

Report on Bachelor / Master Thesis

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

Student:	Bc. Marek Klaus
Advisor:	PhDr. Boril Šopov, MSc., LL.M.
Title of the thesis:	Multivariate Dependence Modeling using Copulas

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

Marek in his thesis deals with a challenging topic of dynamic correlations and dependence in equity returns. The thesis applies a Copula based dynamic conditional correlation multivariate GARCH model (DCC C-MGARCH) on pairs of selected stocks traded at Prague Stock Exchange. Such results were not, to the reviewer's best knowledge, publish anywhere else.

The thesis has a standard structure, where I would like to draw attention to well connected chapters. The author opens each chapter with a short paragraph showing the big picture and introduces reader to wider context. After Introduction, Chapter 2 reviews the relevant literature and describes how several multivariate GARCH models emerged through time. The survey presents fairly wide area and directly links it to the aim of the thesis. Chapter 3 presents the univariate and multivariate GARCH models, narrows down the considered methods and logically follows with chapter 4. Chapter 4 then presents the statistical theory of copulas (a function describing dependence structure of multivariate r.v., thus coupling univariate margins into multivariate distributions). This chapter, in addition, reveals the core model of this thesis; DCC C-MGARCH. The model works similarly to DCC GARCH, yet estimates a copula parameter to describe tail dependence that is supposedly left in the DCC MGARCH residuals.

Chapter 5 presents the used data, estimation techniques and Matlab implementation. In addition to three pairs of Prague stock exchange stocks, one pair consisting of highly liquid indices was added for benchmarking purposes. Importantly, the author, modestly, suppressed to mention the programming difficulty of implementation of such a model, which required not only optimization, yet also numerical integration of Hoeffding's lemma during each objective function evaluation.

Chapter 6 shows the empirical results. I would like to draw attention to Figures 6.2, 6.4, 6.6 and 6.8, which clearly demonstrates that the copula extension is necessary and brings value. The residuals before applying the copula are obviously non-normal, which proves the overall relevance of the thesis's topic. The author comments correctly on the results and the drawn conclusions support usage of the copula extended model over the DCC MGARCH model. This conclusion is an important message for risk management practitioner, who may feel that DCC MGARCH sufficiently captures correlation risk.

In conclusion, this thesis is well written, of high typographical quality and easy to read. The level of both contribution and difficulty exceeds a good master thesis and shorter version is already being prepared to submit for IES working paper series. **Having considered all above mentioned, I award grade 1 and suggest this thesis for the Dean's award.**



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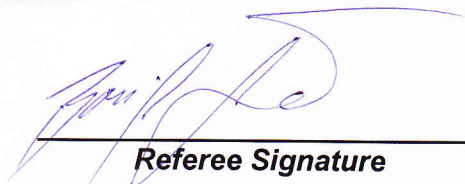
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SUMMARY OF POINTS AWARDED (for details, see below):

CATEGORY	POINTS
Literature (max. 20 points)	18
Methods (max. 30 points)	29
Contribution (max. 30 points)	27
Manuscript Form (max. 20 points)	18
TOTAL POINTS (max. 100 points)	92
GRADE (1 – 2 – 3 – 4)	1

NAME OF THE REFEREE: PhDr. Boril Šopov, MSc., LL.M.

DATE OF EVALUATION: 18th June 2012



Referee Signature