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The sensitivity of growth, conservation, feedback & neutrality hypotheses to sustainability accounting

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ABSTRACT

The relationship between energy consumption and national economic welfare, as measured by gross domestic product, has been evaluated statistically in numerous studies. We summarize and compare the results of several of these studies for 15 emerging economies. Considerable differences between studies and between nations are found. Then, we introduce two measures of welfare based on the "Index of Sustainable Economic Welfare" (ISEW). The first measure, "BISEW" (hereafter BISEW), modifies GDP to emphasize equality, capital stock, and spending on private consumption, education, and medical care. The second measure, "Solid ISEW" (hereafter SISEW), subtracts carbon dioxide emissions and various measures of resource depletion to the BISEW, thus combining economic and environmental considerations in the measure of welfare. We apply Granger causality analysis with a seemingly unrelated regression (SUR) to evaluate how energy consumption correlates with GDP, BISEW, and SISEW for 15 emerging economies over the period 1995–2013. The results are expressed in terms of the directionality of Granger causality. Although there is consistency in many cases, the direction of causality is found to vary substantially between countries and depending on which of the three measures of welfare is evaluated.

Introduction

Research on the relationship between energy consumption and economic output, as measured by gross domestic product (GDP) has shown ambiguous results (Kalimeris et al., 2014; Menegaki, 2014; Ozturk, 2010). Concurrently, there is an increased interest in whether GDP is an accurate measure of progress and welfare (Kubiszewski et al., 2013). These concerns have motivated new research on how energy consumption impacts on welfare that uses various measures of welfare to replace GDP. This paper uses an Index of Sustainable Economic Welfare (ISEW) to replace GDP.

The ISEW was first suggested by Daly and Cobb (1989) but was methodologically improved by Cobb and Cobb (1994). Previous insights had been provided in the Measure of Economic Welfare (MEW) by Nordhaus and Tobin (1972) which modified GDP in a way to subtract from it the value of activities harming human and environmental welfare. The ISEW is a modification of the MEW. The Genuine Progress Index (GPI) has been used interchangeably with ISEW (Lawn, 2013). While a variety of other welfare indexes have been developed up to date (The European Commission in its "2007 Beyond" conference presents an array of 24 indicators), each of them focuses on a certain aspect of welfare and does not encompass all the aspects of economy, environment and society as the ISEW does. Some examples are: the Capability Index (according to which, quality of life is what people do with their resources), the Ecological Footprint Indicator (measures the balance between the demand and supply for renewable resources for a given population or activity and the assimilative capacity for waste), the Environmentally Sustainable National Income — ESNI (measures the number of years that a country with its current production situation is away for a sustainable ideal benchmark), the happy planet index — HPI (ratio of the product of experienced welfare and life expectancy to the ecological footprint), and many others. Also, one of the long developed welfare indicators is the Human Development Index (HDI) that is used by the United Nations but it is criticized for its incompleteness (Dasgupta and Weale, 1992) in all the abovementioned three fields the ISEW can host. The HDI includes purchasing power, education, and longevity but leaves out many of the dimensions the ISEW takes into account. Overall, it may be impossible to find a perfect indicator but ISEW is an attempt to do better than others.

The calculation of the ISEW starts with personal consumption expenditure which is weighted for income inequality to account for the fact that the benefits from economic growth can favor the rich in a disproportional way. With this basis, several welfare generating magnitudes are added and welfare destroying magnitudes are subtracted. Among the former are education expenditure and health expenditure, while among the latter are defensive expenditures, costs of

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environmental degradation, natural resource extinction, noise pollution, cost of biodiversity loss, climate change costs, and air and water pollution costs etc. (Bagstad et al., 2014).

The depth of the magnitudes involved in the calculation of the ISEW is huge and goes through to the roots of Fisher's psychic income (Fisher, 1906) to account for human capital (Lawn, 2003). Beça and Santos (2010) present a calculation of the ISEW also including social factors such as value of household labor, cost of unintentional accidents, cost of crime, cost of leisure time, cost of family breakdown, cost of underemployment and cost of harmful lifestyle. Due to lack of availability to sophisticated data across countries, the ISEW calculated in his paper does not contain social variables. It also contains some of the environmental variables based on availability.

Up to date, Menegaki and Tugcu (2016) have produced the first piece of research that studies the energy-welfare growth nexus in sub-Saharan countries within this perspective. Hence, the questions typically raised in the conventional energy-economic growth nexus, for instance, how much total energy consumption or parts of energy consumption (nuclear, coal, oil, renewable etc.) contribute to economic growth, need to be compared with their sustainable economic welfare counterparts and be reformulated under the lens of sustainability concerns. Foremost, governments would be interested to know how much energy conservation measures may retard sustainable economic welfare, since conservation of energy without hindering sustainable economic welfare is a target for many of them.

