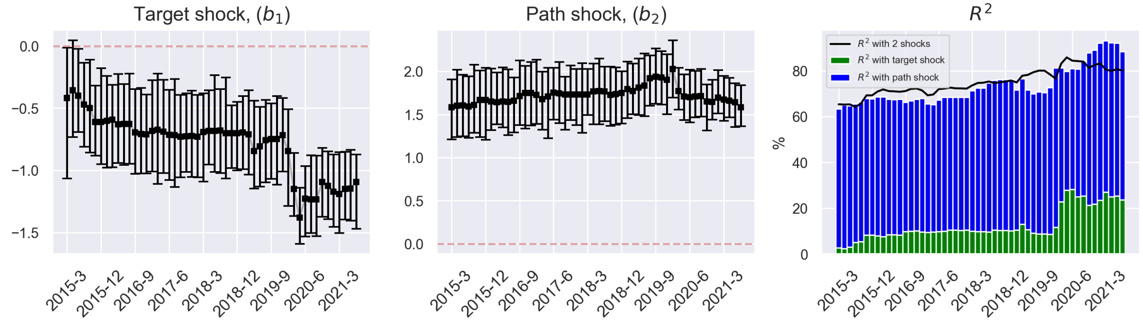
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: Si – futures on USDRUB

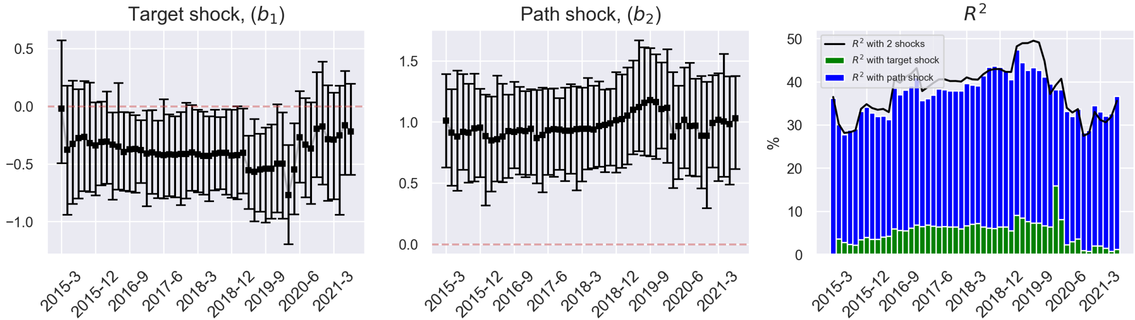
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: USDRUB TOD

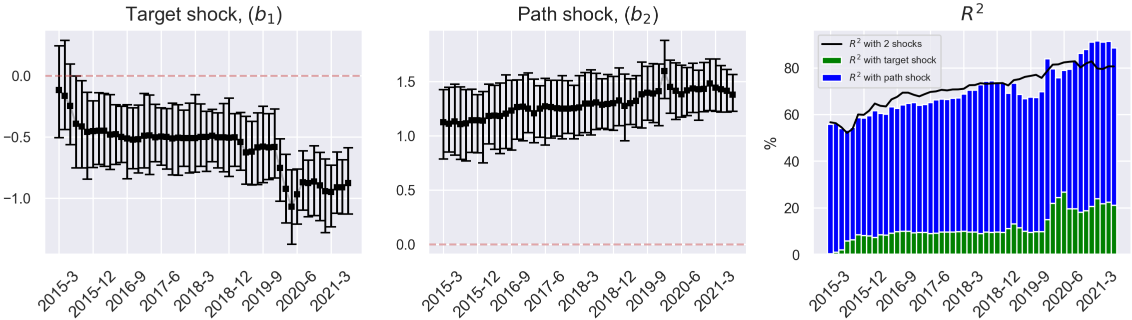
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: USDRUB TOM

