Professor Jan Picek
Chair of the Habilitation Commission
Faculty of Mathematics and Physics
Charles University
Czech Republic

May 6, 2022

Dear Professor Picek,

As an external examiner (opponent) of Dr. Matus Maciak's Habilitation Dissertation, I would like to strongly support his application for tenure and promotion. According to my understanding, this is an outstanding habilitation thesis, and it is sufficient for an assistant professor to be tenured and promote to an associate professor. Let me elaborate it below.

This thesis contains seven new and original research papers at the area of changing point, which is one of the hottest topics in statistics and probability. Dr. Maciak has contributed to this area significantly from two aspects: changing point estimation and detection. It is well known that the changing point is more theoretical area in statistics, and a more solid background on mathematics and statistics will be needed. I believe that, after accomplishing these papers, Dr. Maciak has become a mature researcher, and will be a star in his research area.

Four wonderful research papers are for changing point estimation. The first one is for the possible changing points in conditional quantile estimation. Different from the commonly used conditional mean models, the conditional quantile model can depict a full picture for the conditional distribution of responses. Specific to the changing point problem, it is possible that there is no changing point in the conditional mean, while it happens to some certain quantiles. As a result, the proposed methods in this paper are able to detect some changing points, which may be missed by the conditional mean models. Two penalty terms, the quantile-fused penalty and its adaptive version, were considered. More importantly, this paper also has impacts on theories by extending the commonly used Gaussian or sub-Gaussian assumptions. Specifically, the technical assumptions in this paper allow more heavy-tailed errors, which is closer to the real examples. This piece of work was published in 2019 at the Scandinavian Journal of Statistics, one of top ten statistical journals.

The second one is an extension to the case with LASSO penalty, and the whole estimation can be performed automatically. The consistency was established with mild conditions. Unlike standard LASSO approaches, the proposed method does not rely on some strong conditions, such as Gaussian or sub-Gaussian, and it hence is robust against outliers. Moreover, the quantile loss function can provide more insights into the data. Empirical examples also showed the superiority over other common competitive methods. This piece of work was published in 2020 at the Journal of Statistical Theory and Practice.

The third one considered a linear model with explanatory variables being grouped successively, and the number of groups is of the same order as the sample size. The ordinary least squares

estimation with fused and adaptive fused penalty was conducted to detect and estimation the possible changing points along the successive groups simultaneously. The quantile loss function was also discussed, and a real application on the air quality data demonstrates the usefulness of the proposed methodology. This piece of work was published in 2020 at the Sequential Analysis.

Finally, Dr. Maciak also considered the panel data model for option pricing function. The quantile model with the atomic pursuit idea was discussed, and robust estimates and complex insights into the data are hence obtained. The resulting model was achieved in a data-driven manner with just one single step. The underlying theories were developed for the quantile estimation, and the consistency was also established. This piece of work was published in 2019 at the Econometrics and Statistics.

In the subarea of changing point detection, Dr. Maciak produced three wonderful research papers, and they are all related to panel data models. Not like the regularization methods for estimation, the changing point detection relies more on the self-normalization method, and the corresponding proving techniques are also different. The first research paper is to propose two competitive ratio-type test statistics for changing points in panel data, and a significant improvement was achieved since the proposed method allows for mutually dependent panels, unequal variances across panels, possibly an extremely short follow-up period. The asymptotic properties were established when the number of panels diverge. The consistency of the test was also derived. Empirical performance and finite-sample comparisons are provided under various practical scenario. This piece of work was published in 2018 at the Kybernetika.

The second one is a further extension. Specifically, it allows for non-stationary panels, as well as mutual dependent with an extremely short follow-up period. Two new self-normalized test statistics were proposed, and their theoretical justifications were provided. More interesting, a bootstrap method was considered to approximate the null distributions. The proposed method can detect a common break point even when the change occurs immediately after the first time point or just before the last observation period. This piece of work was published in 2020 at the Statistical Papers.

Finally, a changing point estimation was proposed for a very general panel data structure, and it can estimate the change close to the extremities of the studied time interval. The follow-up period can be extremely short and the change point magnitude may differ across the panels accounting for a specific situation that some magnitude are equal to zero. This piece of work was published in 2020 at the Application of Mathematics.

The seven research papers in this habilitation dissertation are all new and original, and actually all of them have been published at statistical and mathematical journals. I have carefully read the report for the plagiarism check produced by the Turnitin system, and all high percentages of coincidence are linked to the papers or websites related to Dr. Maciak himself. This is due to

the facts that all these seven papers have already been published, and hence they are available online publicly.

In sum, this is an outstanding habilitation dissertation, and these research papers inside the thesis are sufficient for an assistant professor to be tenured and promote to an associate professor. I would like to recommend it without reservation. Please let me know if you want to know more about the thesis.

Yours sincerely,

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