EXECUTIVE SUMMARY

International Specialization, Structural Change and the Evolution of Manufacturing Energy Intensity in OECD Countries by Peter Mulder

I. Motivations underlying the research

Changes in aggregate energy intensity result from technology-driven energy efficiency improvements at the sector and firm level, as well as from changes in the structure of the economy. In the field of energy studies a popular line of research has been to separate the efficiency effect from the structure effect by means of index number decomposition techniques. Most studies in this field conclude that aggregate energy intensity has been influenced more by energy efficiency change than by changes in the production structure. However, recently, some evidence has been presented that the role of the structure effect is nonetheless sizeable and, interestingly, increasing in importance over time.

In this paper we analyze the (changing) role of the structure effect in driving trends and differences in Manufacturing energy intensity trends across OECD countries. Subsequently we link the structure effect to changing global production patterns under influence of increasing international trade and specialization. We hypothesize that this 'globalization trend' may be associated with an increasing importance of the structure effect in energy intensity dynamics. In turn, this development may influence cross-country variation in energy intensity levels in various ways. Growing trade linkages may help reduce productivity gaps among countries by accelerating knowledge diffusion and equalization of factor prices, via high-tech imports or via increasing international competition. But, on the other hand, productivity gaps among countries may also amplify because increasing international specialization could encourage spatial separation of production processes that inherently differ in terms of required energy input. We aim to identify which of these effects prevail and how this impacts Manufacturing energy intensity dynamics across countries.

II. A short account of the research performed

We combine index number decomposition analysis with so-called β-convergence and σ-convergence analyses inspired by the empirical macroeconomic growth literature. Subsequently, we identify the degree of specialization across countries and its evolution over time, both in terms of energy consumption and value added. We measure the geographical concentration of Manufacturing energy use over time, and to what extent countries specialize in sectors for which they have a comparative advantage in terms of energy intensity. Finally, we link the observed patterns of specialization and concentration in Manufacturing to the role that structural changes play in driving the aggregate evolution of cross-country differences in Manufacturing energy intensity. In doing so, we make use of a new dataset that offers industry-level measures of both value added and energy inputs, together with supplementary input and productivity data series, derived from a consistent framework of national accounts and supply-and-use tables across countries. Our analysis includes 19 OECD countries and 25 Manufacturing sectors (10 main sectors, 15 subsectors), and covers the period 1980-2005.

III. Main conclusions

We present new evidence that changes in sector structure explain a considerable and increasing part of Manufacturing energy intensity trends across 19 OECD countries. We show that cross-country convergence of Manufacturing energy intensity levels is caused by efficiency improvements in lagging countries, while undermined by increasing international differences in sector structure. Particularly, we find that efficiency-driven catching-up processes only began to dominate the diverging impact of structural changes after 1995, reversing gradual cross-country divergence of Manufacturing energy intensity levels into rapid convergence. Subsequently, we link the sector structure dynamics to changing global production patterns under influence of international trade and specialization. The data suggest that increasing trade and market integration helped reducing energy productivity gaps across countries, despite the contribution of increasing specialization to growing cross-country variation in sector structure. These trends are mainly driven by energy-intensive sectors, while various countries specialize in sectors for which they do not have a comparative energy productivity advantage.

IV. Potential benefits, applications and policy implications

Understanding the (changing) role of structural changes in driving aggregate energy intensity trends is interesting for various reasons. First, energy-saving programs are more likely to influence energy trends within a sector, while changes due to shifts in the economic structure are more likely to be independent of energy policy mandates. A sizeable structure effect may thus limit the potential of energy policy to influence future energy efficiency trends. Second, production patterns across countries have changed considerably over the past decades under influence of a tremendous increase in scale and scope of international trade, stimulated by reductions in trade barriers and advances in transport and communication technology. This development may impact energy use in countries in various ways. Our analysis suggests that increasing trade and market integration helped reducing energy productivity gaps across countries by facilitating lagging countries to catch-up in terms of energy productivity performance. This result indicates that unlike concerns that trade may spur a ‘race to the bottom’, promoting trade may help stimulate energy efficiency improvements across countries. Further work is needed to explore the detailed mechanism through which trade affects energy productivity.