Report on Master Thesis

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

Student:	**Bc. Marek Fremunt**
Advisor:	**PhDr. Jozef Baruník, Ph.D.**
Title of the thesis:	**Predictability of security returns using Twitter sentiment**

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

The thesis "Predictability of security returns using Twitter sentiment" presents original results of a very up-to-date research topic of a broader extent of how recently emergent technological innovations can enrich the explanatory power of financial models. Particularly, authors focus on the Twitter social network and show that Twitter-derived investors' sentiment influences both the explanatory power as well as predictive accuracy of various volatility models of financial returns and also has some effect on financil returns as such.

From my personal point of view there is one single aspect making a master thesis **outstanding** which is an original contribution to the field. I am pleased to mention at the very beginning that originality and contribution are the most distinctive aspects of the work and together with a very high formal quality and careful elaboration of the entire thesis **I can honestly suggest the highest grade (1)**.

Within the entire thesis, Marek demonstrates not only broad theoretical knowledge of financial econometrics but also very strong quantitative and programming skills without which the technical part of the work could not have been completed. The literature review is extensively elaborated when the novelty of the topic is taken into account. In the methodology part, Marek summarises a broad set of models which are further used in the empirical part, starting from the very basic ARIMA analysis of returns finished by wavelet coherence analysis of two timeseries. This part provide the reader with a comprehensive handout of methods generally applicable to financial series. Chapter 4 provides information about the data collection and dataset description, this must have definitely been the most demanding part of the work which clearly demonstrates Marek's motivation for the topic. For every second, 25 English tweets are automatically collected based on which a hourly Twitter sentiment variable is derived using a Vocabulary of emotions and selection of words based on several aspects and multiple ways of segmentation clearly underlaid by psychological literature. The financial market keywords such as "USD", "oil", and several others are also included. The extent of the methodology part necessarily implies the extent of the empirical part, which is, however, elaborated very thoroughly and the author is able to "extract" the most important results from the load of model outputs and combine it into useful set of main findings (e.g. the different influence of basic emotions for each analysed security which are clearly summarised in the Conclusion).

Nonetheless, below I mention several minor comments which can, however, always be found:

1. In the Introduction, some terms regarding the behavioural biases are relatively vaguely used, a more proper definition would be helpful, e.g. what does it mean that something "negatively influences human decision-making" or what the "free will" concept really represents?
2. In the theoretical part, models with Twitter sentiment variables are presented without lags of Twitter variables (e.g. 3.8), however, lagged variable play (naturally) important role in the empirical part. This is confusing when reading the work chapter by chapter.
3. "tylda" in 3.29 missing; figure 3.43 (pg. 19) does not exist; "n" does not appear in 3.41; multiple ")" should not appear from the typographical point of view (pg. 20).
4. In figures, generally, the dates on x-axis instead observation numbers would serve well. Marking emotions with italic would increase understandability of many sentences considerably.
5. I find the "applying a special formula" explanation in section 4.5 insufficient, the formula should be stated precisely.
6. Some tables and Figures are placed crazily on single pages, eg. pgs. 28, 35, 50, 62.
7. The repetitive comments on all Statistics of the securities' returns (section 4.8, pgs. 29-35!) is redundant, a showcase of one or two representative series would be sufficient, the rest should go to Appendix, all figures might have been summarised in one Table.

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8. Perfect Homo Economicus is an absolute abstraction, we perhaps do not need empirical evidence to suggest that real investors do not behave this way.

The aim, structure, working hypotheses, and conclusion are clearly stated and carefully elaborated. The approach as well the format of the work is more than legitimate for a student of the master lever program, meets very high academic standards and very originally contributes to recent financial literature.

Suggested questions for the defense are:

1. I am wondering whether in section 4.3 (Twitter Sentiment Extraction and Processing) the resulting sentiment figures should not be somehow weighted by number of words. Here, the coefficients of recognised words are simply summed to create the sentiment figure, but what if the strong sentiment is caused partly by excessive number of words (longer tweets selection by chance or in some specific situation). Is this likely to cause some inaccuracies?
2. The trend of Twitter sentiment presented in Fig. 4.1 - 4.3 seems to be very slowly decreasing in time in all cases. I guess there must be a technical reason behind this behaviour, can you explain this a bit, please? Moreover, in Fig. 4.4 the biggest jumps seem to appear in the very same point for all emotions, can you detect specific real world occasions causing this behaviour?
3. In Conditional Volatility models (section 5.3.1), how the optimal lags were selected?

Summary:
All in all, **I do find this thesis well exceeding academic standards for master theses at IES**. Personally considered, the originality of the research together with huge effort in collecting and processing the Twitter data and very careful and extensive subsequent econometrics analyssis of datasets strongly surpassing master level requirements are the most distinctive qualities of the thesis.

I am very pleased **I can strongly recommend the thesis of Marek Fremunt to defense at the IES FSV UK. With no doubts, I suggest the grade "1". i.e. "excellent"**, and if Marek manages the defense procedure well and this option still applies for current students, I kindly recommend the committee to consider the **"Dean's Award for an extraordinarily good master diploma thesis"** as I believe this thesis is likely to belong to the TOP class of the year.

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

CATEGORY		**POINTS**
Literature	*(max. 20 points)*	20
Methods	*(max. 30 points)*	30
Contribution	*(max. 30 points)*	30
Manuscript Form	*(max. 20 points)*	17
TOTAL POINTS	*(max. 100 points)*	**97**
GRADE	**(1 – 2 – 3 – 4)**	**1**

NAME OF THE REFEREE: Jiří Kukačka
DATE OF EVALUATION: 10. 6. 2015

Digitally signed by Jiri Kukacka
DN: cn=Jiri Kukacka, o=Charles University in Prague, Faculty of Social Sciences, ou=Institute of Economic Studies, email=jiri.kukacka@fsv.cuni.cz, c=CZ
Date: 2015.06.16 11:36:31 +02'00'

Referee ***Signature***

EXPLANATION OF CATEGORIES AND SCALE:

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

Strong	*Average*	*Weak*
20	*10*	*0*

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.*

Strong	*Average*	*Weak*
30	*15*	*0*

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.*

Strong	*Average*	*Weak*
30	*15*	*0*

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.*

Strong	*Average*	*Weak*
20	*10*	*0*

Overall grading:

TOTAL POINTS	**GRADE**		
81 – 100	**1**	= excellent	= výborně
61 – 80	**2**	= good	= velmi dobře
41 – 60	**3**	= satisfactory	= dobře
0 – 40	**4**	= fail	= nedoporučuji k obhajobě