A Dynamic Yield Curve Model with Stochastic Volatility and Non-Gaussian Interactions: An Empirical Study of Non-Standard Monetary Policy in the Euro Area

by G. Mesters, B. Schwaab and S.J. Koopman

Discussion:

Jean-Paul Renne, Banque de France

The views presented here are not necessarily those of the Banque de France.

Overview

- Study of the yield curve and its interactions with measures of non-standard monetary-policy.
- (Separate) Modeling of German, French, Italian and Spanish yield curves.
- Various non-Gaussian features.
- Estimation based on importance sampling techniques.
- Results:
  - SMP had a direct and temporary effect on yield curves (10 weeks),
  - Limited evidence that purchases changed the relationship between EONIA and the yield curve.
  - During crisis, response of the yield curve to EONIA was different (impaired) in some countries.

The model

- Yield curves have Nelson-Siegel parametric form:

$$y_{\tau,t} = \underbrace{\beta_{1,t}}_{level} + \underbrace{\beta_{2,t}}_{slope}\left(\frac{1-e^{-\lambda\tau}}{\lambda\tau}\right) + \underbrace{\epsilon_{\tau,t}}_{measur.error} . \quad (1)$$

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- The state vector is $\alpha_t = (\beta_{1,t}, \beta_{2,t}, \theta_{1,t}, \theta_{2,t})'$. It follows a Gaussian VAR:

$$\alpha_t - \mu = H(\alpha_{t-1} - \mu) + \xi_t, \qquad \xi_t \sim \mathcal{N}(0, Q). \qquad (2)$$

The model

- $x_{1,t}$ is the EONIA rate.

  Conditionally on α_t, the log of the EONIA is Gaussian:

$$\log(x_{1,t})|\theta_t \sim \mathcal{N}(\theta_{1,t}, \sigma^2).$$

- $x_{2,t}$ are the the SMP-purchased amounts.

  Conditionally on α_t, the amounts purchased are Poisson-distributed with intensity $\exp(\theta_{2,t})$:

$$\log(x_{1,t})|\theta_t \sim \mathcal{P}(\exp(\theta_{2,t})).$$

- Conditionally on α_t, the $x_{i,t}$s are independent from all other factors.

Comments 1

Arbitrage Opportunities

- Over the last decade, the bulk of interest-rate term-structure (TS) studies relies on the theoretically-appealing no-arbitrage framework.
- This paper does not follow this strand of literature.

  In particular, this prevents the authors from studying the influence of agents' aversion to interest-rate risks on yields (= computation of term premia).

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  In particular, this prevents the authors from studying the influence of agents' aversion to interest-rate risks on yields (= computation of term premia).
- However, important advantage of the present framework: less constraints on the dynamics.
  - To remain tractable, no-arbitrage TS models have to involve "affine" processes (such that $E_t(\exp(-z_{t+1} - \cdots - z_{t+h})) = \exp(A_h + B_h z_t)$).
  - Then, why using a simple (single-lag) Gaussian VAR for α_t?
  - In particular, easy to design a ZLB-consistent dynamics where $\beta_{1,t} + \beta_{2,t}$ (shortest-term rate) and $\beta_{1,t}$ (rate of maturity ∞) are > 0.

$\Rightarrow$ This "advantage" is somewhat underexploited here.

Comments 2

The estimation

- Maximization of likelihood whose computation is based on an importance sampling approach; computationally intensive.
- Advantages of the method should be highlighted/demonstrated.
- Far less sophisticated/complicated approach can be designed to quickly estimate the model.

