

# **The causality between energy consumption and economic growth for China in a time-varying framework**

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The causal relationship between energy consumption and economic growth occupies a particularly important position in energy economics policy and research. This is so because our understanding of this issue will determine to a considerable degree how we will strike the delicate and challenging balance between the two oftentimes conflicting efforts – promoting economic growth and reducing energy consumption (and further, carbon emission). The issue is particularly important for China. As the largest developing country, China has recently become the largest energy user in the world while achieving its status as the second largest economy over a span of just three decades. In a context of global warming, the challenge to balance between economic growth and energy consumption is huge especially as China is still in a stage of industrialization and urbanization, and strives for decades of fast growth.

We seek to obtain further insight into the causality between energy consumption and economic growth for China from two differing but related perspectives. First, making use of recent advances in time series econometrics, we place the causality issue in a framework of time-varying structure, particularly a rolling-window approach, to examine how the causality has evolved over time. This is in contrast to the constant structure as commonly followed in literature so far. Second, proposing a conceptual model that features economic structure, we introduce a structural view to shed light on the structure of the causality issue. Specifically, we conduct the above extended analysis for the case of China over a sample from 1963 to 2010, a period featuring huge transformation of structure for the Chinese economy.

We find the following set of results. First, the time-varying framework we adopt leads us to reject the cointegration relationship widely found in some earlier studies, that is, energy consumption and economic growth are in a cointegrated system over long-run; the time-varying framework leads us to the finding that the causality between energy consumption and economic growth is two-way causal, but has been decreasing in strength over time; Second, over the sample period, the change of economic structure, mainly measured in degree of industrialization, has limited effect on the energy consumption. Given the *ceteris paribus* interpretation of this effect, the above result further leads to the limited effect of structure change on energy intensity when such an effect is compared to that of efficiency change. This result thus provides, for the first time, evidence for the relative importance of structure change and efficiency change on energy intensity at a very macro scale.

The above results carry implications for China in two basic dimensions. First, the lack of cointegration between energy consumption and economic growth is reassuring. It essentially means that it is possible for China's economic growth and energy consumption to deviate from each other in the long run, namely, sustained economic growth and reduced energy consumption at the same time. Second, the limited role of structure change means that China's continued transformation in economic structure will not present a huge obstacle towards energy consumption reduction; instead, fostering efficiency improvements within sectors is more important and should be the primary route. In a broader view, the framework adopted for the case of China may also be applied to other countries experiencing drastic change of structure in terms of economic growth and energy consumption.