

Report on Bachelor / Master Thesis

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

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| Student: | Simon Otruba |
| Advisor: | Lukas Recka |
| Title of the thesis: | Introducing Stochasticity into Energy System Model Times-CZ - Reflection of War-Related Extreme Environment |

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

Please provide a short summary of the thesis, your assessment of each of the four key categories, and an overall evaluation and suggested questions for the discussion. The minimum length of the report is 300 words.

Short summary This thesis is a part of a large ongoing process on model TIMES-CZ used by CUNI Environmental Center. This TIMES-CZ model includes all major phases in energy supply chain from primary energy sources to final consumption of energy services and it provides a comprehensive representation of the Czech Republic's energy balance. The TIMES-CZ model is regularly used by CUNI Environmental Center as one of its principal models. This thesis introduces stochastic elements into the TIMES-CZ energy system model. This improves the model's precision in the face of these market uncertainties. Natural gas prices and European Union Allowance (EUA) prices are used as these two random variables allowing for probabilistic forecasting.

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. The statement that there is a distinct value added of the thesis, is actually very true in this case. I really like this paper because it looks like it is a really useful research paper. It looks like the work on this thesis really substantially helped to improve the quality of TIMES-CZ model. So it is not just a standard application paper, when you take the model and run it on new data (maybe with some small twist in the model), but it is a clearly defined work on improving a large, frequently used, model.

Methods The tools used are relevant to the research question being investigated, and more than adequate to the author's level of studies. The methods used in this thesis and complexity of this thesis project would be perfectly O.K. for IES master thesis. The thesis topic is comprehensively analyzed.

Literature This thesis builds up on the work of McGill professor Richard Loulou and his collaborators dealing with the introduction of stochastic programming into TIMES model. This is well reflected in the references.

Covers well the relevant literature. Including both classical papers (Loulou et al. papers), most recent papers and the Czech Republic focused TIMES -CZ papers.

I do not like the non-alphabetical ordering of the List of References. Alphabetically ordered Lists of References are standard approach in economics writings.

Item 38 in the List of References: Vera Barberán, José. María. What is the meaning of a dot after Jose?

Manuscript form

In Figures (like Figure 2 on page 23), I had a hard time to read the legend and titles of the graph- it was in a way too small font.

On page 47, there is something wrong with headings of figures (for 2 figures there are more than 2 headings in strange order).

Look at the two following paragraphs from Conclusions:

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It is important to mention that, while not directly used by policymakers or other institutions, the TIMES-CZ model is frequently utilised by the Environmental Centre at Charles University. This centre generates forecasts using this model for various purposes, which are then provided to ministries and other institutions. The objective of this thesis was to introduce a new feature to the TIMES-CZ model that could enhance its ability to account for future uncertainties. The benefit of this feature is that it could extend the model's accuracy over a longer period compared to a deterministic model, which may require updates in line with the evolving state of the energy and economic sectors.

The TIMES-CZ model, while not directly employed by policymakers and other institutions, is extensively utilized by the Environmental Center at Charles University. This center generates forecasts using this model for various purposes, which are then provided to ministries and other institutions. Building upon the work of Rečka, Máca, & Ščasný (2023), the objective of this thesis was to introduce a new feature to the TIMES-CZ model that could enhance its ability to account for future uncertainties. This enhancement has the potential to assist Czech decision-makers by providing them with a wider variety of potential scenarios and outcomes for their strategic decision-making processes regarding the nation's energy future. The benefit of this feature is that it could extend the model's accuracy over a longer period compared to a deterministic model, which may require updates in line with the evolving state of the energy and economic sectors. This strategy can enhance the energy system's resilience and adaptability, enabling it to respond effectively to changing conditions and unpredictability.

As you could see, these two paragraphs are rather repetitive. This should not happen in the Conclusions.

Overall evaluation and suggested questions for the discussion during the defense

I consider this an excellent bachelor thesis – in order to write this thesis, student had to understand a state of the art model TIMES-CZ which is really used in policy relevant research. Student had to work with data and most importantly, this thesis improved a quality of the model TIMES-CZ, so it was (hopefully) significant from the point of view of improving a quality of energy economics research at CUNI.

Considering that the main methodological contribution of this thesis is the work on introduction of stochastic elements into Times-CZ model, how much are really Covid 19, Ukrainian war and other recent policy events crucial for this paper? How would you write this paper in 2019, before covid and Ukrainian war?

What comes next? What could be the next steps in increasing stochasticity of TIMES-CZ? Which other stochastic features, besides the two implemented in thesis, we should introduce in the next steps of TIMES-CZ development? Would it be something from the Table 4 on page 41 or something else?

On page 40 you write “Ideally, it is preferable for the historical data range of a prediction variable to be equal to or greater than the forecast period. For example, it is recommended that the optimal historical data commence no earlier than 2016 to facilitate a projection spanning from 2023 to 2030. “ This

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seems contradictory to me. If you want long historical data range, why do you recommend not to have historical data before 2016?

On page 41, since you write that you consider high correlation between candidate variables in table 4 important, why do not you choose coal (with higher correlation) instead of EUA price (with lower correlation)?

In my view, the thesis fulfills the requirements for a bachelor thesis at IES, Faculty of Social Sciences, Charles University, I recommend it for the defense and suggest a grade A. The results of the Turnitin analysis do not indicate significant text similarity with other available sources.

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

| CATEGORY | POINTS |
|---|---------------|
| <i>Contribution (max. 30 points)</i> | 29 |
| <i>Methods (max. 30 points)</i> | 29 |
| <i>Literature (max. 20 points)</i> | 18 |
| <i>Manuscript Form (max. 20 points)</i> | 16 |
| TOTAL POINTS (max. 100 points) | 92 |
| GRADE (A – B – C – D – E – F) | A |

NAME OF THE REFEREE: Karel Janda

DATE OF EVALUATION: August 23, 2023

Digitally signed (August 23, 2023) Karel Janda

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.*

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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.*

LITERATURE REVIEW: *The thesis demonstrates author's full understanding and command of recent literature. The author quotes relevant literature in a proper way.*

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.*

Overall grading:

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