REVIEW OF DOCTORAL THESIS

Title of doctoral dissertation: Contemporary Energy Transition: Patterns and Determinants. Evidence for OECD countries

PhD Candidate: Radosław Ślosarski

Supervisor: Professor Ewa Lechman

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Name of Reviewer: Javier Barbero Jiménez

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Radosław Ślosarski's dissertation, entitled *"Contemporary Energy Transition: Patterns and Determinants. Evidence for OECD countries"* and directed by Professor Ewa Lechman deals with the key topic of energy transition in the field of Economics and Environmental Economics.

The dissertation clearly states three research objectives: (a) analyse country-specific energy transition trajectories, (b) identify the macroeconomic and institutional determinants that influence energy transitions, and (c) develop scenarios for future energy transition, focusing on the transition from fossil fuels to renewable energy adoption. All the empirical analysis is focused on OECD countries from 1980 to 2020, and advanced econometric techniques are used to answer the research questions. The dissertation is organised around seven chapters.

Chapter 1 serves as an introduction, contextualizes the energy transition, and sets the research objectives of the dissertation. Chapter 2 presents an historical overview of energy transitions since the Industrial Revolution and explains the theoretical background of the determinants of energy transitions.

Chapter 3, the first empirical chapter, addresses the first research objective. Using data on the energy mix obtained from the International Energy Agency, this chapter analyses the energy transition trajectories between 1980 and 2020 of selected OECD countries such as Germany, France, Japan, Australia, Canada, and Norway.

Chapter 4 introduces the empirical strategies and methodology used in the following chapters. This chapter introduces static and dynamic panel data regression models relying on the Generalised Method of Moments estimation, and the Fisher-Pry model.

Chapter 5 addresses the second research objective. The author presents the first set of econometric results and discusses the macroeconomic and institutional determinants of the energy transition. The results suggest that the introduction of governmental policies supporting renewable energy is a critical driver of renewable energy adoption. They also find that high economic output, measured using GDP, does not always translate into renewable energy consumption, while past CO_2 emissions are associated with increased renewable energy adoption.

Chapter 6 answers the third research objective by introducing a set of energy transition scenarios to study the shift from fossil fuels to renewable energies in OECD regions (North America, Oceania, Central & South America, Asia, European Union and other European countries). The Fisher and Pry model is used to simulate a logistic growth model for the adoption of renewable technologies between 2020 and 2080. Simulation results shows that the European Union is the only OECD region that will achieve more than 50% of renewable energy use before the end of the simulation time frame. The use of the Fisher and Pry model is an original contribution to know what we can expect from the energy transition without policy interventions.

Finally, Chapter 7 concludes by summarising the results, presenting a set of policy implications and suggesting directions for future research.

Throughout the dissertation, the candidate has proof that he knows how to perform all the steps to conduct scientific research: writing a literature review and historical review, collecting data, analysing data descriptively using advanced econometric models, interpreting and discussing the results, and drawing policy recommendations.

To answer the research question of understanding the dynamics of energy transition, the student has used advanced econometric techniques: static and dynamic panel data GMM regression model, Granger causality test, and the Fisher-Pry conceptual approach. These methods are correctly justified due to the dynamic nature of energy transition and because they handle serial correlation and endogeneity. The Fisher-Pry model is also an original solution to predict and analyse future energy transition paths.

Decision:

<u>Assessment of the research issues undertaken, the aim(s) of the dissertation, including the research methodology used</u>:

Radosław Ślosarski's dissertation aims to understand and analyse patterns and determinants of energy transition in OECD countries. This research problem is very relevant nowadays, given the environmental awareness of most advanced economies and the aim to transit toward a more sustainable and green economy, which is a sustainable development goal. The ambitious research problem is particularised in three research goals: analysing and comparing country energy transition trajectories, identifying the macroeconomic and institutional determinants that influence the energy transition toward renewable sources, and simulating future energy transition scenarios for OECD economies.

To address this research problem, Mr Ślosarski relies on different methodologies: descriptive data analysis, advanced econometric models, and simulation models. Descriptive data analysis is used to achieve the first research goal of analysing and comparing recent energy transition trajectories for a set of OECD countries. For the second research goal, advanced econometric methodologies, such as static and dynamic panel data models estimated through the generalised methods of moments, are used to identify macroeconomic and institutional determinants of the energy transition while controlling for serial correlation and endogeneity.

