Response to Reviewers

for the *Dissertation Defense*

on manuscript

Essays in Financial Econometrics

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I thank the reviewers for insightful comments on the pre-defense version of my dissertation. Since the reviewers suggest that the dissertation can be submitted without major changes, I have made minor adjustments in the text.

Response to Comments from Prof. Ing. Evžen Kočenda PhD.

I thank Prof. Kočenda for his kind assessment of my research. Prof. Kočenda has several suggestions for thesis improvement, mainly for the third essay. I have taken all these comments in consideration while preparing the final version of the dissertation.

Response to Comments from Prof. Tiziana Di Matteo

I am grateful to Prof. Di Matteo for her kind words on my dissertation. Prof. Di Matteo has few minor suggestions with respect to organization and coherent presentation of the dissertation. I considered all her suggestions which resulted in further improvement of my thesis. Thank you!

Response to Comments from Doc. RNDr. Jiří Witzany Ph.D.

I thank Doc. RNDr. Witzany for his kind assessment of my research. Below I answer his questions/comments (*"Q"* refers to question or comment and *"A"* is my answer).

- *Q: The first paper focuses on oil-stock dependence and the diversification benefits. My understanding of the results of the realized GARCH with time varying copula is that the diversification benefits are lower than commonly believed (2.6 Conclusions and Figure 2.3). But conclusions at the end of Section 2.4 say the opposite: "Our results have serious implications for investors as they suggest that diversification possibilities may be even larger than commonly perceived from the mere dynamics of the correlations." I would like to ask the author to clarify the inconsistent interpretations of the results.*

  A: In fact this is some misunderstanding caused by the text. Up to the end of Section 2.4 we are considering the cumulative results which do not take into consideration conditional diversification benefits (CDB).

- *Q: According to Section 2.5.1, it appears that the investigated diversified portfolio of stocks and oil is equally weighted and the weights do not change over time. However, the changing volatilities and correlations (copula parameters) allow re-balancing of the portfolio optimizing the diversification benefit, for example, measured by the diversification index proposed in the paper. The changing volatilities and dependence structure may just cause the equally weighted portfolio being less optimal, not necessarily implying a lower diversification benefit on an optimally diversified portfolio. I would like the author to comment this objection.*

  A: From the literature we know that diversification on an equally weighted portfolio in the case of two assets cannot be (easily) beaten using a dynamic asset allocation strategy. The transaction costs often overcome the benefits. In addition, [Christoffersen et al., 2012] compare the CDB using equally weighted and optimally weighted portfolios. They find that the difference is nonzero, but not very large. They claim that relatively modest differences between optimal and equal-weighted diversification benefits suggest that the $1/N$ style portfolios recently advocated in a normal setting may work relatively well in our nonnormal context as well.

- *Q: A formal remark concerns the quantile definition (2.26) implicitly assuming that the cdf is continuous increasing which does not have to be necessarily the case (e.g. in case of an empirical cdf).*

A: Yes, this is the underlying assumption. I made it clear in the final version of the dissertation.

- *Q: The second paper uses high frequency data and the nonlinear quantile regression framework to study conditional quantiles of returns on a pool of the most liquid US assets across different industries. A formal remark is that sometimes there are notions or shortcuts that are firstly used and only later defined in the text. For example, IVt, integrated variance, is firstly used in Section 3.2, but more precisely defined in 4.2. Similarly, the shortcut LQR is firstly used in Section 3.5 but more specifically defined in Section 4.2 (it would be useful to mention it already in Section 3.2). Figure 3.2 shows dependence of a set of quantiles of a stock returns on its realized volatility. I have not found (in the text preceding the figure) any specification of the probabilities for which the quantiles are calculated.*

  A: This is true. I introduced the acronyms when they first appear in the text and also add the missing information in the text.

- *Q: Finally, the last paper focuses on Conditional Value at Risk estimated using the nonlinear quantile copula regression technique and using the same dataset as the second paper. Already in the introduction, the concept of VaR is used in the nonstandard convention where the values are negative (equal to the respective quantile) while the standard convention is to report VaR as a positive number. This is explained later, in Section 4.2. I recommend to explain this change of convention already in the introduction in order to avoid confusion. I am not sure that the methodology section explains the notion of "inter lagged realized volatility" as opposed to "own lagged realized volatility" used already in section 4.1?*

  The "benchmark" model is based on VaR estimated by rescaling the realized volatility, but still using the same linear quantile regression for CoVaR estimation (Section 4.2.3). It is surprising why the author does not use as a basic benchmark a simpler and easier to implement model, e.g. based on constant correlations and multivariate normality, or DCC GARCH, etc.?

  A: This is correct, I introduced the Value-at-Risk (VaR) convention earlier in the text and also explain *"own"* and *"inter"* volatility.

  Regarding the choice of the benchmark model I chose realized volatility because of three main reasons:

  1. The parametric models tend to overestimate the risk.
  2. Given that the realized volatility is the best in the market, why to use another metrics?

3. We already are using realized volatility in our model so it is easily implemented.

- *Q: Besides the minor comments above there is a more general practical question I would like to ask. It is obvious that the complex realized GARCH dynamical copula and quantile regression modeling framework is technically very demanding in terms of presentation and implementation. On the other hand, it brings a better precision of the VaR estimations, conditional dependence measures, portfolio diversification, etc. Does the author think that, from the practical point of view (of banks, financial institutions, and investors), the benefits out-weight the "costs"?*

  A: I think that all modelling framework I have in my dissertation can be easily implemented. The most demanding from the computational point of view is the provision of inference via bootstrapping and simulations. However, this is done only once to show that the model estimates are significant. Besides, using C code for the bottlenecks of estimation significantly reduces the (computational) costs.

References

[Christoffersen et al., 2012] Christoffersen, P., Errunza, V., Jacobs, K., and Langlois, H. (2012). Is the potential for international diversification disappearing? a dynamic copula approach. *Review of Financial Studies*, 25(12):3711–3751.