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## **FUELLING GROWTH: EVIDENCE OF THE LINK BETWEEN ENERGY DEMAND AND ECONOMIC GROWTH FROM DEVELOPING COUNTRIES**

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### **Introduction**

Over the last few years, key emerging economies such as China and India have been displaying double-digit growth rates. Energy has proven to be a fundamental factor of their growth, particularly as these countries gradually become mature industrial economies, and energy intensity of each new unit of output increases. This process of development, climbing the ‘energy ladder’, is a familiar concept in the energy literature, as industrialized countries have followed similar paths in their process of development. But what emerges clearly from this analysis is how countries end up, at the end of their climb, at very different energy intensity levels. Therefore understanding the way in which developing countries have behaved up to now, i.e. the way in which their energy demand has responded to economic growth and price variations, will give us some foresight on where they will end up in their climb. Existing empirical literature on the relationship between economic growth and energy demand addresses some of these issues for OECD countries, or specific developing regions; due mainly to data issues, there are few comprehensive works that attempt to draw a complete cross-sectional picture of the experience of developing countries using advanced econometric tools.

### **Data and Methodology**

In this paper we use a new panel dataset, which uses a combination of IEA, Enerdata and country specific data on total final consumption, sector specific consumption and end user energy prices for 19 developing countries the 1978-2003 period. We test a reduced form energy demand model, where total energy demand depends on income, domestic energy prices and exogenous technological change. We use country and sector fixed effects and time dummies to control for static differences and dynamic effects, and we test both a long term and a short-term error adjustment model. The latter is given by

$$(1) \quad TFCPC_{ijt} = f(GDPPC_{ijt}, DEP_{ijt}, \theta_{ij}, \lambda_t) + \varepsilon_{ijt}$$

where TFCPC is per capita total final energy consumption, GDPPC is per capita GDP, DEP

is a domestic energy price index,  $\theta_{ij}$  is a fixed effect  $\lambda_t$  is a time effect and  $\varepsilon_{ijt}$  is a normally distributed error term. We test for a number of non-linear specifications to best capture the shape of the underlying relationship, such as including a squared GDPPC term to allow for a non-monotonic relationship between energy consumption and GDP (Medlock and Soligo, 2001).

### **Main Results**

Figures 1 and 2 plot the estimated income elasticities of energy demand for non-OECD countries for three sectors (residential, industry and transportation) and five countries/regions (China, India, Emerging Asia, Latin America and North Africa & Middle East). The results show patterns of increasing energy intensity consistent with the energy ladder hypothesis.

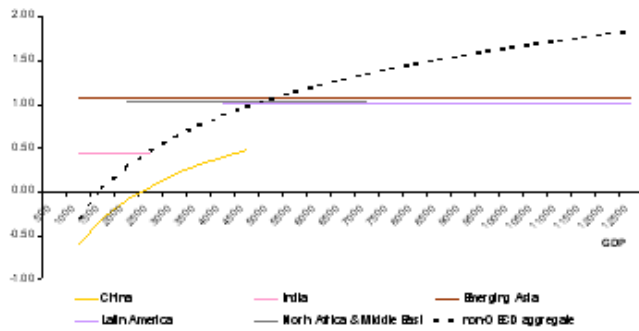


Figure 1: Income elasticity per sector for developing countries

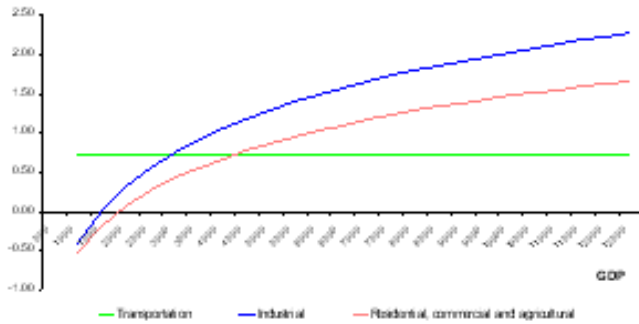


Figure 2: Income elasticity per region for developing countries

Detailed sector-by-sector and regional analysis points to a picture that is more complex than just an increasing energy intensity. In particular, we look at price elasticity, both in the short and in the long term. While prices play a significant role *ceteris paribus*, they are quickly overshadowed by the much larger income effect making them, *de facto*, not very influential in determining energy demand even in the long term.

### Conclusions

The analysis, overall, provides us with some understanding of how energy demand evolves as countries grow richer, and to what extent sector and country differences can lead to different outcomes. It provides for a comprehensive picture of how the developing world has fuelled its economic growth up to now, and offers some foresight on how it will manage the energy and economic growth challenge ahead.

### References

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 Medlock, Kenneth B. and Soligo, Ronald (2001). "Economic Development and End-Use Energy Demand." *The Energy Journal* 22(2), 77-105