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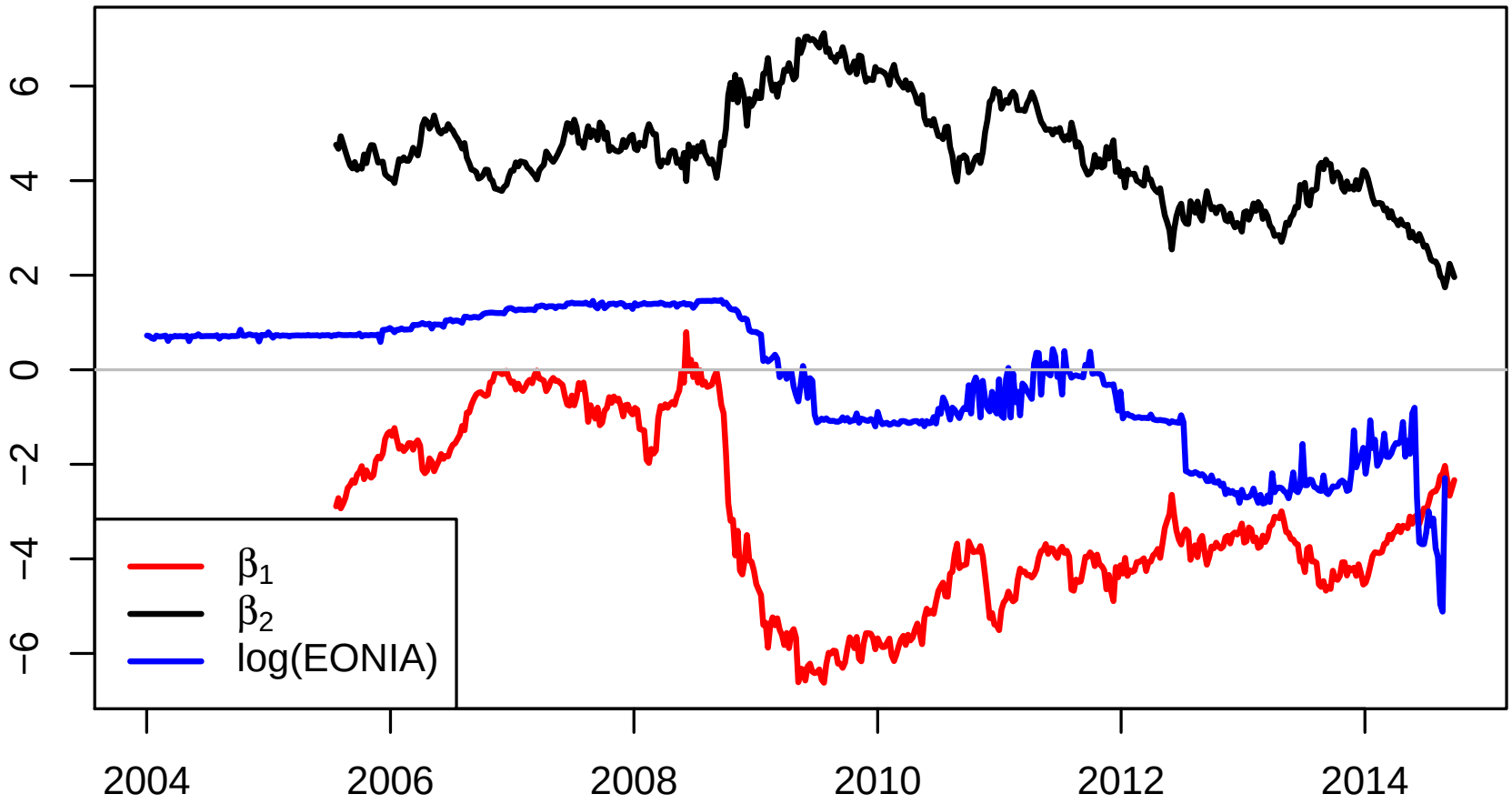
- Maximization of likelihood whose computation is based on an importance sampling approach; computationally intensive.
- Advantages of the method should be highlighted/demonstrated.
- Far less sophisticated/complicated approach can be designed to quickly estimate the model.
- For instance, recall that (Λ = Nelson-Siegel factor loadings):

$$\underbrace{Y_t}_{(N\times 1)} = \underbrace{\Lambda'}_{(N\times 2)} \underbrace{\beta_t}_{(2\times 1)} + \epsilon_t,$$

