

REPORT ON MASTER THESIS
CENTER FOR ECONOMIC RESEARCH AND GRADUATE STUDIES

STUDENT:	Jan Žemlička
ADVISOR:	Ctirad Slavík
TITLE OF THE THESIS:	Macro-Epidemic Modelling: A Deep Learning Approach

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

The goal of the thesis is to explore the state-of-the-art numerical methods, namely neural network based deep learning, in particular their ability to efficiently solve high-dimensional dynamic stochastic general equilibrium models. The backdrop for this exercise is a recent macro-epidemiological model of Eichenbaum, Rebelo and Trabandt (2021) that studies the interaction between consumption choices, spread of an epidemic, and the optimal tax policies. The key aspect of the model is that higher consumption increases the infection rates and so becomes a negative externality. Over the course of the last year, the model has become very influential in the academic literature on COVID-19.

The numerical methods employed in the thesis are nontrivial, at the frontier of economic research, and are likely to be used in many more applications in the near future. The application of those methods to macro-epidemiological modeling is, to my knowledge, novel. It is, however, not convincingly explained, in what aspects (beyond the curse of dimensionality) are those models more challenging to solve relative to standard dynamic macro models. A deeper discussion of this aspect would help to highlight the originality of the thesis.

The thesis comes up with several extensions, or modifications, of the existing computational methods. The most interesting one is the idea of simultaneously solving for a large set of policies to generate speed gains in computing the model. It is not clear how far one will be able to extend it beyond simple policies considered in this thesis. I would definitely like to see how far this can be pushed.

There is one area, however, where the thesis falls somewhat short, and that is its economic content. The model is explained clearly, but it is rather obvious that Jan is interested more in numerical methods than in its economic implications. There is no discussion of what the economic implications are, especially with respect to economic policies. What have we learned about the COVID-19 epidemic? The lack of economics is unfortunate especially for the stochastic version of the model, which goes beyond the original Eichenbaum, Rebelo and Trabandt (2021) contribution.

CONTRIBUTION:

The thesis contributes primarily to the growing literature that uses neural network based learning methods to solve models with many state variables and stochastic shocks. It modifies the existing algorithms in several aspects, including investigating alternative activation functions, construction of boundary conditions, or the application of the parametric set method. While none of the modifications appears to be path breaking, they are all useful and deepen our understanding of those numerical methods.

METHODS:

The methods used in the thesis are the main contribution and are already described in previous paragraphs. However, given that the thesis is built around them, I would expect a deeper comparison with alternative methods. What are the gains relative to the methods used in Eichenbaum, Rebelo and Trabandt? What about relative to the existing alternatives? The thesis should compare the execution speeds controlling for the Euler equation errors, for example.

LITERATURE:

All the relevant literature is included.

MANUSCRIPT FORM:

No issues with the manuscript form.

SUMMARY AND SUGGESTED QUESTIONS FOR THE DISCUSSION DURING THE DEFENSE:

Overall, despite several weaknesses described above, the quality of the thesis clearly exceeds what is expected from a Master-level student. In addition, it constitutes an excellent investment into Jan's future research career.

Questions:

What have we learned about COVID-19 epidemic from your thesis?

How does deep learning approach compare to alternative solution methods in terms of speed and accuracy?

Please indicate whether you recommend the Thesis for defense or not.

I recommend the thesis for defense.

TEXT ORIGINALITY CONTROL

I confirm that I acquainted myself with the report on the originality of the text of the thesis from

Theses Turnitin Ouriginal (Urkund)

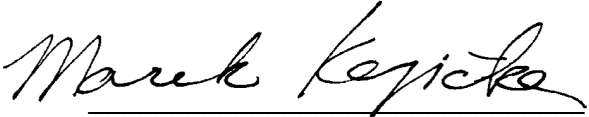
Comments on the reported results:

SUMMARY OF POINTS AWARDED *(for details, please see the page 3)*

CATEGORY	POINTS
Contribution <i>(max. 30 points)</i>	25
Methods <i>(max. 30 points)</i>	28
Literature <i>(max. 20 points)</i>	20
Manuscript Form <i>(max. 20 points)</i>	20
TOTAL POINTS <i>(max. 100 points)</i>	93
GRADE <i>(A – B – C – D – E – F)</i>	A

NAME OF THE REFEREE: Marek Kapička

DATE OF EVALUATION: 31.8.2021



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