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The index of sustainable economic welfare in the energy-growth nexus for American countries

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ABSTRACT

Our paper is an empirical study on the comparison between the conventional energy- growth nexus and the energy-ISEW (Index for Sustainable Economic Welfare) growth nexus. We use a sample of American countries in a multivariate panel framework for a data span from 1990 to 2013, with variables such as labor, capital, carbon emissions, energy use, renewable energy, rents and trade. Results from this paper are critical for governments and institutional investors who are nowadays concerned with sustainable economic growth and welfare and not only the short-sighted GDP growth. An additional contribution of this paper is the calculation of the ISEW index for American countries, based on data availability.

1. Introduction

The critique against the usage of GDP as a measure of economic progress (Karanfil and Li, 2015), combined with the controversy and ambiguity characterizing the up-to-date results in the energy-growth nexus (Chang and Gupta, 2015; Bhattacharya and Paramati, 2016) is the reason that led us to suggest a new paradigm in the energy-growth nexus.

The ineffectiveness of GDP to measure real progress had been pinpointed already at the time it was first established. From the Great Depression and thereafter, GDP has been used as a convenient tool for measuring economic growth, but its main defect is that it does not distinguish welfare improving activity from welfare reducing activity (Saunoris and Sheridan, 2013). Defensive expenditure incurred to remedy disservices from various externalities is also accounted in the GDP. For example, suppose a country has a bad road network and this causes a lot of car accidents to happen. The repairs for the damaged cars and the expenses victims pay to doctors for their therapy, contribute to the increase of GDP. However, ceteris paribus, an economy with less car accidents is more sustainable than an economy with more accidents. Similarly, in cities with high pollution people spend more money on health services which increases investment and GDP, but this growth is unlikely to be sustainable. Moreover, unofficial economic transactions, namely those that take place in the so-called black market, also go unaccounted for in the GDP calculation.

Overall, GDP reveals which country is richer, but it does that in a short-sighted manner, because it tells little about the genuine progress and the welfare a country is experiencing. It does not take into account the degree of disintegration in human relations and the ecosystem damage caused by increased and reckless industrialization. Due to the sterile accountancy permeating GDP, a series of other indexes have been suggested to supplement GDP or replace GDP. The European Commission in its "2007 beyond" conference has presented an array of 24 sustainability indicators. However, each one of them focuses only on one or some aspects of sustainable welfare and none of them is all inclusive, i.e. measuring sustainability in all walks of life: economics, environment and society. The ISEW and its variant Genuine Progress Index (GPI) are the only indexes that claim to be all inclusive sustainable welfare indexes (Lawn, 2003; Brennan, 2008; Bagstad et al., 2014).

The current paper replaces the GDP, as a measure of economic growth (in the energy-growth nexus), with the ISEW and aims to find out how conservation measures, that are usually used to restrain energy consumption, will impact on sustainable economic welfare (an aspect concealed when using GDP economic growth). Given that sustainable growth is the only answer to, concurrently,

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solve the environmental, social and economic crisis afflicting many countries, it might be more informative incorporating the ISEW in the energy-growth nexus. Its parallel estimation with the conventional energy-GDP growth may give useful insights with respect to the foregone information when policy making is based solely on information stemming from the energy-GDP growth nexus.

The interest in American countries is justified from the fact that American economies are large consumers of fossil energy and producers of greenhouse emissions. Large American economies, such as the USA have been blamed for not taking measures against climate change and in favor of sustainability. For example, the USA has not ratified the Kyoto Protocol (The Encyclopedia of Earth, 2013). Latin America and the Caribbean region have not made a lot of progress with respect to the demands of Agenda 21 and the Rio Declaration (UN and UNEP, 2002).

The novel contribution of our paper lies in the following four points:

i) First, it calculates the first Index of Sustainable Economic Welfare (ISEW) for 20 American countries (upon data availability). This, alone, is by itself an important stand-alone piece of research.
ii) It suggests an innovative way of literature review in the energy-growth nexus for American countries, by separating studies into aggregate and disaggregate energy studies and other sub-groupings which allow a better systemization of literature.
iii) It re-estimates the conventional energy-growth nexus with a wide selection of regressors, applying panel effects model analysis, quantile regression (for further proof of robustness) and panel- Granger causality estimation.
iv) I) It estimates the conventional energy-ISEW growth nexus and compares the produced results with the ones produced from the aforementioned point iii).

