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Can decarbonization policy results be detected by simplistic analysis of macro-level statistical data?

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ABSTRACT

We study some simple statistical relations between several sets of macro-level data related to decarbonization of the power sector. The data used in the research was obtained from Eurostat's web site. Besides regressions between the variables, we also ran Granger causality tests to explore whether the expected causation relations between them are recognizable from such macro-level data. Although regressions alone proved to be as theoretically expected, we found causality relations to be sometimes counterintuitive, that is, unexpected. The reason to do such a probing analysis was to show whether the macro-level data gathered by official statistical bureaus can be used to present results of policy implementation measures in a convincing way, with clear indication of causality. This may prove to be important because the measures from an energy policy framework usually incur additional costs on citizens. Without being able to see causal relationship (instead merely a coincidental one, which can be seen from simple regressions) between money they (are supposed to) spend, and the policy results, people may develop opposition against the measures, however good they may be.

1. Introduction

Due to human-induced climate change, and inevitable exhaustion of fossil fuels, decarbonization became one of the most important and prominent global processes. Carbon policy influences energy technologies, and vice versa. Energy itself is a key enabler of modern life. Therefore, there is an unbreakable link between society, state, energy policy and politics, climate policy, and related technologies. Technological innovations in energy and environment will make the necessary change physically possible. This change will have profound influence on people's lives.[1]

The European Commission has defined the EU's energy sector strategy until 2020 (a document called "Energy 2020", see European Commission [1]). Given its very short time horizon, one could object from the beginning that it lacks a long-term vision. In 2011, however, the Commission issued another strategic document, so-called "Energy Roadmap 2050" (see European Commission [2]), in which strategic goals until 2050 were set. The 2020 strategy is based on five propositions:

- significant improvements in energy efficiency with a goal of reduction of energy consumption by 20% until 2020;
- free energy trade across European area;
- security of supply and affordability of energy for citizens and businesses;
- leadership in technological advancements in energy sector;
- strong international partnerships, especially with neighboring countries.

A particularly important piece of present decade's European strategy is so called "Agenda 20/20/20", which is a catchy political parole, designed to communicate the following basic goals for 2020 to the public:

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[1] Perhaps the best example of causality between technology and social change comes from another industry sector. A huge advance in electronic communication technologies during nineties transformed not only the industry itself, but the way of life, too, in a very fundamental way. Can we really imagine living, or working, without access to Internet, or mobile communication, anymore? We can only expect decarbonization process to affect society even more, in ways we probably still cannot anticipate.

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- twenty percent energy savings through improvements in energy efficiency;
- twenty percent share of energy from renewable sources (RES) in total energy consumption;
- until 2020.

Measures that should be taken in order to achieve these goals were specified, amongst other, in the RES Directive (see European Communities [3]). For each EU Member State, a target for RES′ share in total consumption in 2020 was set. The overall EU goal is twenty percent, while national targets were adjusted to specific circumstances in each Member State.

The long-term strategy relies in the first place on rapid decarbonization of energy sources, i.e. minimization of energy generation from CO_2-emitting sources. Since technological limitations still do not allow for a significant reduction in fossil fuel usage in transport industry, it was only logical to put political emphasis, and pressure, too, on electricity generation.

The EU energy strategy for 2050 relies on ten basic structural changes that must be undertaken across the EU space in order to successfully lower the CO_2 emissions. They are listed and described in Table 1.

Just as in other parts of the World, EU policies aimed at decarbonization have been exerting a profound influence on various aspects of EU national economies. As implementation of these policies require certain shifts in people's spending habits (basically, to spend more on energy and less on everything else), it is never politically simple to get public approval. As already discussed in many valued previous works, such as Stern [4], or Nordhaus [5], today's generation of people devalues future generation's interest in inheriting clean environment. The bigger the devaluation rate (so called *discount rate of social costs and benefits*, see Hope and Newbery [6]), the smaller part of actual ecological external costs we are willing to bear now. From a purely ethical standpoint, the discount rate should ideally be zero.