<u>Assessment and justification of whether the doctoral dissertation is an original solution to a research problem, an original solution in the application of the results of one's own scientific research in the economic or social sphere:</u>

The doctoral dissertation constitutes and original solution to the research problem of understanding the determinants of energy transition. The result that higher GDP per capita does not necessarily translate into renewable energy adoption is important, as it challenges the hypothesised environmental development trajectory by the environmental Kuznets curve. However, this is not explicitly mentioned in the dissertation. The econometric results also point to that policy interventions introducing renewable energy policy foster the deployment of renewable energy sources. Although the econometric model cannot distinguish between different policy interventions, as they enter the model as a binary variable, this result is highly relevant and opens an avenue for future research.

Simulations about future energy transition paths are performed using the Fisher and Pry model. Although the Fisher and Pry methodology was introduced decades ago to simulate technological change, it is not commonly used in the field of economics, and Mr Ślosarski originally used it to solve the research problem of

predicting future energy transition patterns, the third research goal. While the presentation and explanation of this methodology in Chapter 4 is short and could have been extended, its usefulness in solving the research problem is clearly stated once the reader reaches Chapter 6.

<u>Assessment of whether the doctoral dissertation presents general theoretical knowledge in the discipline or disciplines, and demonstrates the ability to independently conduct research work:</u>

The doctoral dissertation shows that the candidate has general theoretical knowledge in the field of economics as it presents an extended conceptualisation and theoretical background on the economic history of energy transitions since the first industrial revolution and the economic determinants of the energy transition, with a focus on investment, the environment and the institutional framework. It also presents technical knowledge of the different energy production technologies. Mr Ślosarski shows that he is able to collect all this theoretical knowledge and combine it with appropriate methods to draw policy conclusions about what policies intervention OECD economies could follow to accelerate the energy transition. This demonstrates the ability of the PhD candidate to conduct research work independently.

<u>Assessments, with justification, of whether the doctoral dissertation demonstrates the ability to independently conduct scientific work by the person applying for a doctoral degree:</u>

Overall, Mr Ślosarski's dissertation combines scientific rigour and presents an original solution to the scientific problem. Along the seven chapters of the dissertation, Mr Ślosarski demonstrates that he has the theoretical knowledge to address scientific problems, knows how to use the appropriate methods, accurately interprets the results, and draws policy conclusions. This shows that the candidate can conduct scientific work independently.

Therefore, I positively review Mr Ślosarski's dissertation and request admission to defend.

Questions:

During the PhD defence, I would like the candidate to answer the following questions:

1. In Chapter 1, you said that *"there is no universally accepted definition of energy transition"*. What is for you, or how you will define energy transition?
2. The current industrial transformation in Poland's economy has important consequences for energy consumption. Why have you not included Poland

as one of the main countries of analysis? You only briefly discuss Poland later when doing the energy policy mix review at the end of chapter 3 and include a set of graphs in the appendix.

3. The exchange rate variable used in Chapter 5 is not clearly explained. With respect to which currency is the exchange rate computed? Is it a multilateral exchange rate weighted by trade flows?

4. I miss a discussion about the environmental Kuznets curve. Do your results on the effect of GDP per capita on the adoption of renewable energies support or contradict the theory of the environmental Kuznets curve?

5. The explanation of Figure 6.3 for Central and South America is confusing. In the graph we can see that the blue line corresponding to *"Predicted Renewable Share"* is decreasing, while the text says that *"The predicted renewable share shows a slow upward trajectory, while the predicted fossil fuel share gradually declines over time"*. Could you please develop a more detailed explanation of the Central and South Marica simulation scenario?

6. The simulations of future energy transition paths are run till 2080, a simulation period of sixty years. Why have you chosen this time frame?

7. The relocation of production to Asian economies has an impact on the greenhouse gas emissions and energy consumption statistics. While energy consumption and the use of more polluting technologies decrease in advanced economies due to its specialization in the service sectors, energy consumption and greenhouse gas emissions increase in producing countries. How could be attribute to the importers countries the energy consumption embedded in the goods they import? Do you think that taking this into account could change your results?

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