Quality of institutions as a factor to energy transition in South Africa: Econometric and System Dynamics modelling evidence

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Overview

The level of greenhouse gas emissions globally with its dire consequences on climate has intensified the efforts of many countries in proceeding with drastic changes in their supply mixes, recognizing that the power generation sector is the main contributor to air pollution (AlFarra & Abu-Hijleh, 2012; Apergis et al., 2010; Bellakhal et al., 2019). The flexibility and more minor initial capital investment requirements of the renewable energy option also suggest them as a solution to energy (in)security and energy poverty, particularly in developing countries.

Even though however, the transition towards renewable energies and "away" from fossil fuels is a given internationally, not all countries adopt the new technologies with the same speed. Cadoret and Padovano (2016) concluded that regardless of the institutional and policy environment where usually decisions on the supply mix are taken, the ideological orientation of the government and industrial lobbying can hinder the adoption of renewable energies. Bourcet (2020) adds that complementary to the policy and regulatory framework included in the literature, the political environment is also considered in some studies: specific projects benefit from political stability and sound regulatory frameworks.

The primary purpose of this paper is to examine the impact of institutional and policy factors in the decision by countries to use renewable energy in their electricity supply mix in South Africa. To do so, this study will combine empirical evidence from a System Dynamics model and a time-series econometric model.

Methods

Econometrically, this paper follows a particular part of the literature (Komendatova et al., 2012; Cadoret and Padovano, 2016; Pfeiffer and Mulder, 2013; Verdolini and Vona, 2015; Holdmann et al., 2019) that attributes the delays in renewable energy share increases to the role of national policy frameworks and government efficiency, as well as a historical dependency to fossil fuels and market structures. Most of these studies approached the part of political factors from the point of view of investment risk due to the relatively high cost of renewable energy. The current renewable energy technology pricing conditions are changing rapidly, with IRENA (2018) forecasting that renewable energy will cost less than fossil fuels per unit of electricity generation.

In our model, the dependent variable is the growth in renewable energy share in a country's energy supply mix. Following the literature, the explanatory variables will be categorized into three vectors: 1) political economy, 2) economic, and 3) environmental and energy variables. The political and governance variables will represent the quality of governance, institutional structure, levels of corruption etc. The Corruption Perception Index (CPI) from Transparency International and the Control of Corruption Index from the World Bank's World Governance Indicators will be employed to capture the quality of governance in South Africa. Another important factor that might hinder the adoption of new alternative types of energy is the share of fossil fuels historically in South Africa – reluctance to adopt renewables can be rooted in the already established power generation capacity in fossil fuels.

Subsequently, with the use of a fundamental system dynamics causal loop model, the study will examine the role of institutions in the renewable energy adoption for the South African electricity sector where the adoption has been considered relatively slow even though the country suffers from overall mismatches between supply and demand resulting in frequent power interruptions. The SD model's parameters will be derived from econometric partial equilibrium models to represent elasticities for the relationships between the model's variables.

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