Report on **Master Thesis**

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

Student:	Bc. Vendula Procházková
Advisor:	doc. PhDr. Jozef Baruník, Ph.D.
Title of the thesis:	Asset Prices, Network Connectedness, and Risk Premium

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

Please provide your assessment of each of the following four categories, summary and suggested questions for the discussion. The minimum length of the report is 300 words.

Contribution

The diploma thesis of Vendula Prochazkova presents an original research contribution in the field of asset pricing. Namely, it introduces new factors of asset network connectedness into Fama-French type of pricing models and provides robust empirical evidence for the U.S. stock market that the new risk factors are statistically as well as economically significant for most of the analysed sectors. While the sector classification is enforced especially since the complete-sample analysis is computationally infeasible, it actually brings interestingly detailed viewpoints for different industries and provides more granular analysis and economically valuable comparisons.

At the methodological side, the thesis contributively analyses various connectedness measures starting from the overall connectedness, through the directional measures of asset-specific „TO" and „FROM" connectednesses, to the NET connectedness calculated at the their difference. Each of those is computed based on the daily returns and realized volatilities between Jul 2005 and Dec 2018. One of the most robust results of the analysis suggests that the connectedness of volatilities is considerably higher than the connectedness of asset returns. I am, however, not sure how original or obvious such a result actually is as the author immediately indicates this as a confirmed „assumption".

When it comes to the final asset pricing analysis, the thesis benefits from a rather advanced methodology of the Fama-MacBeth regression which allows for subsequent analysis of the individual factors' significance in a given asset pricing model (answering the research hypothesis whether the connectedness risk should be priced) and estimation of the sizes of the risk premia for each of the factors (answering the research hypothesis how the connectedness risk should be priced).

Methods

The thesis covers a range of methods surpassing the IES curriculum. The complete methodology actually consists of the four skilfully and originally interconnected but in fact to some extent distant concepts: the network theory and its application to assets or portfolios, connectedness measures, volatility estimation, and asset pricing. All methodological concepts are reasonably described and explains, although sometimes the level of detail is not sufficient or a lack of rigour might hinder the complete understanding of the matter. Some examples:

- the connectedness methodology is being explained via so-called „connectedness table" and the „*H-step forecast error variance*" without actually explaining the latter (3.1.1).
- for the spillover index the „*w bar*" term is not explained for eq. 3.1.
- for the Fama-French 3-factor model, the conceptual difference between the specification without and with the intercept (the equivalent of Jensen's alpha in the CAPM, eq. 3.14 and 3.16) is not commented at all.

When it comes to empirical data, I am not completely happy with statements such as *„The analysed dataset of stock returns was obtained from the stock exchange which provided the data to Charles University in Prague. … From these data, the daily returns were calculated together with the realized variances by the IES FSV UK. … All of the processes were conducted by the researchers at the IES FSV UK and their modified daily data are the source for this diploma thesis."* What is then the „relation" between the author and the data? Did she not process the data herself? Not every reader will be familiar with the situation at IES and given statements sound at least weird.

For the realized volatility computation, the LASSO is used due to need of variable selection and regularization. However, neither the LASSO nor the two remaining concepts are well described and

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their importance well explained. It is also not true that it shrinks coefficients not providing „any" information. I also believe that stationarity testing using the ADF and KPSS tests or the usual diagnostic tests to control for VAR assumptions are not completely out of the scope of this diploma thesis and hence should have been elaborated and reported (at least to some extent). Finally, especially in an econometrics work, one should not „juggle" with confirmation or rejection (pg. 39) of a hypothesis which is clearly stated in statistical terms (ie. $H\_0 : beta\_C = 0$).

Literature
The literature section presents an extensive overview of the related research. It structures the discussion to several topical sections, but especially the 5-page long flow of 2.1 would have definitely benefited from an additional division of the text. Nonetheless, citations are done properly (with an exception of an insufficiently cited webpage of Kenneth R. French) using a standard style for economic papers combined with the Czech citation norm in the template (capitals).

Manuscript form
The thesis is standardly structured, typeset in LaTeX, and the text reads well. I am, however, not completely happy with informal statements such as *„quite comparable"* or *„a lot of zero coefficients"*. Bibliography section seems complete but journal names contain a mixture of uppercase and lowercase letters. Referencing to tables and figures is done correctly in the text, the tables are reasonably labelled but the figures are not completely self-contained. It is also difficult to grasp a more detailed information from the heatmaps despite the elaborate computations beyond the graphics.

Summary and suggested questions for the discussion during the defense
Although from the opponent's position I have provided some critical remarks, my overall conclusion is positive, the thesis meets well the IES master level standards and I can thus **suggest the grade B**.

- While the overall connectedness factor in eq. 5.13 is shared for all assets (i.e. it follows the construction of the MKT, SBM, and HML factors), the FROM and TO connectedness factors are asset-specific by definition. Does this not violate the idea of the „factor regression"?

- In case the heatmaps are being produced by the standard heatmap function in R, is the author sure that individual heatmaps are mutually comparable wrt the shades of grey? My experience suggests that the actual shading might be relative to the min/max values in each dataset.

- How is the current macroeconomic episode (lockdown, a shift of consumer expectations, looming crisis) likely to impact the volatility and return connectedness of the U.S. stocks?

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

CATEGORY		POINTS
Contribution	*(max. 30 points)*	28
Methods	*(max. 30 points)*	24
Literature	*(max. 20 points)*	17
Manuscript Form	*(max. 20 points)*	17
TOTAL POINTS	*(max. 100 points)*	**86**
GRADE	**(A – B – C – D – E – F)**	**B**

NAME OF THE REFEREE: Jiří Kukačka
DATE OF EVALUATION: 8. 6. 2020

Referee Signature

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*

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*

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*

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