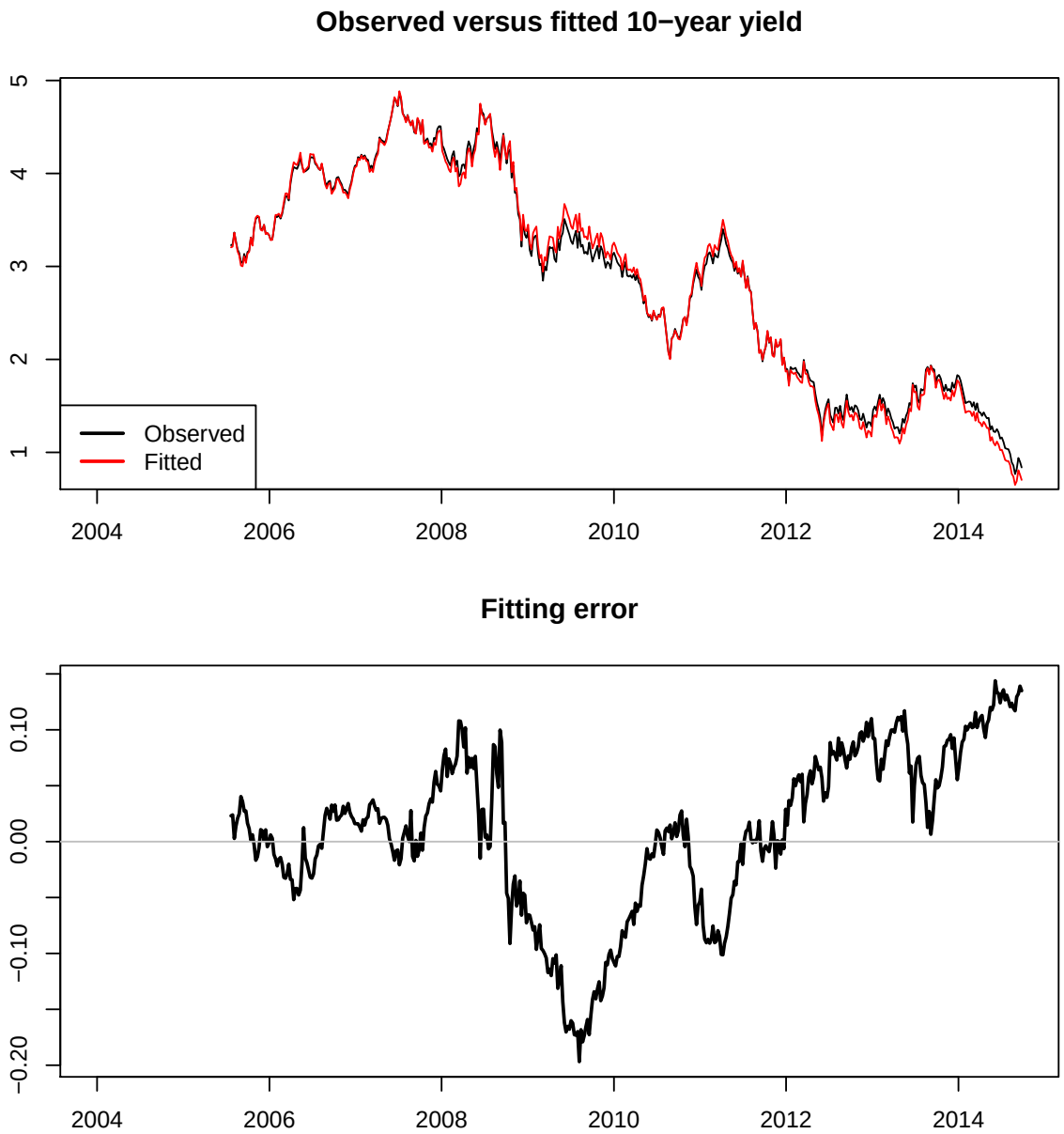
$\Rightarrow$ Immediate estimates of β_t can be obtained by regressing Y_t on Λ (Renne, 2012):

$$\underbrace{\hat{\beta}}_{(T\times 2)} = ((\Lambda\Lambda')^{-1}\Lambda \underbrace{Y}_{(N\times T)})'.$$

