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Interest Rates and Derivatives

Modelling short run interest rates using 3M Russian ZCB

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Introduction. ZCB 3M maturity

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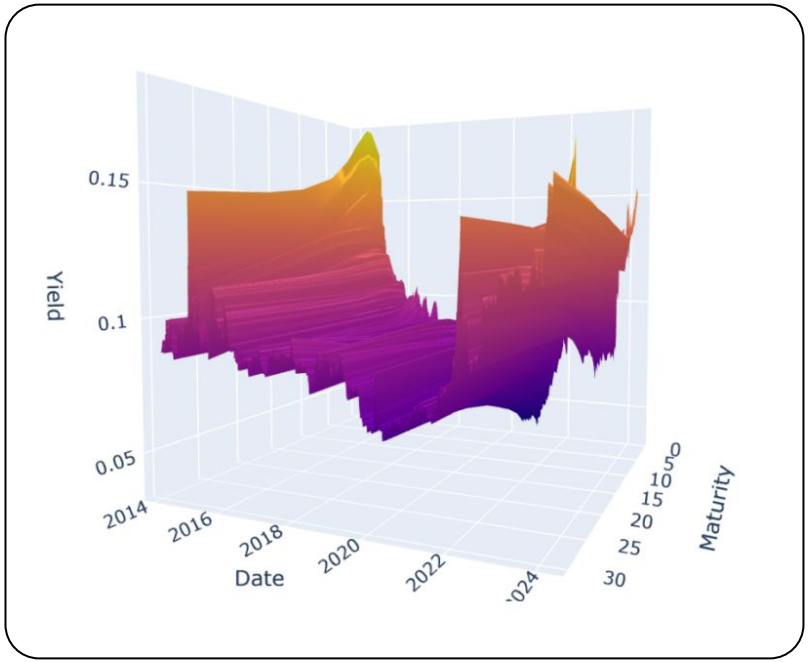

Introduction. Goals

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With our work we pursue the following goals:

1. Finding a good proxy for short interest rates and getting correct data
2. Modelling short interest rates using Vasicek and Hull-White models
3. Comparison of two models. Evaluation of their performance on the same left out test set.

Modelling short rate. Vasicek model

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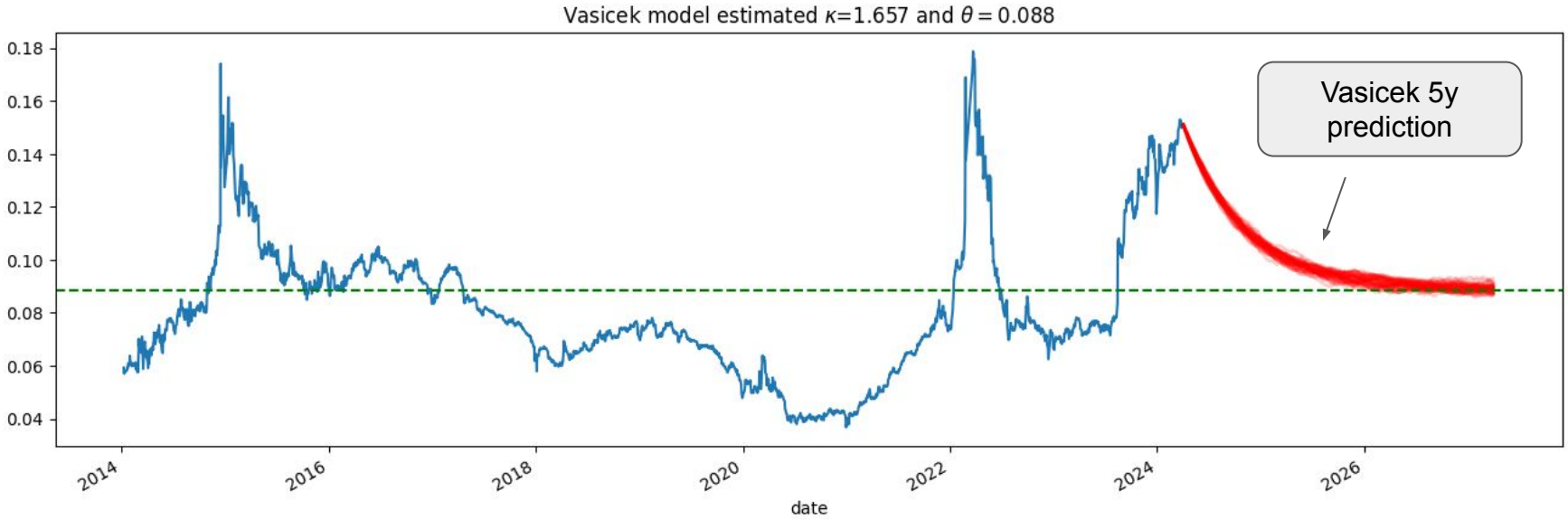