The rest of the paper is organized as follows: After this introduction (part 1), follows the literature review (part 2). Part 3 offers the details of the ISEW calculation, while part 4 deals with empirical analysis, results and their discussion. Last, part 5 concludes the paper.

2. Literature review: the energy- GDP growth nexus in America

Quite often, the literature review in papers dealing with the energy-growth nexus encloses a table containing information about the data-span of the study, the variables perused as independent, most often labor, capital, emissions etc and information about the hypothesis or hypotheses that is/are confirmed for the whole sample of countries or for different groups of studies. An example of such a literature review table can be found in Huang et al. (2008). Also, some studies even report the econometric method used while some others do not include such tables at all, but they simply include an account of what each study has found and they place their own study results vis-à-vis the existent ones such as is done for example in Apergis and Payne (2011).

Our literature review in this paper is performed in a different way than the above. It does not aim to replace the existent practices but rather to enrich them with a more meta-analytic perspective. First, studies are allocated into two categories. One containing aggregate energy- GDP growth studies and another containing disaggregate energy- GDP growth studies. Aggregate studies usually employ total energy used by the economy as a whole, while disaggregate studies specify on energy consumption by particular sections of the economy, namely industry, agriculture, commercial, households etc. Moreover, disaggregate studies specify on particular types of energy consumption, namely oil produced energy, natural gas energy, electricity, renewable energy or even particular types of renewable energy such as biofuel, solar, wind etc. Therefore, disaggregate energy studies are concerned with a particular sector of the economy and a particular type of energy. Understandably, the latter group throws more light onto the anatomy of the energy-growth nexus, since different sectors and different energy types respond differently to energy conservation policies and therefore different policy measures might be applicable.

That been said, each of the aforementioned two strands of studies is sub-divided into four further categories, depending on which literature hypothesis they confirm: Growth, Conservation, Feedback and Neutrality. A brief explanation of these four hypotheses typically examined in the energy-growth nexus is as follows:

I. Growth Hypothesis

The "Growth Hypothesis" is characterized by uni-directional Granger causality running from energy consumption to economic growth. In such as situation, conservation measures will uphold economic growth because energy consumption is very important for economic growth to take place, either directly or indirectly, as a complement to labor and capital (Apergis and Payne, 2012). The Growth Hypothesis entails that increases in energy consumption, help increase forecasting performance of economic growth, and vice-versa. When economies are very energy dependent, this means that they are not so smart or technologically advanced and major structural changes must take place for more efficiency to characterize energy consumption.

II. Conservation Hypothesis

The "Conservation Hypothesis" is characterized by uni-directional Granger- causality running from economic growth to energy consumption. In an economy where the Conservation Hypothesis holds, conservation measures can take place without upholding growth. Such an economy is less energy dependent and more sustainable.

III. Feedback Hypothesis

The "Feedback Hypothesis" is characterized by bi-directional Granger-causality running from energy consumption to economic growth and then vice-versa. Consequently, conservation measures will impact on economic growth and changes on economic growth will impact on energy consumption as well. Therefore, when this hypothesis holds, it suggests that there are some complementarities between energy consumption and economic growth.

IV. Neutrality Hypothesis

The "Neutrality Hypothesis" is characterized by the absence of any Granger- causality between energy consumption and economic growth. For economies where these two magnitudes are independent from each other, means that growth is driven by other factors. Together with the Conservation Hypothesis, Neutrality Hypothesis can be encountered in more sustainable economies.

Besides the abovementioned second division of studies, based on the hypothesis they find evidence for, we suggest a third division of studies, based on the country or countries the study encompasses. We distinguish four groups of studies in this literature review. Groups 1 & 2 are "groups of countries" studies. Particularly Group 1 encompasses studies that focus on American countries groups solely, e.g. 7 American countries, 3 Latin American countries etc. (entitled Table of Appendix A as "Groups of countries I"), Group 2 encompasses studies where American groups of countries are one group among many other countries or groups of countries (entitled in Table of Appendix A) as "Groups of countries II"). Groups 3 & 4 are single country studies, e.g. Group 3 is about single American countries −most of them are about USA and only one about Brazil (entitled in Table of Appendix A as "Single countries I"), while Group 4 is about single American countries within a greater group of countries such as the G7 countries or others (entitled Table of Appendix A as "Single countries II").