

Opinion on the dissertation thesis
Modelling of Sustainable Development in a Region
Author: Ing. Richard Gardiner
Supervisor: prof. Ing. Petr Hájek, Ph.D.

The dissertation thesis is focused on a very current topic of sustainability within the regions. With help of econometric model, the relationship between sustainable development goals and indicators at national and European level is examined. The relatively extensive work consist of 8 chapters and 133 pages if not including pages with resources.

The study is based on a comprehensive analysis of sustainable development goals and indicators used, followed by an equally comprehensive analysis of methods that can be used to solve the selected problem. In the introductory theoretical chapters, author demonstrated a well-founded theoretical background, as evidenced by a number of citations (the list of used resources has a range of 27 pages). I appreciate that there are three own publications in the resources list.

The work has a balanced logical structure, divided evenly into theoretical and practical part. The theoretical part of the work, due to the chosen topic, deals with the goals and indicators of sustainability and the possibilities of their analysis. In the practical part, the author deals with the construction of three econometric models.

The work probably does not explicitly state working hypotheses, however, the author incorporated them into the text itself at the beginning of Chapter 3. The working prerequisite is based on the verification the existence of the economy-society-environment nexus.

I see the focus of the work in the fifth chapter, which presents three implemented models, including discussions of the modeling results. The author then continues with an extensive chapter 6, where he deals with the results obtained, which he further examines in terms of causality. On this way, a comprehensive scientific study was created. On the basis of it, the author subsequently draws relevant conclusions.

I consider the conclusions regarding the identified links between indicators to be very interesting, original and beneficial for theory and practice. I appreciate the fact that the author also takes into account the geographical aspect and differentiates in the reflections between the old and new EU countries. In this context, he comments the differences in the links between indicators.

I see the main benefit of the study in the original approach to examining the links between sustainability indicators. The proposed procedure for examining the relationships between sustainability indicators is an original tool that can provide quality information for decision-making, especially at the public sector level. The theoretical contribution of the work is verification the possibility of using selected econometric models for analyzing the links between sustainability indicators for use in environmental policies.

I also have a few comments on the work.

The content of the work itself is somewhat confusing, as for each of the models, it presents only subchapters:

Theoretical background

Econometric model and

Data,

which gives the impression that these subchapters concern only a general description of selected models and data preparation. However, a closer reading will show that each of these sections is a complete application of the model, including a discussion of the modeling results.

The formal comment concerns the adjustment of the graphs on: fig. 5, p. 81; fig. 6, p. 89; fig. 8, p. 97; fig. 9, p. 98; fig. 17, p. 120; fig. 18, p. 121 and fig. 19, p. 122, which are practically illegible.

Questions:

1. Why did you decide to take into account the differences between new and old EU countries?
2. Is it possible to evaluate from the conclusions of the performed analysis whether the achievement of goals in the field of circular economy by 2030 from the current state is realistic?

I recommend the dissertation thesis for defense and after success the award of the Ph.D. to the author.

Opinion review on the dissertation thesis:

Title: Modelling of Sustainable Development in a Region

Author: Ing. Richard Gardiner

Supervisor: prof. Ing. Petr Hájek, Ph.D.

Institution: The University of Pardubice, Faculty of Economics and Administration

Reviewer: Prof. RNDr. Oto Hudec, CSc., Technical University of Košice, Faculty of Economics

Theoretical background and topicality of the thesis:

In 2015, the Member States of the United Nations adopted a common plan for peace and prosperity for people and planet entitled the 2030 Agenda for Sustainable Development. The comprehensive and ambitious plan seeks to manage the major challenges we face, poverty eradication, economic growth, environmental protection, social needs including health, education, or gender equality. Sustainability is a key concept, and in total, it comprises 17 Sustainable Development Goals (SDGs), focusing on diverse dimensions of development.

This plan is extremely robust, encompassing countries at different stages of development; and therefore proposing universal targets is itself a rather ambitious endeavour. Moreover, the definition of sustainability is also broad and challenging to capture. Added to this is the natural question of monitoring and/or measuring the performance of countries and regions, which is a big mission.