We successfully estimated Vasicek model parameters using data from 2014-2024 using MLE
We found that long run average of the short interest rate is around 8.8%

Modelling short rate. Hull-White vs Vasicek

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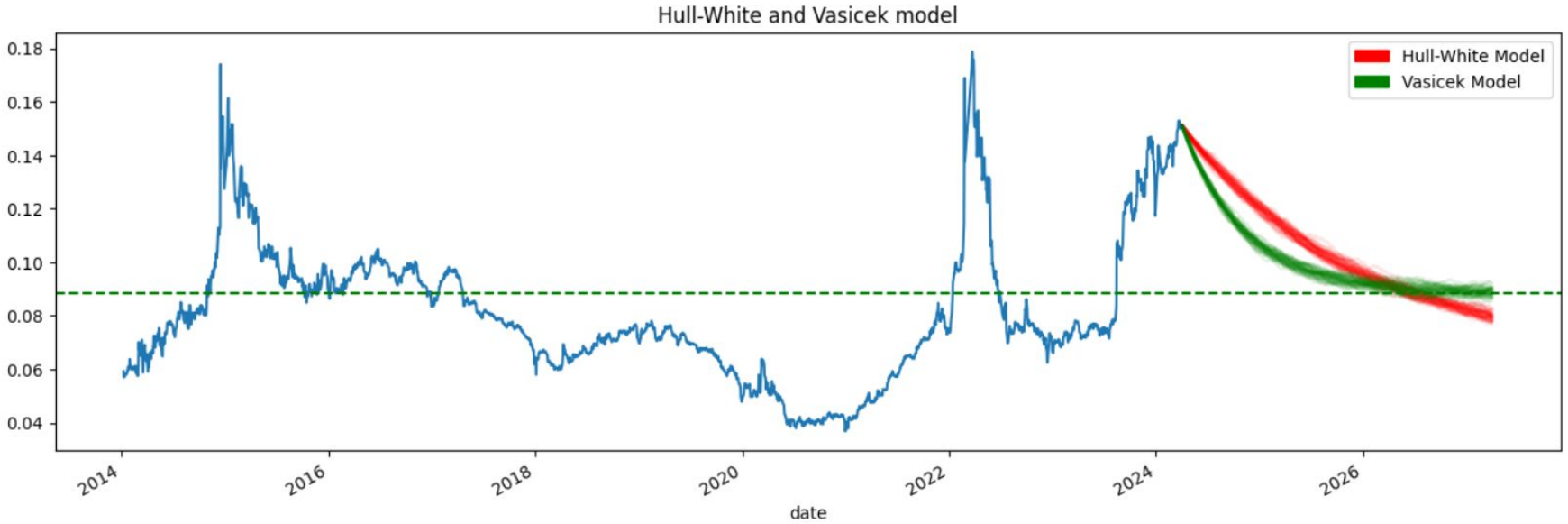

We also estimated Hull-White model, where long run mean is not a constant but a function. This way model becomes more flexible and produces a better fit to the data.

