EIGHT METHODS FOR DECOMPOSING THE AGGREGATE ENERGY INTENSITY OF ECONOMIC STRUCTURE WITH SPECIAL REGARD TO THE INDUSTRIAL SECTOR

Tekla Sebestyén Szép, +362056116682, regtekla@uni-miskolc.hu

Overview

The energy intensity of the East-Central Europe strongly improved in the last two decades and it has two main reasons. The first one is that after the change of regime the heavy industry collapsed, and there were a shift from the agriculture towards the service sector. The second is the technological development of the economy, which increased the energy efficiency of the economic sectors. The subject of my paper is to give a comprehensive analysis and decompose the energy intensity of the industrial sector and the aggregate energy intensity of the whole economy in East-Central Europe (Czech Republic, Slovakia, Slovenia, Poland and Hungary) between 1990 and 2009. My hypothesis is that *in East-Central-Europe after the change of regime the energy intensity (both in the industrial sector and in the whole economy) is significantly affected by changes of the economic structure and changes of energy intensity of economic sectors as well.*

Methods

The effects of economic activities on energy intensity have been central research topic of the energy and environmental economy after the first oil price shock (Boyd et al. 2004.). The Index Decomposition Analysis (IDA) is a widespread method: it is used for the analysis of energy consumption and emission both in the energy and environmental economy, furthermore in the last years it appeared as a toolbar of human resource economy (Achao et al. 2009.), it gives new additives for the examination of income inequalities. It can be easily interpreted and nowadays it is a frequently used tool for the decision-makers (Ang 1995, 2000; Hoekstra et al. 2003; Zhao et al. 2010; Liu et al. 2003., Unander 2007.).

The index decomposition method has many similar characteristics with the shift-share analysis which is presented by Nemes Nagy (1995). But the latter is an additive approach, the former one can be additive and multiplicative as well. The target of both of them is the decomposition of an aggregate data to components. The essential of the IDA is that it can explain the changes of an indicator at sectoral level, and another advantage is the lowest data request (Hoekstra 2003). The starting point is the final intensity in the economic structure (aggregate energy intensity) which is essentially affected by two factors: changes in energy intensity of economic sectors (intensity effect) and the shift in the mix of products or activities (structural effect) (Liu et al. 2003. pp.16.). The method disaggregates the economy into sectors and then weighting the sectoral energy intensity by their output shares.

The index decomposition analysis is a really wide research topic, many kinds of methods live parallel. I used the most popular ones: the Laspeyres-, Paasche-, Marshall Edgeworth-, Walsh-, Fisher Ideal, Drobish, LMDI and the AMDI-methodology. The Laspeyres-index shows the changes in the examined time period and it uses the weights based on values in base year. In contrast the Paasche-index uses values of the current year as weight. The Marshall-Edgeworth index calculates the arithmetic average of basic and target years, the Walsh-index uses the geometric means. The Fisher Ideal-index is the geometric mean of the results of the Laspeyres and Paasche method, while the Drobish-index argues for the arithmetic average of them (Liu et al. 2003). According to Boyd et al. (2004), the perfect index decomposition method is the Fisher Ideal index, because it fit for all of the strict requirements and the value of residual term is one. Both the AMDI and LMDI are integral index numbers and they have many advantages such as “path independency, ability to handle zero values and consistency in aggregation” (Zhao et al. 2010. pp.1382.).

Results

The results of the decomposition analysis presented in this paper show that between 1990 and 2009 in East-Central Europe the intensity changes have significantly affected the energy use in the industrial sector and the whole economy as well. In the first part, I analyzed the industrial sector with the following subsectors: chemical industry, primary metals, non metallic minerals, wood industry, paper, pulp and printing industry, food industry, textile and leather industry, machinery, transport equipment, other industries, mining and construction. Here the magnitude of the intensity effect was double in comparison with structural effect except Hungary where the size of these two effects was equal. In the second part the subject of the index decomposition analysis methods was the whole economic structure with the primary, secondary and tertiary sectors. The impact of the structural change would increased the energy use in Hungary, Slovakia and Poland (in these countries, the mix of industrial

output moved away towards energy intensive sectors), but the intensity effect was so strong that finally the energy intensity of this sector improved everywhere.
These results confirm Ang's conclusion that "… for the industrialized countries, declining sectoral energy intensity has generally been found to be the main contributor to decreases in the aggregate energy intensity … The impact of structural change is smaller in comparison." (Ang et al. 2000. pp.1162). It is also supported by Kuttor statement, that "it is important to state and emphasize that in spite of the vigorous tertiarisation of the economies, the industry has maintained its significance in the economies of the region [Visegrád countries], both in terms of the employment of workers and of the production of added value." (Kuttor 2011. pp.51).

Conclusions

In my paper I study how the aggregate energy intensity is influenced by the shift in the mix of products or activities (structural effect) and the changes in energy intensity of economic sectors (intensity effect). My hypothesis was that both of these effects were significant. I carried out the examination with the index decomposition analysis and I used eight types. Significant differences between the results did not appeared, the size of residual term was treatable. The results can't prove my hypothesis so my new theses are the next ones. *In East-Central Europe between 1990 and 2009 the intensity effect contributed to a larger extent to the improvement of final intensity in the economic structure than the structural effect. The magnitude of structural effect is less than the intensity effect from the energy intensity perspective.*

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