Reviewer´s Report on the Habilitation Thesis

of Peter Molnár

Title of the thesis: Volatility modeling and forecasting: utilization of realized volatility, implied volatility and the highest and lowest price of the day

The habilitation thesis is written as a collection of previously published papers in the highly ranked international journals. The collection is extended for short introduction to GARCH family modeling approach. The issue of capital asset volatility is the main topic of the recent empirical literature in finance that attracts attention both empirical economists and practitioners (especially portfolio managers) around the globe. The thesis is very well written and offers several reasonable contributions to the recent literature.

First, the applicant deals with the highest and the lowest price of the day and suggests range-GARCH model. He compares robustness of several estimators and shows that the Garman-Klass volatility estimator is the only one estimator based on daily data. He argues that standard deviations obtained from high frequency data are not Guassian and have heavy tails. The applicant also shows that range-GARCH models serve as very well approach when the level of volatility changes quickly. Moreover, he shows that range-GARCH models can be easily estimated in any software that can estimate the GACRH model.

Second, he incorporates range-GARCH approach in DCC framework to improve portfolio management processes and risk forecasts. The applicant modifies recent estimators replacing squared errors in the univariate GARCH model by volatility estimator and shows that covariance forecasts based on his estimations are more accurate. He evaluates his results on three different datasets: currencies, ETFs and stocks.

Third, he focuses on the impact of monetary policy announcement on stock market volatility in the selected developed capital markets. He provides relevant policy contribution finding that quantitative easing announcements have no impact on stock market volatility in G7 countries. five days before and after the announcement date. Such as findings are not in line with the previous studies and provide reasonable contribution to the recent literature. However, the theoretical argumentation could be better developed.

Finally, he uses developed volatility forecasting methods for crude oil and natural gas and shows how lagged volatility of the related commodity is related to out-of-sample volatility forecasts of another commodity. He also offers consistent improvements in forecasting accuracy using combination forecasts and model averaging.

The undoubted contribution is confirmed by the quality of journals in which the main results of the thesis have been published (International Review of Financial Analysis, Applied Economics, Journal of Empirical Finance, Journal of International Financial Markets, Institutions & Money, Energy, and Finance Research Letters).

I didn't find any important errors or imperfections in the thesis and must applaud the author's skills in the advanced methods employment and results interpretation. The author is

familiar with up-to-date literature and able to provide both theoretical and methodological contribution.

The thesis is fully in accordance with formal requirements in the field. The language used is appropriate and consistent with scientific standards. The author cites the literature correctly in the text as well as in the reference list which contains comprehensive literature overview.

In conclusion, the thesis presented by Peter Molnár is well motivated and highly relevant to the financial literature. He also convincingly proved his ability to conduct competitive research at the international level. **Based on this thesis, I wholeheartedly recommend Peter Molnár to be appointed as associated professor.**

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