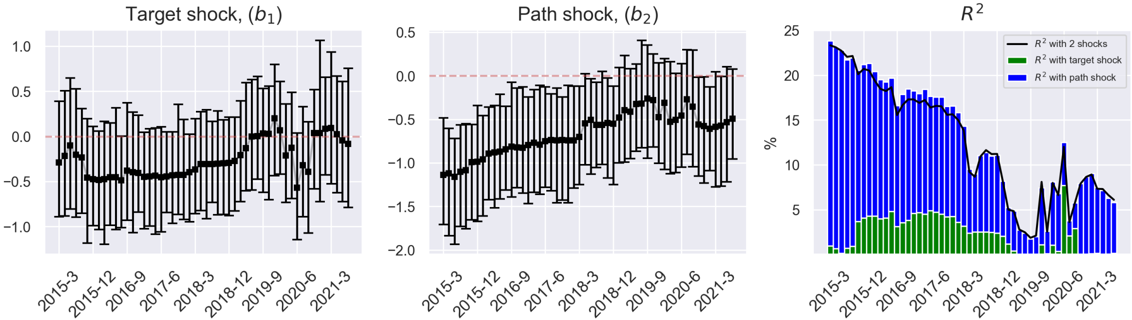
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: IMOEX – spot stock market index

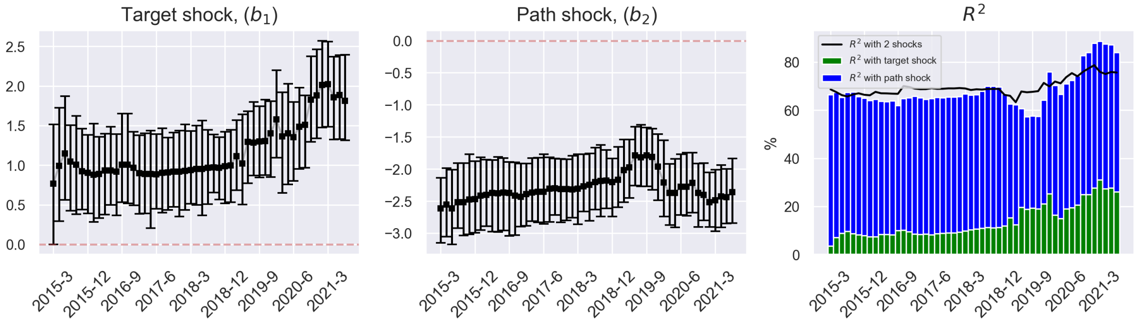
Rolling window OLS



$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: RTS – futures on stock index in USD

Rolling window OLS



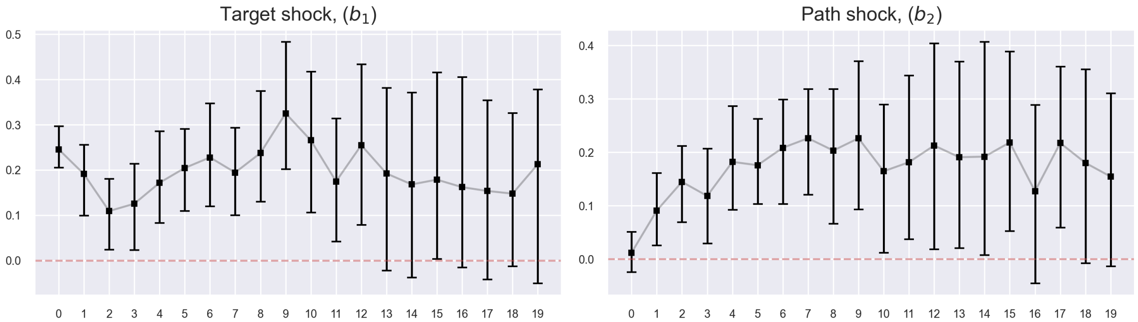
$\Delta y_t = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Back