The interest in studying emerging economies in this framework stems from the fact that they are large energy consumers because of their population size (which equals to about 80% of the global population) and the significant growth in investment and production taking place within their economies. Emerging economies are typically low or middle income countries undertaking serious developments and reforms, opening their markets to “emerge” in the global market. Economic growth of emerging countries has been accompanied by environmental and social costs.

In addition to that, nowadays, all countries are facing international pressure to comply with new guidelines about sustainability and to reach certain targets about climate change and renewable energy penetration. Europe in its sustainable strategy aims for 2020 has the following three priorities: To develop economies based on knowledge and innovation, to promote green and resource efficient economies and foster high employment with social and territorial cohesion (European Commission, 2010). Large emerging economies such as China have realized the importance of sustainability and thus set reduced economic growth targets (a reduction by 7% in 2015) in order to put the country to a more sustainable level of growth path (International Business Times, 2015). United nations Rio + 20 conference participating countries namely, all in our sample, have stipulated on the following: greening of the economies in a context of sustainable development and poverty eradication as well as setting and safeguarding the institutional framework for sustainable development (United Nations, 2015). However, the Doha amendment to the Kyoto Protocol, which is the second commitment period of the Kyoto Protocol that began in January 2013 to December 2020 and has been ratified only by few of the countries in our sample such as China, Indonesia, Mexico, Morocco, and South Africa (United Nations Framework on Climate Change, 2015) required that 75% of the parties to the Kyoto Protocol sign for this amendment to enter into force (United Nations Framework Convention on Climate Change, 2014). Being the core of all these international agreements, sustainability reveals the timeliness of the answers the energy-growth nexus study can provide, and hence a fresh research interest is more than justified. Thus, the novelty of our paper is threefold:

1) We summarize previous work on the energy-GDP growth nexus and expand on it.
2) We calculate the BISEW and SISEW for a set of 16 countries of emerging economies. Then we perform an econometric analysis of the energy-welfare nexus, the analytic procedure being similar to that of item 1.
3) We evaluate the results of both item 1 and item 2, so as to highlight insights on both the energy-welfare nexus and the usefulness and shortcomings of the econometric method.

The rest of this paper is organized as follows: After this brief introduction, we continue with a literature review on the energy-growth nexus for emerging countries as the second section. The third section discusses the sustainability and sustainable economic welfare for emerging countries, the fourth section shows the data and empirical analysis with results, while the last section concludes the paper.

Literature review of the energy-GDP growth nexus in emerging countries

The energy-growth nexus studies so far have identified four hypotheses on the effects energy conservation measures have on economic growth. To identify the existence of the hypotheses, Granger causality tools are employed. The Granger causality test is a statistical hypothesis test for determining whether one time series or panel data is useful in forecasting another. It can be said that a variable X that evolves over time, Granger causes another evolving variable Y, if predictions of the value of Y based on its own past values and on the past values of X are better than predictions of Y based only on its own past values. When an observation of the variable X Granger causes an observation of the variable Y, the patterns in X are approximately repeated in Y after some time lag.

Thus, if Granger's causality shows an increase (decrease) in energy consumption to consistently precede a corresponding increase (decrease) in GDP, we can say that increasing energy consumption has Granger-caused GDP growth or that decreasing energy consumption has Granger-caused a decrease in GDP. This gives reason to hypothesize that changes in energy consumption may cause corresponding changes in GDP. That is, the given statistical correlation suggests that a nation might promote GDP growth by promoting energy consumption.

Energy can be used in ways that promote economic growth or in ways that do not promote it and a full analysis of the hypothesis is not provided by the Granger method. Furthermore, a trend present during one period of time cannot necessarily predict the trend at another time.

Having said the above, next we explain in brief, what the content of the four hypotheses is. Also, we use the following notation for the content and direction of effect: G: growth, E: energy consumption, →: is causing, ↔: mutual causing and ~: no causal relationship.

i) Conservation hypothesis (G→E)
When the Granger method shows uni-directional causality running from GDP growth to energy consumption growth, the “conservation hypothesis” is suggested. That is, the statistical analysis may be used to support the hypothesis that efforts to conserve energy will not lead to a decrease in GDP and may even lead to an increase in GDP. However, just as energy may be used to support GDP growth or to not support it, differing energy conservation measures may differ in their effects on the economy. One may reasonably expect that certain energy conservation measures may promote (or at least not hinder) economic growth, even in an economy for which Granger causality supports the growth hypothesis. In all cases, analysis beyond the Granger method may either support or weaken the hypothesis.

ii) Growth hypothesis (E→G)
The “growth hypothesis” is characterized by uni-directional causality running from energy consumption to economic growth. In such a situation, conservation measures will hinder 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