PEELING THE ONION: ANALYZING AGGREGATE, NATIONAL AND SECTORAL ENERGY INTENSITY IN THE EUROPEAN UNION: AN APPLICATION OF THE WIOD DATABASE

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Overview

The improvement of energy efficiency is one of the most promising measures to meet emission targets set exogenously by climate policy. Beside this effect, it may also help to reduce the dependence on fossil fuels as well as it can foster the competitiveness of industries (Ang et al. , 2010). In this paper, we will introduce and employ the new WIOD Database in order to tell an interesting story about the development of the energy intensity in Europe between 1995 and 2009. Is the decline in energy intensity due to a shift in the composition of the aggregated European economy from energy-intensive production towards less energy-intensive production? Or are there more fundamental improvements with respect to energy utilization responsible for the decline? How did individual countries perform in the period? What are the main economic or political drivers? This paper deals with the decomposition of this cleanup and separates the contribution of structural changes (composition effects), the effects of efficiency improvements (technology effects) and their regional and sectoral patterns (spatial effects) by relying on the commonly used approach of index decomposition analysis. The questions asked some lines above are of fundamental importance: If such a cleanup came simply from a changing composition combined with increasing imports of energy-intensive goods from outer-Europe, the development of the energy intensity in Europe would not be replicable in other, less developed regions. But if the decrease in energy intensity was due to an increased efficiency, this development would be replicable in other regions in the world (maybe even easier due to technology transfers, spillover effects, economies of scale or learning-by-doing). As Wolfram et al. (2012) argue, energy consumption in OECD and non-OECD countries was almost equal in 2007, "but from 2007 to 2035, it [the U.S. Energy Information Administration] forecasts that energy consumption in OECD countries will grow by 14 percent, while energy consumption in non-OECD countries will grow by 84 percent" Wolfram et al. (2012, p. 119). To investigate whether the European clean-up is potentially replicable is against this background of tremendous importance. To anticipate the major finding of this paper, a substantial fraction of the decrease of energy intensity can be attributed to different facets of technological change and therefore it is replicable in currently less developed countries. In our analysis we consider Europe for various reasons: First, the European Union regards itself as a leading actor in international climate policy, and as improving energy efficiency is central pillar of Europe's strategy, we want to investigate the development in this particular region. Second, the data we are using for our analysis allows us to split the sample into three parts. The first part is "before climate policy" between 1995 and 2001, the second part is the "EU ETS Phase 1 + 2" and the third phase is between 2007 and 2009 and makes it possible to investigate the impacts of the financial crisis and the accompanying peak in oil prices in 2008 on technical efficiency in energy use. Finally, and most important, the European integration process is an outstanding example for structural change. While other studies focused mainly on e.g. the impacts of NAFTA on trade and structural change in the United States, we take large structural shifts causing enormous opening to international trade into account. Grossman and Krueger (1991) analyze the impact of the NAFTA free trade agreement on pollution, whereas others look at samples of countries where also structural changes are present but no large differences in the development of e.g. openness across countries have happened (see Antweiler et al. (2001); Cole and Elliott (2003); Cole (2006) or

Managi et al. (2009)). Cornillie and Fankhauser (2004) investigated the development of energy intensities for these economies under transition, but their time-frame was 1992 to 1998 and therefore very short. Furthermore, it was the period when the structural break has happened. We also investigate the results of this transition process.

Methods

Our analysis consists of two interrelated parts and is organized as follows. In the first part we describe the different data sources we have used and then we present an index decomposition analysis of the energy intensity in Europe between 1995 and 2009. We show measures for the EU 27 aggregate and individual countries with additional sectoral disaggregation. Our analysis reveals the large heterogeneity within Europe. While some countries experienced a clean-up due to structural change, most countries have benefited from technology improvements. One exemption is Metcalf (2008), who investigated the development of U.S. energy intensity on aggregate and state level between 1970 and 2001. He also used an index decomposition framework, but added an econometric analysis to investigate the main economic drivers. In the second part of the paper, we build on Metcalfs work and extend his approach in order to investigate the European economy. By doing so, we can identify causalities that would be unable to be found by an index decomposition framework. We construct several variables are potential drivers of the different effects, such as an estimate for total factor productivity, trade openness, income, regulation and country characteristics.

Results

Our analysis reveals the large heterogeneity within Europe. While some countries experienced a clean-up due to structural change, most countries have benefited from technology improvements. We show that there is a strong relationship between total factor productivity, human capital formation, income and the clean-up of energy-intensity in Europe. We also demonstrate, that the clean-up was not driven by energy-prices or regulation and that structural change was not affected by much through a trade induced channel. Furthermore, we illustrate the importance of controlling for country-specific characteristics.

Conclusion

The purpose of this paper is to explain the forces driving improvements in energy intensity in the European Union between 1995 and 2009, i.e. in a time without and with climate policy and economic turbulence. It contributes to the large literature in energy decomposition analysis in three ways. First, it is the only analysis of changes in energy intensity at the country and sectoral level using a perfect decomposition methodology. Second, this study uses econometric methods to identify the drivers of changes in efficiency and economic activity indexes. And finally, it demonstrates the scientific usefulness of the new WIOD database.

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