Local projections

Δy: 3 month OFZ

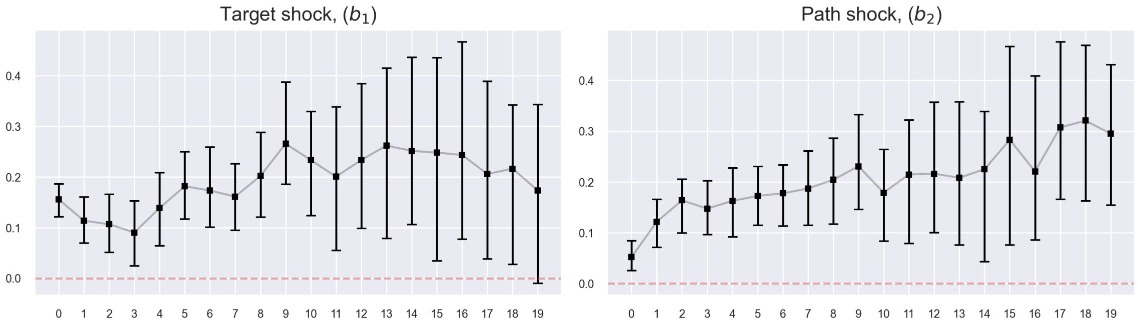
Local projections



$$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Δy: 1 year OFZ

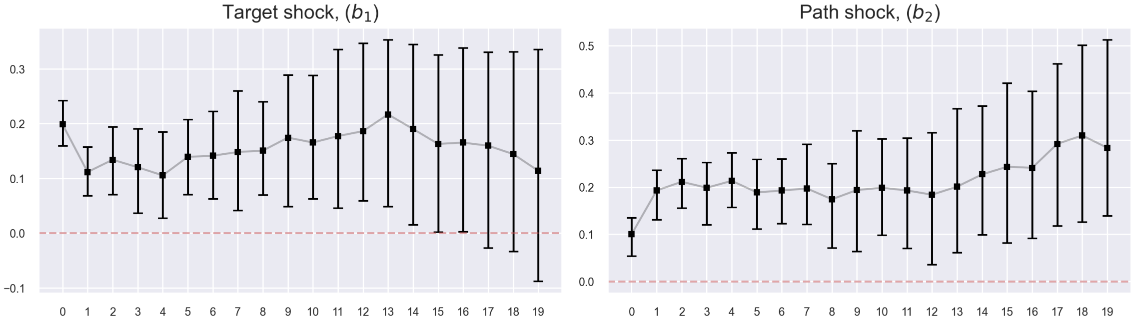
Local projections



$$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Δy: 3 years OFZ

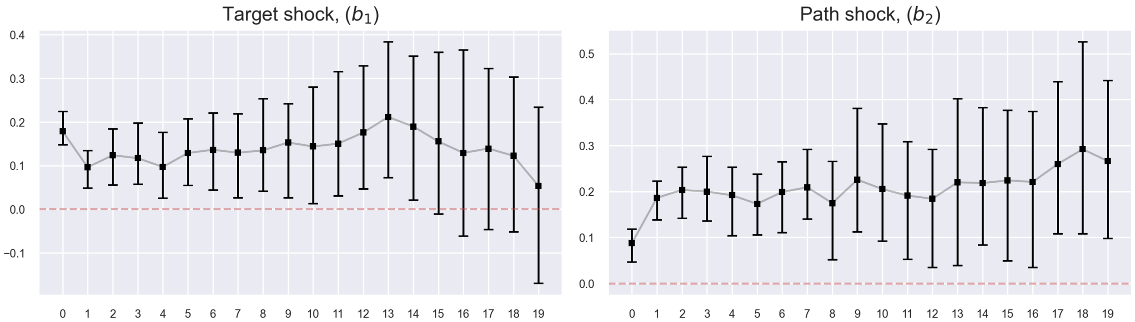
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 5 years OFZ

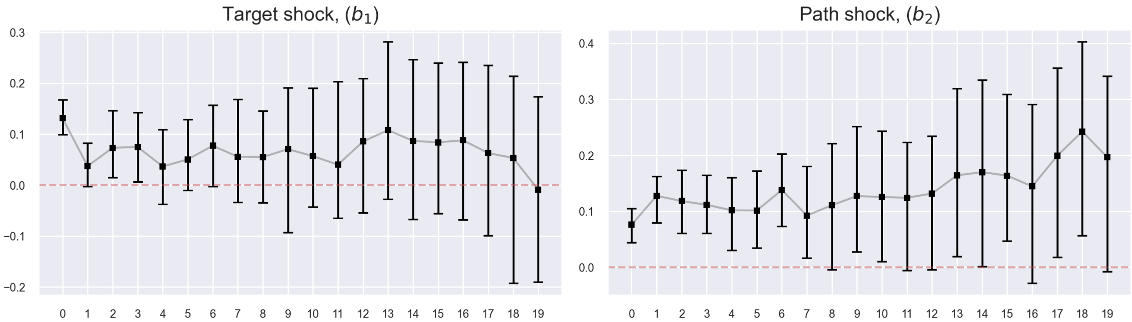
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 10 years OFZ

