Report on **Bachelor / Master Thesis**

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

Student:	**Vojtěch Kořínek**
Advisor:	**Jiří Kukačka**
Title of the thesis:	**Cusp catastrophe theory: Application to the housing market**

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 bachelor thesis of Vojtech Korinek „Cusp catastrophe theory: Application to the housing market" analyzes the recent US housing market development using the methodology of the catastrophe theory which allows to model sudden drops of financial markets as a result of a continuous development of explanatory variables and, most importantly, without the need for large exogenous shocks. The catastrophe theory has been applied in the economic literature primarily to stock markets in the past. A first serious application to the housing market appeared not before Dick and Wang (2016). The thesis builds partially on this research as well as on other applications of the catastrophe theory to financial markets and brings the following contributions to the literature: 1) compared to Dick and Wang (2016) who compute the fundamental value for housing market indices using an inherently questionable and simplifying methodology, Vojtech constructs his model directly based on the observed market price of the US housing index; 2) an extended set of originally suggested prospective empirical explanatory variables used as a proxy for market activities of fundamental traders and housing market speculators is identified, economically motivated, and econometrically applied; 3) Vojtech also tackles one of the theoretical deficiencies of the previous research and solves the unrealistic constant volatility assumption of the model by estimating a GARCH model for volatility which is used for normalization of the dependent variable.

From the point of view of a supervisor, am satisfied with the cooperation with Vojtech and his honest approach to the thesis elaboration, although the development of the thesis topic was a bit „painful" for both sides. As a result, the main part of the the thesis was being written in a relative rush during April, which effectively precluded some potential extensions and improvements I would otherwise suggest to incorporate. E.g., at the empirical level, an additional search could have been undertaken for other potential proxies for activities of different types of investors.

Methods

The thesis covers a range of methods definitely surpassing the bachelor level IES curriculum. First, Vojtech demonstrates a good understanding of the theoretical framework and applies correctly an advanced cusp model from the field of catastrophe theory for the economic analysis of the US housing market. Second, he proves his ability to work with professional databases of economic empirical data (Thomson Reuters Eikon). Third, Vojtech also applies methods of time-series analysis from the master level course Applied Econometrics (GARCH) which he studied as an extra subject. Advanced concepts beyond the scope of the bachelor level econometrics are also applied for evaluation of results and related interpretations, such as a pseudo R^2, model selection using information criteria based on the likelihood optimization, or comparison of non-linear models.

I especially like the methodology section of the cusp model where Vojtech not only describes well the model itself but also provides the reader with a very good economic intuition beyond the model equations and with additional mathematical details of some related concepts such as the Cardan's discriminant or the actual likelihood formula. On the other hand, some improvements of the econometric analysis could have been considered, e.g. a rigorous comparison of models using the Likelihood-ratio tests.

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Literature

The literature section is effectively divided into two chapters, one devoted to the housing market research and the other describing the history and development of the catastrophe theory and its financial markets applications. As far as I can consider, the second part is elaborated very well, actually going back in history as late as to Newton and Leibnitz, also a few existing financial applications are described well. The first part is mostly focused on the heterogeneous agent modelling of housing markets, a subset of models to which the cusp catastrophe model belongs. The housing market research is, however, not covered in its broadness. Except for the must-read Shiller, no traditional/mainstream housing market valuation approaches or branches of research are mentioned. On the other hand, the second chapter combining the motivation with the up-to-date info about the pre-crisis and the current state of the US housing market provides a very nice extended introduction.

Finally, citations are done properly using a standard style for economic papers perhaps combined with the Czech citation norm (capitals).

Manuscript form

The thesis is written in decent English and typeset in LaTeX, which I need to appreciate at the level of a bachelor thesis. All formating comments from my side were considered in the final version. Bibliography section seems complete and well formated. Referencing to tables and figures is done correctly in the text and tables are reasonably labelled and described. The thesis is reasonably structured and the text reads well. The only undetected imperfection I can see at the moment is that asterisks simplifying interpretations of statistical significance of coefficients are not explained in the notes below tables. It would make the tables more self-contained.

Summary and suggested questions for the discussion during the defense

My overall conclusion is positive, the thesis definitely meets IES bachelor theses standards and I can thus suggest the committee the grade B („very good“).

Two potential questions suggested for the defense:

- Can you explain the idea and application of the Likelihood-ratio test?
- Can you explain the idea of model selection using information criteria? How do AIC and BIC relate to the Likelihood-ratio test? How do AIC and BIC differ?

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

CATEGORY		**POINTS**
Contribution	*(max. 30 points)*	22
Methods	*(max. 30 points)*	27
Literature	*(max. 20 points)*	15
Manuscript Form	*(max. 20 points)*	19
TOTAL POINTS	*(max. 100 points)*	**83**
GRADE	**(A – B – C – D – E – F)**	**B**

NAME OF THE REFEREE: Jiří Kukačka
DATE OF EVALUATION: 30. 5. 2019

Jiří Kukačka

Digitally signed by Jiri Kukacka
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Date: 2019.05.30 22:12:07 +02'00'

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.*

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**