

Report on Master Thesis

Institute of Economic Studies, Faculty of Social Sciences, Charles University

Student:	Bc. Jan Cvrček
Advisor:	doc. PhDr. Jozef Baruník Ph.D.
Title of the thesis:	Can Image-Based Convolutional Neural Networks Forecast Volatility?

OVERALL ASSESSMENT (provided in English, Czech, or Slovak):

Short summary

This thesis explores the idea that time series of financial volatility can be transformed into images and then predicted using modern image processing tools. The work fits well with a recent strand of financial literature that explores deep learning to improve predictability, as well as the literature that looks at uncertainty and volatility of markets trying to control risk. At the same time, the idea of looking at financial data as images and using deep learning through image processing tools is very new. Jan is successful in predicting volatility, and although the results are inconclusive, the analysis is interesting because it is the first of its kind.

Contribution

Financial stock returns are generally very difficult to predict for a number of reasons, including an extremely low signal-to-noise ratio, which makes the problem attractive. In his thesis, Jan contributes to the broad debate with a fresh and novel idea of transforming financial time series into images and predicting future realisations using advances in image processing. This idea is quite recent and has been proposed for financial returns. Jan's contribution is to test the idea on volatility time series, which is challenging because volatility contains persistent structures. Jan's contribution is one of the first pioneering studies to explore volatility time series as images and to document the first results that may be useful for further development.

Methods

The thesis uses appropriate advanced statistical tools for analysis. I must stress that image-based convolutional neural networks are tools not commonly used by an economist, and therefore Jan had to deal with a number of issues to learn the tools properly. At the same time, the problem of using image processing learning tools to predict volatility is recent and novel, and itself carries a number of issues that Jan had to deal with. He did this in a professional manner.

Literature

The author uses all relevant literature correctly, introduces the literature well and discusses all relevant sources in sufficient detail.

Manuscript form

The thesis is very nicely and logically written and links the findings well to the existing literature. The introduction and motivation are clear and the reader can see that the author has put a lot of care into the text.

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Overall evaluation and suggested questions for the discussion during the defense

In conclusion, I believe that Jan has shown himself to be an independent researcher who has produced interesting results that are relevant to both academic literature and practitioners. He has mastered advanced methods not commonly used by economists to study the economic problem of financial time series forecasting and has acquired skills to produce a sound and relevant paper. Jan has worked consistently with me and I must highlight the hard work he has put into the analysis to answer his question of whether image-based learning methods can be used to improve volatility predictability.

A general area of discussion during the defence could be whether Jan can see any room for improvement in his analysis, as well as discussing limitations.

The thesis deserves to be defended without reservation. If Jan is confident in presenting the details of the work, I suggest awarding an A.

Finally, the results of the documentary analysis do not indicate any significant similarity of the text to other available sources.

SUMMARY OF POINTS AWARDED (for details, see below):

CATEGORY	POINTS
<i>Contribution</i> (max. 30 points)	30
<i>Methods</i> (max. 30 points)	30
<i>Literature</i> (max. 20 points)	20
<i>Manuscript Form</i> (max. 20 points)	17
TOTAL POINTS (max. 100 points)	97
GRADE (A – B – C – D – E – F)	A

NAME OF THE REFEREE: Jozef Baruník

DATE OF EVALUATION: 15.8.2024

Referee Signature

EXPLANATION OF CATEGORIES AND SCALE:

CONTRIBUTION: *The author presents original ideas on the topic demonstrating critical thinking and ability to draw conclusions based on the knowledge of relevant theory and empirics. There is a distinct value added of the thesis.*

METHODS: *The tools used are relevant to the research question being investigated, and adequate to the author's level of studies. The thesis topic is comprehensively analyzed.*

LITERATURE REVIEW: *The thesis demonstrates author's full understanding and command of recent literature. The author quotes relevant literature in a proper way.*

MANUSCRIPT FORM: *The thesis is well structured. The student uses appropriate language and style, including academic format for graphs and tables. The text effectively refers to graphs and tables and disposes with a complete bibliography.*

Overall grading:

TOTAL	GRADE
91 – 100	A
81 - 90	B
71 - 80	C
61 – 70	D
51 – 60	E
0 – 50	F