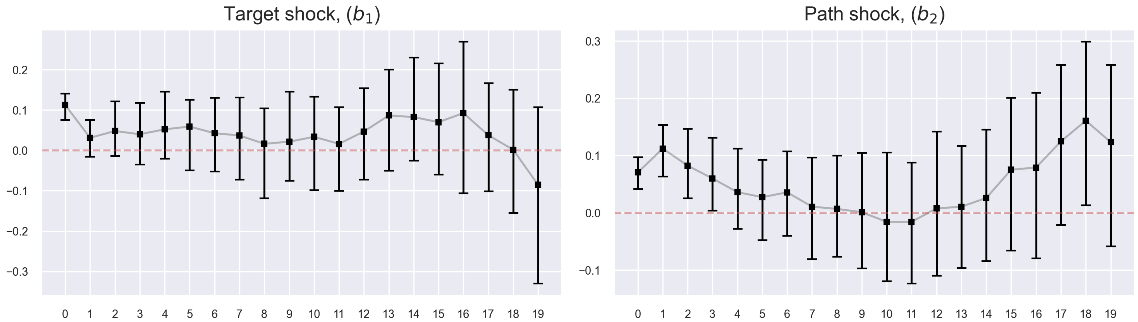
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: 15 years OFZ

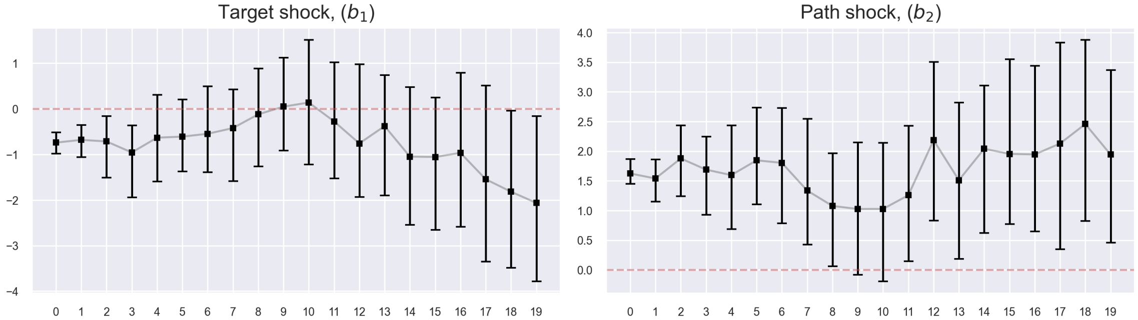
Local projections



$$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Δy: Si – futures on USDRUB

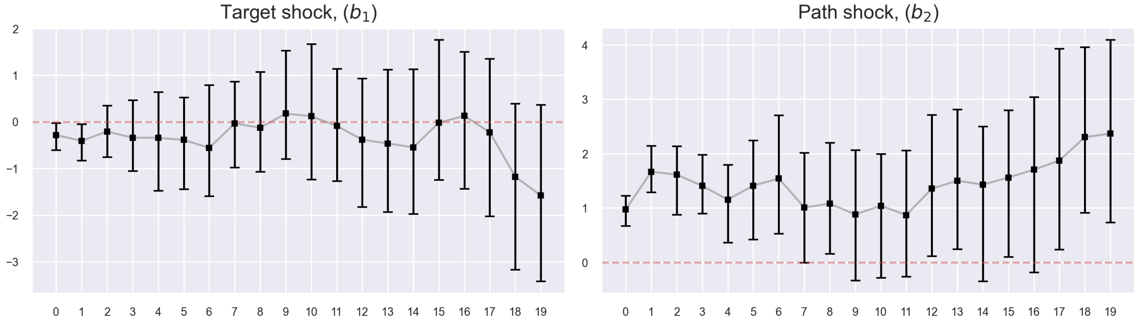
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: USDRUB TOD

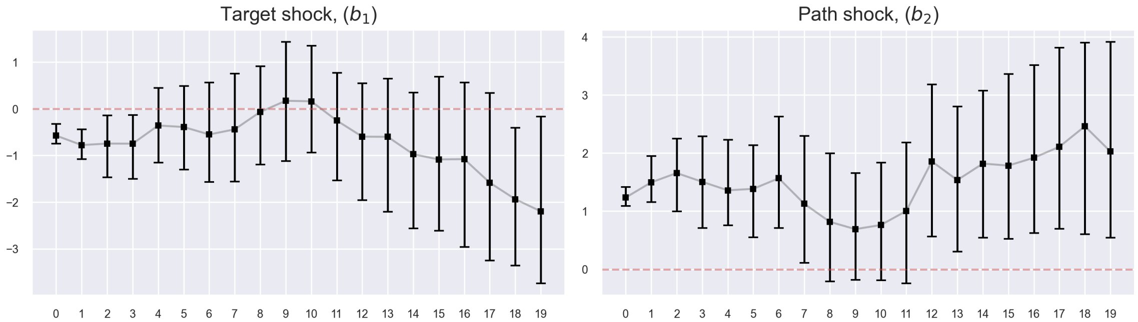
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: USDRUB TOM