Quick $\hat{\beta}s$



Persistence in fitting errors (not addressed by the model)



Comment 3

About the use of the EONIA

(a) While it is also a yield ($\tau \longrightarrow 0$), the EONIA is treated in a very different way:

- Up to the (assumed i.i.d.) measurement errors, the model reckons that yields are (marginally and conditionally) Gaussian whereas EONIA is lognormal.
- The (mean) log of the EONIA enters the VAR $\Rightarrow$ a cut in the policy rate is expected to have a stronger impact on yields in low-yield environment.

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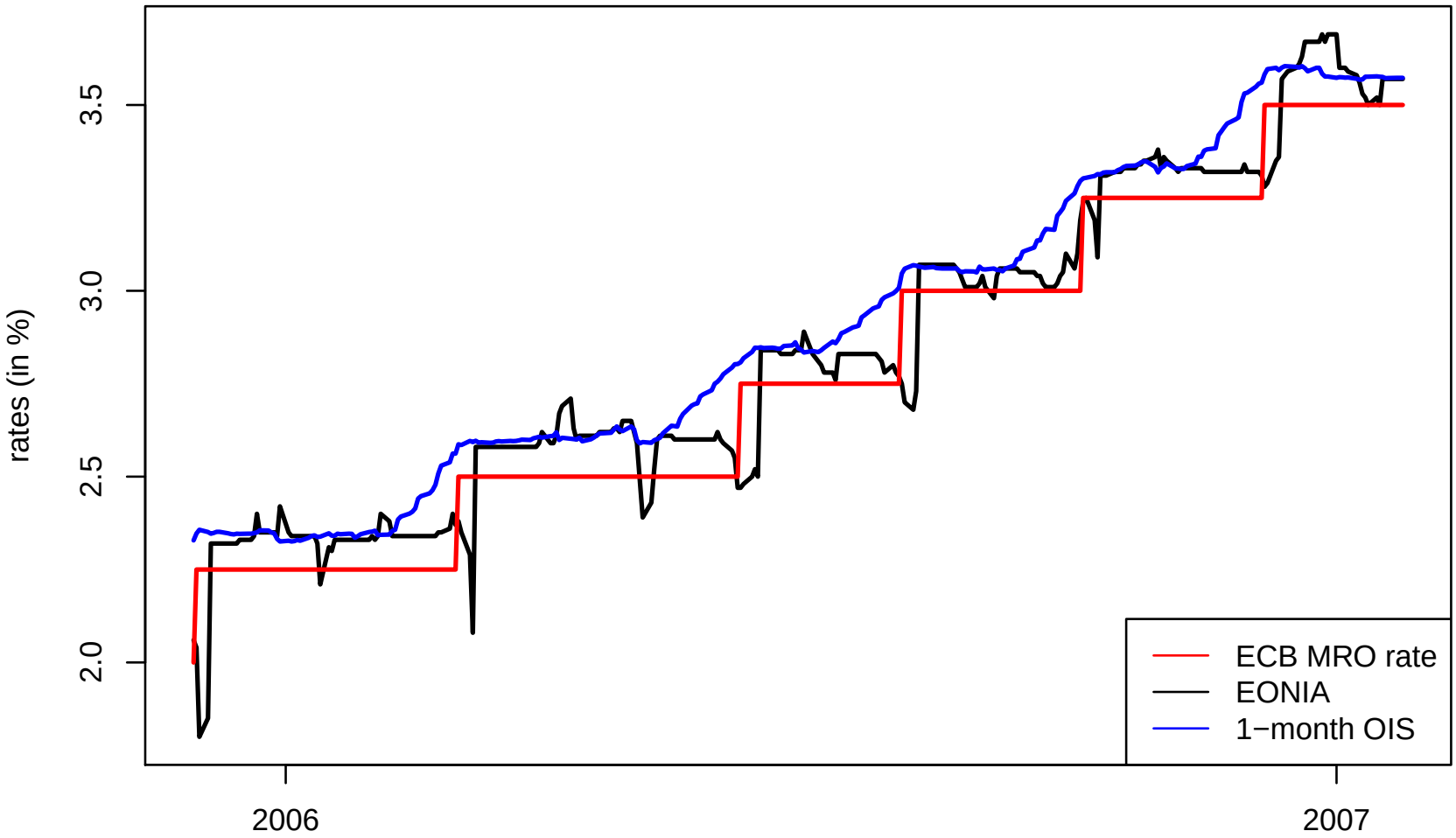
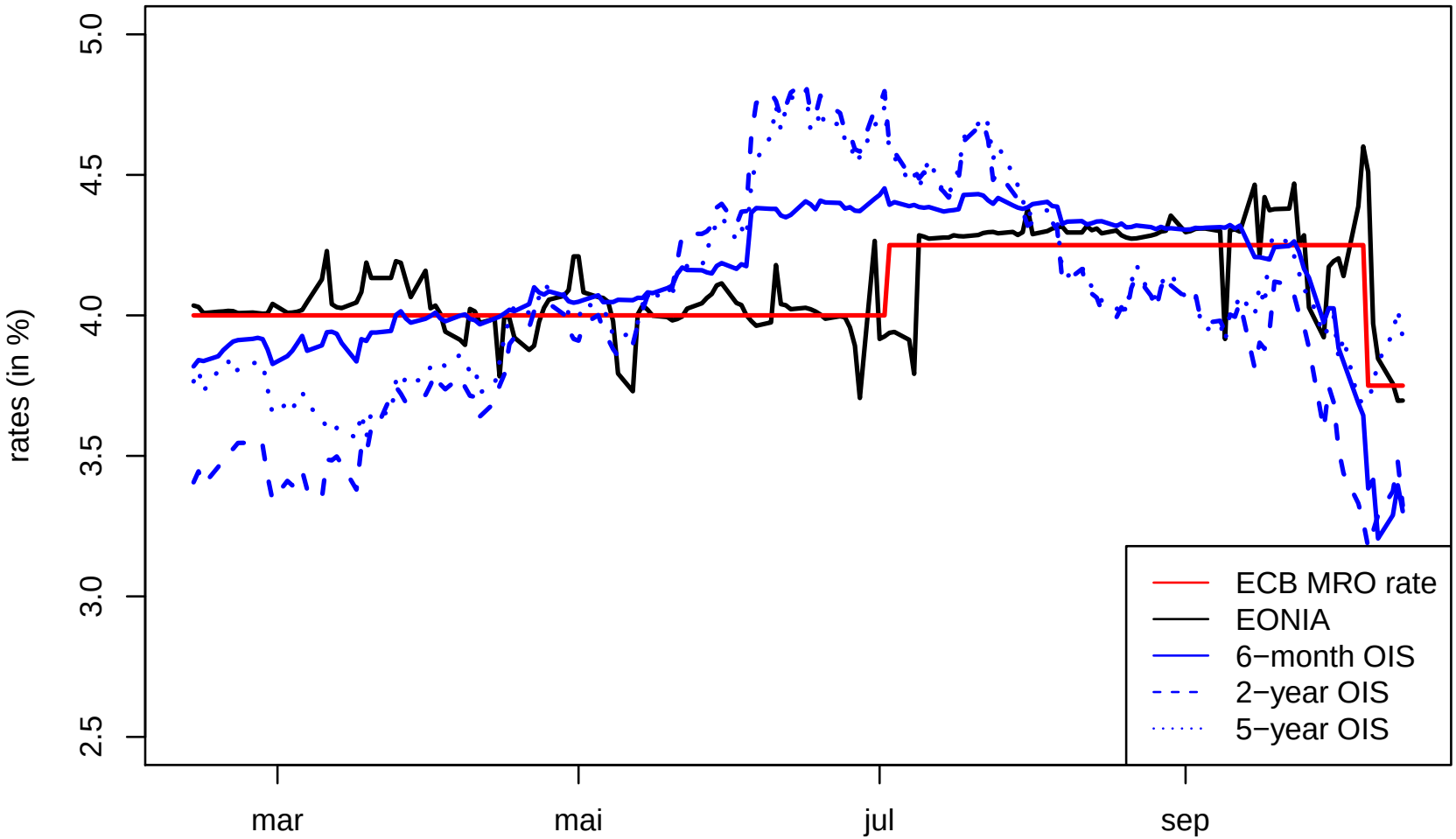
(b) The EONIA is used as a proxy of the monetary-policy stance. However, the EONIA is a lagged proxy of the monetary-policy stance:
- Interest-rate decisions (MRO, Deposit facility, Lending facility) are taken on Thursdays.
- The EONIA tends to be affected on the next Tuesday (first day on which new MROs are operated).

