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China's Technological Catch-up to a Green Future

Rock, Michael T.; Toman, Michael A. *China's Technological Catch-up Strategy: Industrial Development, Energy Efficiency and CO2 Emissions*, Oxford, New York: Oxford University Press, 2015. 296 pp. £37.49 (cloth), ISBN 978-0-19-938532-4.

The book by Rock and Toman is themed on the extensively discussed and debated issue of China's transition towards a low-carbon economy. The issue is of tremendous significance and meaning to both China and the world, as the country has become the single largest emitter of greenhouse gases since 2007, accounting for 29% of the world's total CO2 emissions in 2013 (Olivier, Janssens-Maenhout, Muntean and Peters, 2014, p.13).

The central argument of the book is that improved energy efficiency in Chinese industries is highly dependent on industrial policies and institutions that encourage enterprises to build technological capabilities. It is pointed out that enterprise investments in technological upgrading lead to successful technology transfer and the building of more robust technological capabilities.

To construct their analytical framework, the authors draw on literature from neo-classical and evolutionary theory and the study of technological change, and develop a mixed approach that embodies both models. The book adopts both a case study and an econometric approach. The authors begin with case studies demonstrating how technological learning happens within particular enterprises in the four industries of aluminum, cement, iron and steel, and paper, which are typically energy-intensive and account for nearly 60% of China's CO2 emissions from industry (Rock and Toman, 2015, p.3). They then employ econometric tests of the determinants of energy intensity on a sample of enterprises in these industries.

The regression analysis finds that successful industrial restructuring and enhanced technological capabilities lead to lower CO2 intensities in these industries. Therefore, the study proves the positive impact of technological learning and progress in terms of lowering energy intensity and improving energy efficiency — a proposition that seems self-evident, but should never be taken for granted. To further the causal link, the study attributes the building and improvement

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of firms' technological capabilities to China's industrial development strategy that aims at "grasping the large and letting go the small". The book's findings confirm that the course to technological upgrading is difficult and costly, ultimately depending on the existence of policy incentives that encourage firms to make investments in technological learning.

The authors mainly study the role of institutional and policy factors in bringing technological changes that contribute to a decline in energy intensity, while the impact of market factors is not explicitly accounted for in the book. Though the authors do identify the relative increase in energy prices as a major driver of the improvement of energy efficiency in their econometric analysis, market factors as such are not integrated into the analytical framework. For example, a firm's energy consumption pattern might be influenced not only by changes in energy prices, but also by factors such as information problems and liquidity constraints in capital markets.

Besides domestic institutional and market factors, the book does not make clear whether external factors such as international pressure for emissions cutting and bilateral and multi-lateral technological cooperation might also play a role in bringing down energy intensity. How do these external factors interplay with domestic factors to make an impact on China's energy consumption patterns? It would have been desirable for both domestic factors and external factors to have been integrated into the development of the book's theoretical framework.

In Chapter 8, the authors make a comparative study of the energy efficiency performances of the cement industries of China and Indonesia. They find that Chinese enterprises outperform their Indonesian counterparts due to their comparative advantage in technological upgrading. The selection of Indonesia as a comparative case is due to the fact that the two countries share certain similar characteristics in terms of development strategy.

The empirical dataset used for the econometric analysis in the book is a combination of three firm-level variables: economic financial variables, science and technology variables, and energy variables. The dataset dates from 1995 to 2004. Meanwhile, the authors touch upon new industrial policies and institutional reforms that have been initiated in the studied industries since 2004. It would also therefore have been desirable to incorporate new data beyond 2004 in the econometric modeling, in order to support the theoretical framework and make the argument coherent.

Overall, the content of the book is comprehensive, well structured and detail-oriented. The analytical framework is based on a substantial survey of existing literature and hypothesis testing is supported by rich and concrete empirical evidence. The book makes an academic contribution by empirically verifying the role of technological upgrading in improving energy efficiency in an institution-friendly policy environment. The findings will be particularly helpful to readers in the academic and policy fields to deepen their understandings of the institutional factors driving China's efforts towards improving energy efficiency. Despite the challenges ahead, based on the findings of this book we have reason to be optimistic about China's prospects of achieving low-carbon development.

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