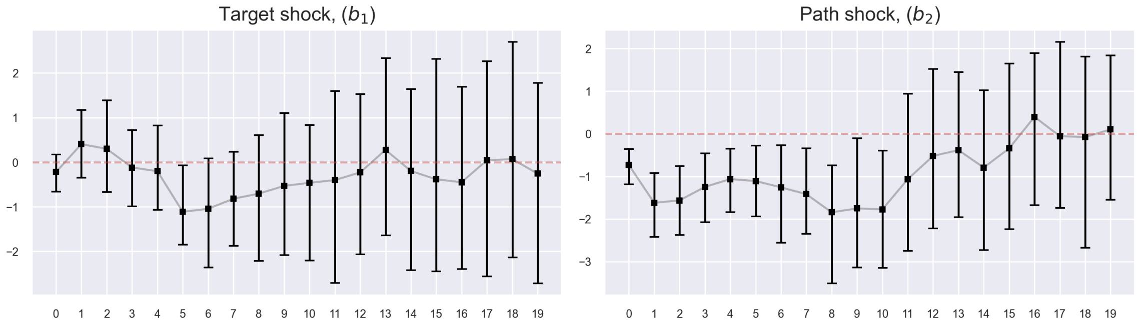
Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Δy: IMOEX – spot stock market index

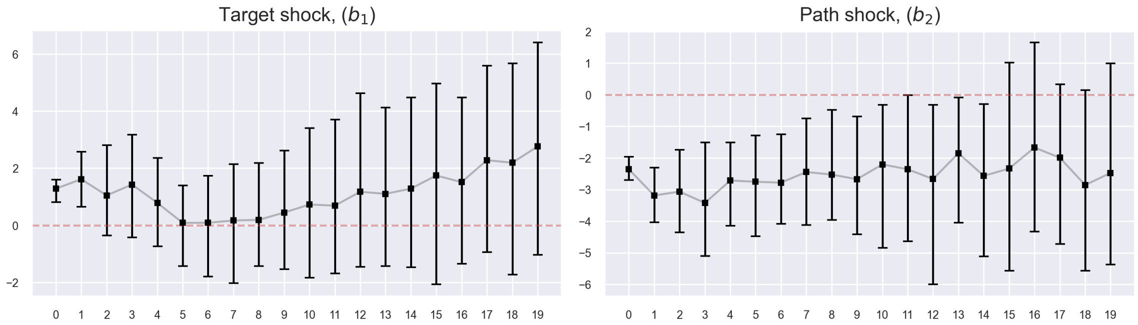
Local projections



$$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$$

Δy: RTS – futures on stock index in USD

Local projections



$y_{t+h} - y_{t-1} = b_0 + b_1 \cdot \text{target shock}_t + b_2 \cdot \text{path shock}_t + e_t$

Back

Bibliography I

Baumeister, C. (2021). Measuring market expectations.

Diebold, F. X., & Li, C. (2006). Forecasting the term structure of government bond yields. *Journal of econometrics*, *130*(2), 337–364.

Gürkaynak, R., Sack, B., & Swanson, E. (2005). "do actions speak louder than words? the response of asses prices to the monetary policy actions and statements". *International Journal of Central Banking*.

Jarocinski, M. (2021). Estimating fed's unconventional policy shocks.

Leombroni, M., Vedolin, A., Venter, G., & Whelan, P. (2021). Central bank communication and the yield curve. *Journal of Financial Economics*.

Pestova, A., & Bannikova, V. (2021). The effects of monetary shocks on inflation: High-frequency approach. *Voprosy economiki*, (6), 47–76.

Swanson, E. T. (2021). Measuring the effects of federal reserve forward guidance and asset purchases on financial markets. *Journal of Monetary Economics*, *118*, 32–53.

Tishin, A. (2019). Monetary policy surprises in russia. *Russian Journal of Money and Finance*, *78*(4), 48–70.