Opponent's Report on Dissertation Thesis

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Author:	**Luboš Hanus**
Advisor:	Mgr. Lukáš Vácha Ph.D. (IES)
Title of the Thesis:	Essays on Data-driven, Non-parametric Modelling of Time-Series
Type of Defense:	**DEFENSE**
Date of Pre-Defense	January 10, 2024
Opponent**:**	Simon Trimborn PhD (University of Amsterdam)

Address the following questions in your report, please:

a) Can you recognize an original contribution of the author?
b) Is the thesis based on relevant references?
c) Is the thesis defendable at your home institution or another respected institution where you gave lectures?
d) Do the results of the thesis allow their publication in a respected economic journal?
e) Are there any additional major comments on what should be improved?
f) What is your overall assessment of the thesis? (a) I recommend the thesis for defense without substantial changes, (b) the thesis can be defended after revision indicated in my comments, (c) not-defendable in this form.

(Note: The report should be at least 2 pages long.)

It is my pleasure to provide a review for the doctoral thesis handed in by Lubos Hanus at Charles University. Mr. Hanus thesis consists of 4 Chapters spanning topics of data-driven model construction and data analysis. He analysed the business cycle co-movements between Visegrad countries and the EU, time-varying effects between macroeconomic variables, probabilistic forecasting and energy price forecasting. I raised various comments in the pre-defense which Mr. Hanus addressed to my satisfaction. To sum up this report, I have no hesitations towards awarding Mr. Hanus the title of doctor.

Mr. Hanus added in all 4 chapters to the academic literature. Chapters 3 and 4 stand out as they contain methodological advancements whereas empirical contributions were made in Chapters 2 and 5. In Chapter 3 Mr. Hanus suggests to use a time-varying parameter model in a VAR framework based on which to conduct impulse response analysis but in the frequency domain, not the time domain. This allows for differentiating between impulse response effects as by their occurrence. In Chapter 4, Mr. Hanus suggests to utilize deep learning to conduct probabilistic forecasting. Indeed the complex structures of density functions are difficult to estimate, in particular when only little data are available. Turning towards deep learning techniques for such an estimation is a novel and smart way of conducting such an analysis. Based on the methods suggested, I can confidently say that Mr. Hanus made original methodological contributions in his thesis.

Further in the Chapters 2 and 5, he conducted an empirical investigation of business cycles and electricity prices. Utilizing the method developed in Chapter 4, Mr. Hanus contributes to the literature on electricity price forecasting by showing that his method excels on the task. Given the recent excessive price changes in electricity prices, accurate estimation of prices became more important to ensure stable pricing for the consumers. By this, Mr. Hanus makes an important contribution to recent societal issues.

Mr. Hanus extends with his methodological contributions studies which are published in respected journals such as Review of Economic Statistics, Review of Financial Studies, Journal of Business and Economic Statistics, among others. Consequently he makes contributions to method which are relevant to the wider academic community. With his empirical work he adds to the literature published in Journal of Macroeconomics, Journal of Political Economy, International Journal of Forecasting, among others. These empirical studies are published in some of the most respected journals in their field.

Given the contributions made, I am certain all chapters will be published in respected topical journals. In fact the first chapter is already published, one has an invitation for revise and resubmit and another one is currently submitted. Based on what I saw, I could imagine that Chapter 4 stands a chance of publication in the Journal of Financial Econometrics and Chapter 5 in the International Journal of Forecasting. Also Journal of Empirical Finance or Quantitative Finance are possibilities.

In my opinion, in particular after the revision based on the comments raised, Mr. Hanus thesis is a fine piece of work which would also be eligible for thesis defense at other institutions. I did raise one comment: Chapters 3 and 4 only compared the suggested method against one other method. This raises the question why that particular method was chosen and how the methods of Mr. Hanus would compare against other methods. It would be good to comment on this in the thesis. Mr. Hanus responded well to this suggestion and clarified the main objectives of the studies.
Apart from this, I did not have any major comments but a suggestion for future research. I observed that the analysis in Chapter 5 focused on the overall prediction accuracy. Given the recent excessive price changes in the electricity markets, it would be interesting to develop a method based on deep learning for probability forecasts to predict accurately prices during periods of market excesses as we saw them recently. This would be accompanied by sparsity in the data, resulting in a research problem which is interesting from a methodological and societal standpoint. Mr. Hanus signaled in his response that he is interested in working into this direction. Given the quality of his thesis, I look forward to seeing his work on this.

Lastly, I would like to recommend the thesis of Mr. Hanus for defense without substantial changes.

Date:	04.03.2024
Opponent's Signature:	
Opponent's Affiliation:	Simon Trimborn PhD (University of Amsterdam)