The identification of targets is crucial, for not all of the 17 SDGs (and the 169 related targets) are in quantitative terms. Countries choose their own indicators, which makes any comparison difficult and introduces relativity into the assessments. The actual selection of indicators and their target values are an input into defining SDGs performance metrics, and there is a whole range of possible methods, each with its particular limitations. Last but not least, very many targets necessarily carry with them a contradiction or correlation, and to engage in their analysis is to sense the complexity of, say, an all-human development model.

The theoretical overview allows the reader a good orientation in the concepts and it should be appreciated how possible methodological approaches are classified and explained.

Methodology and results:

In the first part of the thesis, the aim is to propose a model of the economy-society-environment nexus to explore the interactions between sustainable development goals and indicators, the spatial units of investigation being countries and regions.

The second research question is aimed at studying the short- and long-term causal relationships between economic development, social development and environmental quality.

Given the diversity of countries and regions, new and old EU member states are also examined separately, taking into account the context, the economic environment, the level of technological development and the diverse patterns of sustainable development. A variance decomposition is used to assess the magnitude of interaction effects between sustainable development indicators.

Clearly, cross-sectional dependence is problematic and causality detection is essential. At the same time, however, the author also had to deal with the problems of stationarity, invariance of the statistical measures of the variables under study over time. Methodologically, the procedures are adequately explained and justified; however, the econometric approaches used are sometimes challenging.

The author has chosen three separate models; in simplified terms, we can talk about 1. Energy Consumption, 2. Inequality and 3. Municipal Waste Generation and their interactions with the chosen related variables. The econometric analyses made it possible to detect interactions between the variables even with their causal unidirectional or bidirectional directions, subsequently schematically depicted in figures.

The models stand on the results of the literature review, and these are translated into models, and then empirically evaluated. This is hard work, and if we are talking about nexus between variables, the most difficult part is the final interpretation and explanation of the mechanisms that interact between the variables.

Comments and Questions:

1. The work is very broad indeed, exploring new themes in context, the results are many, with an attempt to capture time, space and interrelationships. Then it is very tricky to make a straightforward and all-encompassing synthesis.
2. Thus, after such an advanced econometric analysis, the interpretation of the results sounds qualitatively weaker.
3. The nexus between economic growth and environment is the fundamental question that emerges in the dissertation in broader dynamics. Looking at Figure 7 on page 96, how would you explain the relationship between GDP per capita (SDG8) and FDI (SDG7) for the new EU countries? Namely, in the CEE countries, including the Czech Republic, the economy is strongly influenced by foreign direct investment. How would you

explain the lack of a direct relationship between FDI (SDG17) and GDP per capita (SDG8) ?

Ing. Richard Gardiner has used several advanced econometric methods, demonstrating his skills in working with data and using methods and software. The dissertation is well designed and thoughtful, clear in its intentions.

Statement:

The PhD. student demonstrated his capacity to develop a theoretical concept, to choose appropriate econometric methods to work with the data. Thus, the thesis meets the requirements of the dissertation. I recommend submitting the presented dissertation for the defence and awarding Ing. Richard Gardiner the Ph.D. degree.

Košice, 15.11. 2021

Oto Hudec

Review on the dissertation thesis

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|-------------------------|---|
| University of Pardubice | Faculty of Economics and Administration |
| Author | Ing. Richard Gardnier |
| Dissertation thesis | <i>Modelling of Sustainable Development in a Region</i> |
| Supervisor | prof. Ing Petr Hájek, Ph.D. |
| Reviewer | doc. Ing. Mgr. Jana Soukopová, Ph.D. Department of Public Economics Faculty of Economics and Administration Masaryk University |

The dissertation thesis has been evaluated according to the following criteria as follows:

I. Content

I evaluate the content of the dissertation thesis according to the following criteria as follows:

1. Definition of the research subject and its scientific relevance

This dissertation thesis aims to propose an economy-society-environment nexus model to examine interactions among sustainable development goals and indicators at national and regional EU levels.

