AGGREGATE ANALYSIS OF ENERGY INTENSITY IN BOLIVIA: AN APPLICATION OF LOG-MEAN DIVISIA INDEX DECOMPOSITION

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Overview

Countries have oriented their development through agreements and strategies framed in the Sustainable Development Goals (SDGs). The United Nations has defined as goal number 7, the achievement of affordable and clean energy, where the goal by 2030 is to double the global rate of energy efficiency (target 7.3). In this sense, it is important for Bolivia to analyze an indicator that allows interpreting energy efficiency, measured by energy intensity, and to know the implications that this entails.

The research analyzes the change or variation of Bolivia's energy intensity using two effects that determine it: the effect of the economic structure and the effect of energy intensity by sectors. Quantifying these effects provides evidence to clarify, to some extent, the decision-making on energy management by the State and economic agents; in this sense, the objective is to explain how the effects of economic structure and energy intensity have an impact on the change or variation of the interannual energy intensity in Bolivia.

For the application of the method, two sources of information published by the National Institute of Statistics (INE) and the Ministry of Hydrocarbons and Energy (MHE) were used. In relation to the INE, the data used correspond to the statistics of the Gross Domestic Product (GDP) at basic prices, or Value Added (VA), of the 35 activities or branches of activity of the economy in Bolivia, and in relation to the MHE, the data of the National Energy Balance (BEN) is used, referring to the 7 sectors of energy consumption.

Methods

The method is derived from Index-based decomposition analysis, which is widely accepted as a methodological tool in energy and environmental issues. Its application was conducive to study the impact on energy demand of industry structure change, energy efficiency and energy security (Ang & Zhang, 2000). Within the index-based decomposition analysis are the methods linked to the Divisia Index, and on the latter is the Logarithmic Mean Divisia Index (LMDI) method, which is widely used for its properties (Ang, 2004).

In this sense, although the method is applied both in the multiplicative and additive form (in the multiplicative decomposition the change in the ratio -or quotient- is decomposed, while in the additive decomposition the change in the difference is decomposed), here we take the additive form. The additive decomposition allows the analysis of absolute changes in the variable under study, which is more convenient when talking about energy intensity, while the multiplicative decomposition is expressed in percentage terms, thus expressing relative changes, i.e. a change in the ratio or quotient.

The sectoral structure of the BEN is taken into account, since these represent the lowest level of disaggregation compared to the disaggregation of GDP at basic prices (GDP at basic prices is said to be when the GDP value does not include the indirect taxes of the economy) in order to classify the branches of activity. At the same time, the 35 economic activities (or branches of activity) corresponding to GDP at basic prices are included in order to have the information matched. The information available for the classification presented covers the period 2000 to 2021.

Results

Bolivia's energy intensity (ratio of energy consumption to the value of GDP at basic prices) has gone through different cycles in the period 2000-2021. Starting in 2000, energy intensity has grown rapidly until 2005 and then, for a period of 4 years, it has been maintained and then increased again without exceeding 1.5. It is congruent to see that during the pandemic period there was less energy intensity due to the effect of the paralysis of activities, which influenced energy consumption.

The structure effect by sector presents relevant data regarding the weight of the Transport, Energy Transformation, Industry and Residential sectors on energy intensity. The other economic activities do not contribute more to the effect than the previous ones. At the time of the pandemic, the Transport activity accounts for a marked improvement in energy efficiency or reduction of energy intensity. Energy Transformation, Transport and the Residential part are so for the period 2011-2018.

The intensity effect by sectors reveals that in the period 2011-2018, the Industrial sector has contributed to energy efficiency since its energy intensity has a negative sign and in large proportion. During the initial period 2000-2010, the Transport sector has a marked incidence in energy consumption by production value, but there is an improvement in subsequent years. Here it is important to note that with the pandemic and in the following years there is greater energy efficiency, but it is recovering pre-pandemic values.

Conclusions

Taking into account the aggregated analysis of energy intensity in Bolivia, by applying the decomposition of the logarithmic mean Divisa index, results have been obtained on the relationship between energy efficiency and economic activity at the macroeconomic level. This is the generalization at the aggregate level of the elements that determine the change or variation of the inter-annual energy intensity in Bolivia under the top-down approach, since it starts from aggregate values to make conclusions about the effects that determine it.

Thus, with the differentiation of periods under study (2000-2010, 2011-2018 and 2019-2021) and the results obtained from the decomposition for the entire period of analysis (2000-2021), it is observed that the effect of energy intensity is the one that has a greater incidence than the effect of the economic structure of the productive sectors. In this way, a result has been obtained that allows making a recommendation on energy management by the State to focus its attention on improving energy efficiency and consequently, it is necessary to differentiate the sectors in order to have a better performance.

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