For example, Stern [4] uses a low estimation of 0.1%, which would add on average €70 per ton of CO_2 emitted from power plants (that is, per approx. 1 MWh of electricity) to the wholesale electricity prices.[2] With that money, the society could (ideally) finance mitigation of pollution from electricity plants to a relatively great extent. Discount rate of 0.1% means that we underestimate future generation's pollution-related costs by half only about 700 years in advance. Nordhaus [5], however, uses the discount rate of 4%, which means that we are now prepared to pay about €6.5 per MWh more for wholesale electricity for the sake of future generations. With the rate of 4%, we devalue future pollution costs by half merely 18 years in advance. Therefore, according to [5], we myopically ignore a great portion of our own interests, too, because most of us have still more than 18 years to live.

There are many discussions on people's willingness to pay pollution mitigation (i.e. to give up spending on something else), although it is not easy to conduct a proper econometric analysis of the phenomena. To give an example, one such study was made by Scarpa and Willis [7], in which they showed that an average British household was not willing to wait more than 3–5 years to return of investment in microgeneration technologies (photovoltaic, solar thermal, wind, heat pumps, biomass). At the same time, the life cycles of these technologies span between 10 and 25 years. This result shows that today's people[3] are not really ready to redirect spending towards clean technologies more than symbolically, probably because they do not see *immediate* gain for themselves.

Therefore, it is not surprising to see media and the public advocating, for example, against increased taxes (or other parafiscal levies) for subsidies for renewables.[4] On the other hand, success of public policies, even the best ones, critically depends on general public attitudes towards such things as reasonability and profitability of pursuing some political agenda by giving up a part of their income and consumption habits in the name of “greater good”.

One of obvious ways to deal with hardships of public acceptance of often costly policy measures is to *make easier for people to understand and see their effects*. Publically gathered statistics can be of use, because statistical bureaus are both trustworthy, and generally trusted, sources of data. Thus, it is interesting to explore how the existing macro-level data reflect what are believed and/or expected results of national and super-national policies. It may be useful to show the citizens that the huge amounts of money invested in implementation of carbon policies actually give the results.

The problem with macro-level data, such as those gathered by Eurostat or national bureaus, is that they are used to describe economic and physical processes that are very complicated and influenced by many different factors, the effects of which are often masked by inevitably coarse and superficial structure of final descriptive data. Naturally, a scientist or professional interested in deeper and more detailed understanding of certain phenomena can always seek more detailed data from whoever produces them (e.g. government agencies, companies involved in energy sector, consultants, etc.). However, too detailed picture can be too complicated to explain to the general public without expert knowledge of the subject in question.

In this work we will try to capture some interdependencies between macro-level statistical variables related to energy system greenification, to explore whether they produce reasonably expected results, or they are not able to capture essence of the phenomena, (probably) due to the lack of detail in underlying data.

2. Analysis of basic statistical indicators

Eurostat publishes a number of statistical indicators on macro-level. They comprise data from EU28 countries, augmented by Island and Norway (EU28 + 2), as well as some other European countries. In this work we used EU28 + 2 data in time series from 2005 to 2014.

Besides basic statistical analysis, we also ran simple Granger causality tests over certain pairs of variables, to see whether macro-level statistics can reveal relations of causation (or, better to say, time precedence) between them, in a manner one would normally expect. As regards Granger causality tests, they were carried out according to Granger ([8], p. 427). Since all the variables analysed do exhibit trendy behavior, and thus are not stationary, we first

[2] At the time of writing, Sept. 2017, average wholesale prices in Central Europe were about €40/MWh. For current prices, visit e.g. www.eex.com.

[3] Note that this is a study from the UK, where the citizens are probably better informed and more aware of ecological aspects of energy usage than in most other countries in the World.

[4] In author's country, Croatia, there has been a huge public opposition against increase of levies on final electricity consumption, imposed purposely for subsidization of renewable sources. The new level, that was increased in Aug. 2017, is €c1.4 per kWh of finally consumed electricity, which is about 10% of average final price for households. In response to public pressure, to compensate for the increase of average monthly electricity bill by some €2.7, Croatian Government lowered the VAT on electricity from the general rate of 25%–13% as from the beginning of 2017.However, the Croatian example is most probably not alone, as energy prices are, among other things, a very good theme for political arenas everywhere. Here is one random example of media coverage of energy prices issue in a western country: http://www.telegraph.co.uk/comment/9617742/Energy-prices-Turning-up-the-political-heat.html.