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} = \beta_{1,t} + \beta_{2,t} \left( \frac{1 - e^{-\lambda \tau}}{\lambda \tau} \right) + \epsilon_{\tau,t}.
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- The \( x_{i,t} \)'s are monetary-policy-related explanatory variables. Their conditional distributions depend on factors \( \theta_{i,t} \)'s whose dynamics interact with the \( \beta_{i,t} \)'s.
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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:

\[ \alpha_t - \mu = H(\alpha_{t-1} - \mu) + \xi_t, \quad \xi_t \sim \mathcal{N}(0, Q). \] \hspace{1cm} (2)
The model

- $x_{1,t}$ is the EONIA rate.
  
  Conditionally on $\alpha_t$, 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 SMP-purchased amounts.
  
  Conditionally on $\alpha_t$, 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 $\alpha_t$, 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).

\[ \text{to remain tractable, no-arbitrage TS models have to involve “affine” processes (such that } E_t(\exp(-z_t + 1 - \cdots - z_t + h)) = \exp(A_h + B_h z_t)). \]

\[ \text{Then, why using a simple (single-lag) Gaussian VAR for } \alpha_t? \]

\[ \text{In particular, easy to design a ZLB-consistent dynamics where } \beta_{1,t} + \beta_{2,t} (\text{shortest-term rate}) \text{ and } \beta_{1,t} (\text{rate of maturity } \infty) \text{ are }> 0. \]

⇒ This “advantage” is somewhat underexploited here.
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However, important advantage of the present framework: less constraints on the dynamics.

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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.
**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.
- For instance, recall that ($\Lambda = $ Nelson-Siegel factor loadings):

\[
Y_t = \Lambda' \beta_t + \epsilon_t,
\]

⇒ Immediate estimates of $\beta_t$ can be obtained by regressing $Y_t$ on $\Lambda$ (Renne, 2012):

\[
\hat{\beta} = ((\Lambda\Lambda')^{-1}\Lambda Y)'.
\]
Quick $\hat{\beta}$s
Persistence in fitting errors (not addressed by the model)

Observed versus fitted 10-year yield

Fitting error
Comment 3
About the use of the EONIA

(a) While it is also a yield ($\tau \to 0$), 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.

(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).
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J.-C. Trichet, 5 June 2008:
"We could decide to move our rates by a small amount in our next meeting."
### Table: Regressing yields on EONIA

<table>
<thead>
<tr>
<th></th>
<th>rate_2yrs</th>
<th>rate_10yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>lagged_rate</td>
<td>1.010***</td>
<td>0.999***</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.003)</td>
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<tr>
<td>EONIA</td>
<td>-0.012</td>
<td>0.007</td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td>(0.006)</td>
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<tr>
<td>D_EONIA</td>
<td>0.039</td>
<td>-0.007</td>
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<tr>
<td></td>
<td>(0.025)</td>
<td>(0.026)</td>
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<tr>
<td>Observations</td>
<td>561</td>
<td>561</td>
</tr>
<tr>
<td>R²</td>
<td>0.996</td>
<td>0.996</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.996</td>
<td>0.996</td>
</tr>
</tbody>
</table>

*Note:* *p*<0.1; **p**<0.05; ***p**<0.01

(ECB workshop on non-standard monetary policy measures)
Table: Regressing yields on MRO (policy rate)

<table>
<thead>
<tr>
<th>Dependent variable:</th>
<th>rate_2yrs</th>
<th>rate_10yrs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>lagged_rate</td>
<td>1.018***</td>
<td>0.999***</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.003)</td>
</tr>
<tr>
<td>MRO</td>
<td>-0.023**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.010)</td>
<td></td>
</tr>
<tr>
<td>D_MRO</td>
<td></td>
<td>0.158***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.056)</td>
</tr>
<tr>
<td>Observations</td>
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<td>R²</td>
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Note: * p<0.1; ** p<0.05; *** p<0.01
Comment 3
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.
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