The EONIA is a lagged proxy of monetary-policy stance



The EONIA does not react contemporaneously to key MP announcements



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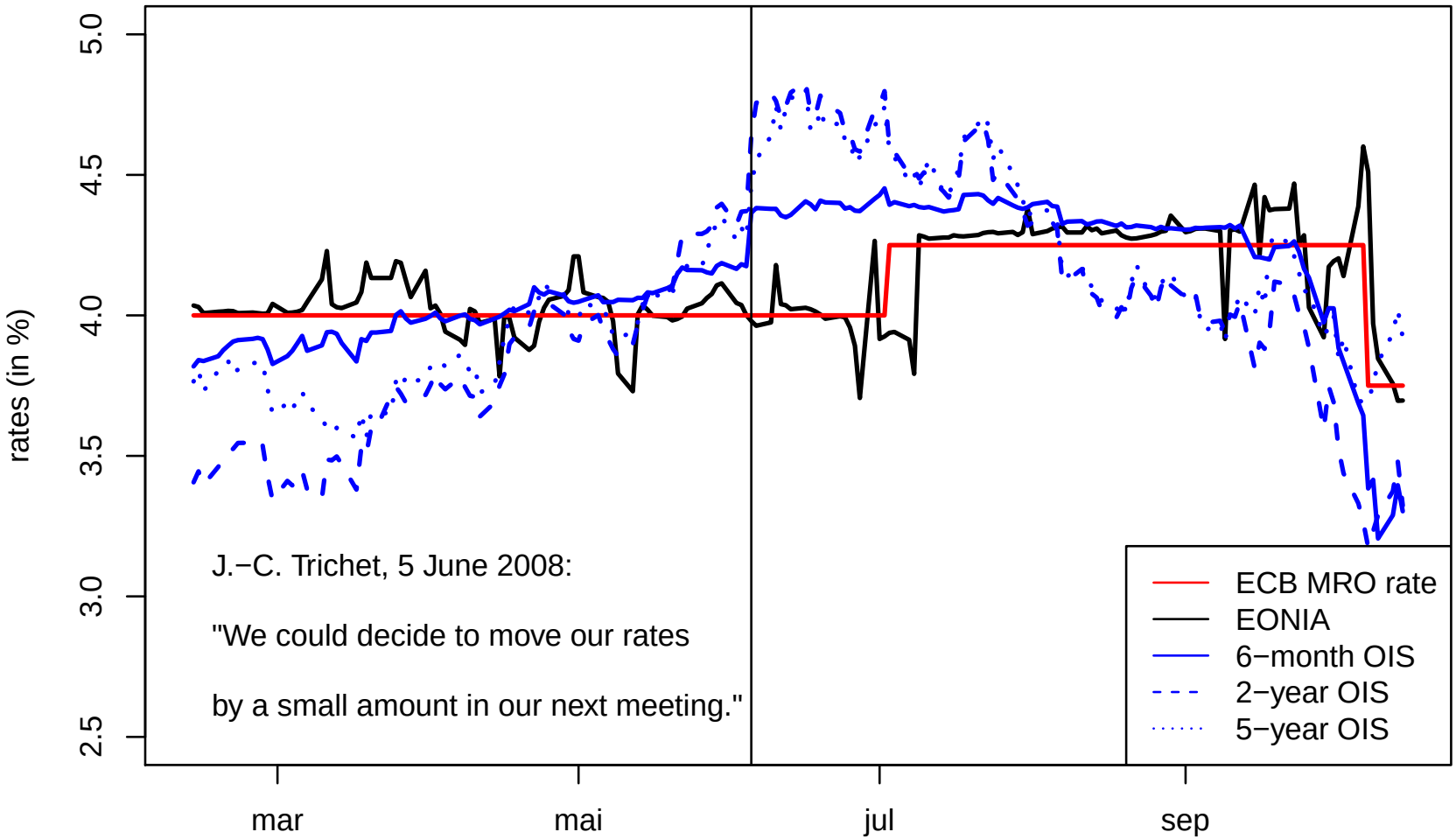