The Agenda 2030 with its 17 Sustainable Development Goals (SDGs) provides the framework that all 193 United Nations (UN) member states have pledged to achieve (United Nations, 2015). Unlike previous development agendas that put an emphasis on economic growth, the SDGs are a universal framework that contains many potentially diverging policy goals in the economic, social, and environmental sphere, while some goals are thought to be mutually supportive. Not all are in quantitative terms. The achievement of the agenda crucially depends on whether states will be able to maximize such synergies and resolve the existing trade-offs.

The research subject is defined correctly and represents an area that is important for scientific research. The scientific relevance is given on the one hand by the independent importance of the given problem and on the other hand by the fact that the problem thus constructed has so far been insufficiently researched in many respects in the Czech Republic.

2. Evaluation of the knowledge base and theoretical background

Ing. Richard Gardiner has worked with a very rich spectrum of studied publications (more than 300 research papers). It is evident from the text of

the thesis that the author not only knows the authors of the cited papers thoroughly, but also takes a critical scientific attitude towards them. Overall, I state that Ing. Richard Gardiner has a broad overview of this evaluation criterion on the researched issues and existing sources dealing with the issues of sustainable development, SDGs, methods and models of integrated assessment and knows the work that goes beyond the subject of research.

3. Objective of the thesis and its accomplishment

The main aim of the dissertation thesis is to propose an economy-society-environment nexus model to examine interactions among SDGs and sustainable development indicators at national and regional EU levels. To achieve this aim and model the complex interactions among sustainable development components, the author defined four specific objectives. Especially the second specific objective to develop an appropriate econometric model to study the short- and long-run causal relationships between economic development, social development, and environmental quality is rather ambitious and from my point of view at work is not completely fulfilled.

Despite that I can state that the main goal comprehensively covers the research subject, which is also reflected in the specification of sub-goals. For the overall evaluation of the objectives, I state that they were set correctly and are fulfilled at work.

4. Research methodology and methods of the solution chosen

The research design of the dissertation was created regarding the set goal. In the dissertation thesis the author integrated indicators from all the three dimensions of sustainable development (social, economic, and environmental) and used the vector error correction model (VECM) to model interactions among sustainable development indicators in EU 28 countries at both the national and regional level. The author has applied a nexus approach and used panel cointegration and vector error correction models to examine causalities among the sustainable development indicators. The author has chosen three models: Model of energy consumption, CO₂, and economic development nexus, Model of inequality, economic growth and risk of poverty nexus and Model of municipal waste generation, R&D intensity, and economic growth nexus.

Overall, in relation to the evaluation of the research methodology and the research methods used, I can state that Ing. Richard Gardiner has demonstrated his research skills in working with data and using advanced research methods including econometric methods and software.

For greater correctness, the author could even more deal with the limiting assumptions of the methods used from the text, but it is clear, that he knows the limiting assumptions (chapter 7).

II. Formal particulars of the dissertation thesis and layout

The overall approach to the solution can be appreciated, which is evident from the structure of the thesis, which is appropriately chosen in relation to the fulfilment of the overall goal and the individual sub-goals. Formal requirements and quoting seem to be appropriate. I do not find any big in formatting the text or citing different authors. Some figures are difficult to read (e.g. Figure 5, 6, 8, 9, 14, 15, 17-19) In addition to the introduction and conclusion, the author divided the work into eight chapters, where these chapters follow each other logically. Some chapters are unnecessarily short, but that doesn't spoil the good impression of work.

III. Comments and questions

1. This dissertation thesis is a very interesting and valuable input to the evaluation of sustainable development, but it is also very broadly focused. If author should narrow your work, which way will he go?
2. The author has applied a nexus approach and used panel cointegration and vector error correction models to examine causalities among the sustainable development indicators and have chosen three models. What other models could the author use? Which of the models can be suitable for the Czech Republic?

Statement

The Ph.D. student demonstrated his capacity to develop theoretical concept, to choose appropriate research methods (including econometric methods) to work with data and his thesis meets the requirements of the dissertation. I recommend submitting the presented dissertation for defence and awarding Ing. Richard Gardnier the Ph.D. degree.

V Brně dne 24. 11. 2021