Modelling short rate. Hull-White vs Vasicek

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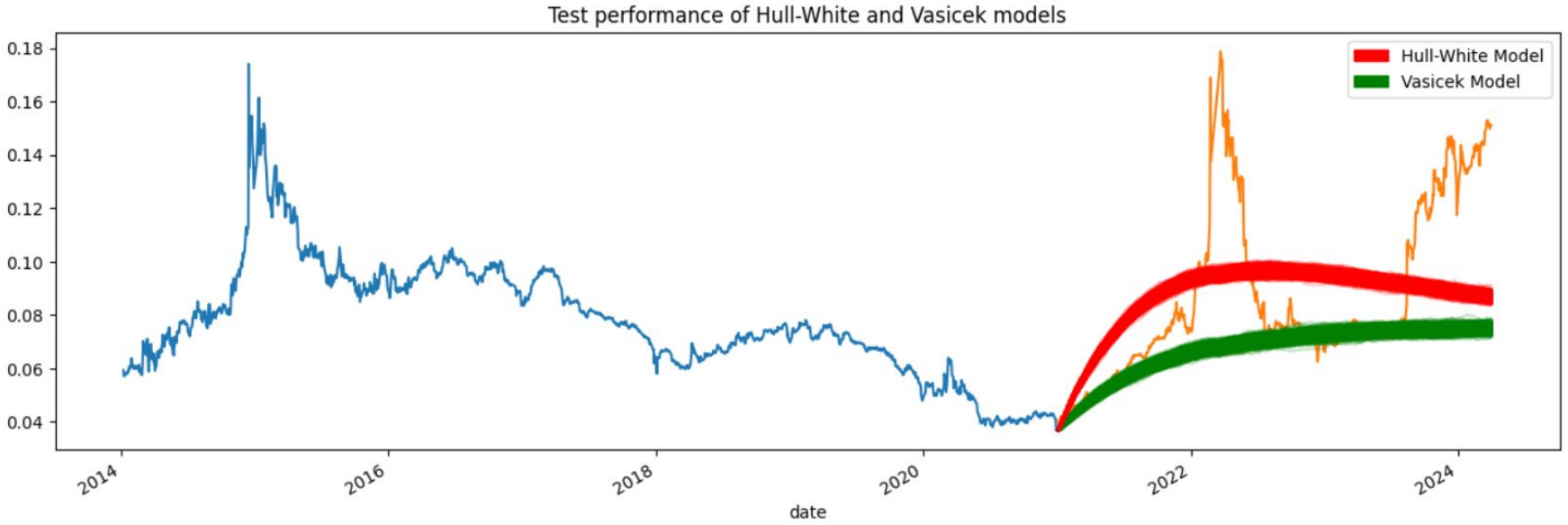

In this slide, we compared Hull-White and Vasicek models, we estimated the models using data up to 2021 and then simulated 1000 different paths for the 3 following years for each model to see how they will match real data.

Modelling short rate. Hull-White vs Vasicek

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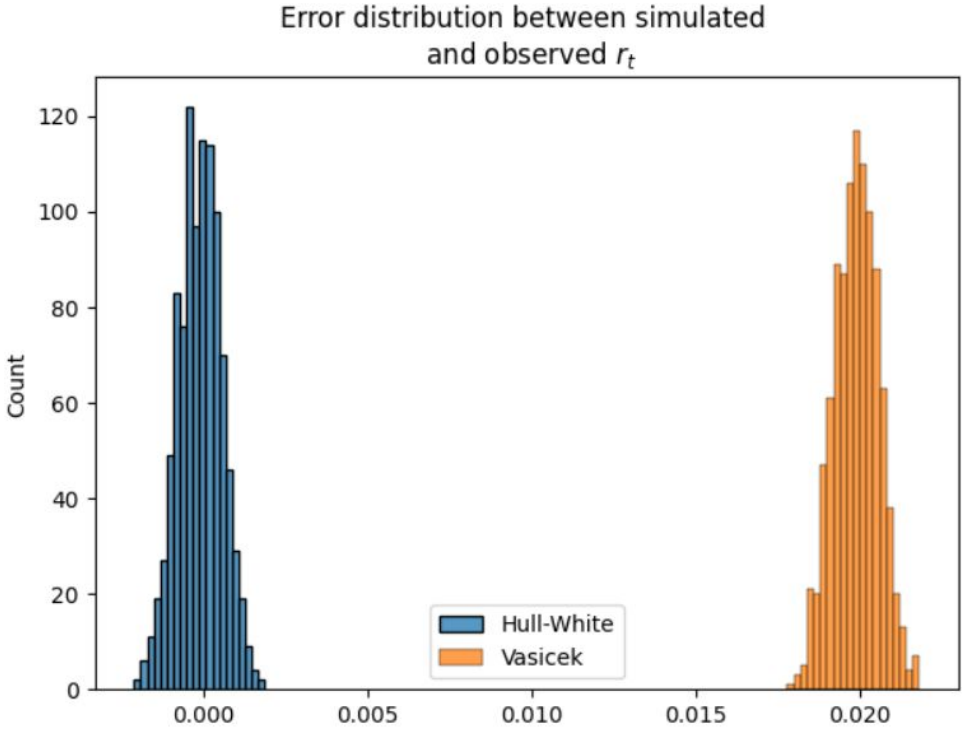
Main points:

Hull-White has the same variance in errors as Vasicek model

Hull-White model is unbiased - on average it has an error of 0

Vasicek model due to having the constant mean is biased as it can't capture structural breaks in the long run mean.



Modelling short rate. Hull-White vs Vasicek

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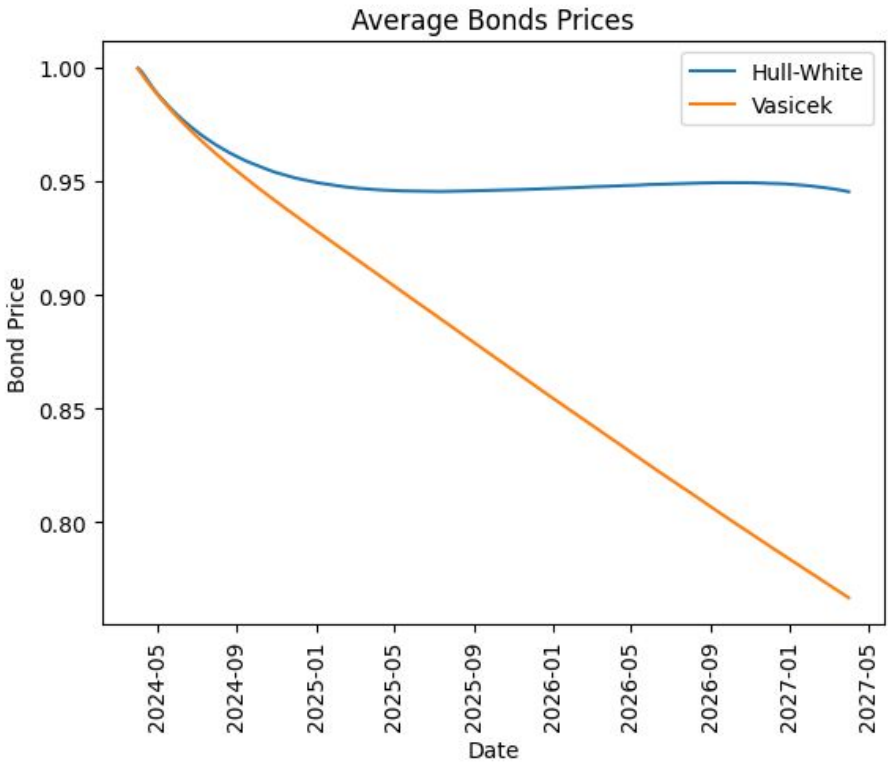
Bonds Prices:

Hull-White has a more smooth bonds prices, which stabilizes around 0.95 in the long run

Vasicek model presents bonds prices as 45 degree line, without any stabilization. It implies, that yield curve has normal shape.



Additional Resources

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Github: https://github.com/B0R0koko/IRD

You can find the code as well as the report in pdf file with snippets of code.

Thank you!!