Table: Regressing yields on EONIA

	Dependent variable:			
	rate_2yrs		rate_10yrs	
	(1)	(2)	(3)	(4)
lagged_rate	1.010***	0.999***	0.991***	1.000***
	(0.010)	(0.003)	(0.008)	(0.004)
EONIA	-0.012		0.007	
	(0.010)		(0.006)	
D_EONIA		0.039		-0.007
		(0.025)		(0.026)
Observations	561	561	479	479
R^2	0.996	0.996	0.993	0.993
Adjusted R^2	0.996	0.996	0.993	0.993
Note:				*p<0.1; **p<0.05; ***p<0.01

Table: Regressing yields on MRO (policy rate)

	Dependent variable:			
	rate_2yrs		rate_10yrs	
	(1)	(2)	(3)	(4)
lagged_rate	1.018***	0.999***	0.992***	0.999***
	(0.009)	(0.003)	(0.009)	(0.004)
MRO	-0.023**		0.007	
	(0.010)		(0.007)	
D_MRO		0.158***		0.155***
		(0.056)		(0.057)
Observations	561	561	479	479
R^2	0.996	0.996	0.993	0.993
Adjusted R^2	0.996	0.996	0.993	0.993
Note:				*p<0.1; **p<0.05; ***p<0.01

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About the use of the EONIA

- EONIA should be replaced with more appropriate measures of monetary-policy surprises.
- $\Delta(MRO)_t$ (used in previous slides) is only a rough measure.
- See Kuttner (2001) or Piazzesi & Swanson (2008) for market-based measures of monetary-policy surprises:

  e.g.: Changes in OIS prices around ECB announcements events reflect unanticipated changes in future policy rates (Jardet and Monks, 2014).
- The distribution of these shocks is far from Gaussian. The model/estimation method could be appropriately exploited to handle that.

Conclusion

- Nicely-written, interesting and stimulating paper.
- The SMP analysis is too short; bond-purchase factors show up at the very end of the paper.
- The study of the impact of ECB stance on yield curve could be improved.
- The fact that authors do not have to care about affine-related constraints could & should be better exploited.
- Looking forward to reading future version.

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Thank you!