BOOK REVIEWS

Energy Economics: Modelling and Empirical Analysis in China by Yi-Ming Wei, Ying Fan, Zhi-Yong Han, and Gang Wu (CRC Press Taylor & Francis Group, 2010) 313 pages. ISBN: 978-1-4398-1121-4 (Hardback).

Energy, similar to labour and capital, is universally acknowledged to be a fundamental production factor and strategic resource in the twenty-first century high-tech industrial society. Uncertainty and structural imbalances in energy supply can certainly exert an impact on both developed and developing nations' economic growth and social development. Countries with high energy consumption, such as China and the U.S. have implemented significant clean energy policy reforms over the past decades through institutional and management innovation. The introduction and proliferation of advanced technology in this policy reform aim to ensure energy efficiency improvement as well as maintain energy consumption growth, especially at the lowest income levels.

Asian economies, especially China, have experienced substantial economic growth over the last two decades as a result of rapid urbanization. This significant economic development has resulted in these nations relying heavily on energy or oil imports to sustain their economy. Highly volatile energy and fuel prices in recent years have also raised concerns about the cost of energy consumption in the Asian region. China, in particular, has now gained awareness of the national energy security issue and the need to ensure that national energy efficiency is increased at the lowest cost.

Such hot issues regarding China's current energy strategies that need to be addressed immediately are the main focus of this book. It analyses the scenarios of different policies for Chinese energy policy makers. Six key issues are addressed in this volume. Firstly, it considers the gross and structural features of China's energy economy since the opening-up economic reforms in 1978. The sustainability of China's energy economy has attracted broad attention since then. Secondly, the book investigates the forecasting of China's energy supply and demand. Such forecasts are essential knowledge for driving Chinese energy strategy and policy. Scientific analysis and accurate forecasting of energy supply and demand are crucial, because China's energy strategy and policy formulation methods have fundamentally changed. Energy demand and supply are no longer exclusively controlled by the state planning industry, since the energy industry is undergoing the transformation from a centrally planned to a market system. Thirdly, fluctuations in the international oil market and China's countermeasures are discussed. Implementing a much better oil price mechanism in China can prevent market risks and ensure better oil price security. With the significant growth of the Chinese economy, its dependence on oil imports from the international market has increased dramatically. The transformation of this market system has induced Chinese leaders to investigate the future trend in oil prices and develop a petroleum strategy that can benefit their country. Fourthly, the book considers the policy to tackle key energy and environmental problems including the immediate challenge of reducing CO_2 intensity and emissions. Fifthly, the book discusses the implementation of strategic petroleum reserves and national energy security. China has launched its strategic petroleum reserve (SPR), but such a reserve takes some time to become adequate. To minimize the threats that China's energy security faces today, it is imperative to conduct a comprehensive and systematic analysis for Chinese policy makers to safeguard their energy security. Sixthly, the book considers technological progress to ensure that economic, energy, and environmental activities are all sustainable. Having an adequate and comprehensive understanding of energy technological changes including the changing impetus, speed, and direction of innovation, can certainly improve China's ability to choose energy technology to sustain growth while improving and protecting the environment.

This book is the first in the series China Energy Reports. This volume discusses not only the policies for specific issues to be addressed in the current Chinese energy economic climate but also econometric models and methodologies, data sources and pre-treatment, empirical outcomes, as well as opportunities for further study. Nevertheless, one of the important features of this book is a collection of the research outcomes concerning energy strategy and policy issues investigated by the Centre for Energy and Environment Policy Research (CEEP), Institute of Policy and Management (IPM), and the Chinese Academy of Sciences (CAS).

This publication comprises eight chapters. Chapter One reviews the energy development in China. Energy is one of the essential resources for driving economic growth and supporting human survival and social progress. China is the largest developing nation in the world and the second-largest energy producer and consumer. Topics relating to energy strategy and policy are prominent issues on China's governmental agenda and have now become a developmental bottleneck as a result of the country's rapid industrialization. These issues have already drawn significant attention from different areas, both at home and abroad. This chapter provides a basic introduction to the international background, history, and circumstances around China's energy production and consumption *vis-à-vis* the trend of world energy development. The chapter also addresses some questions concerning how these problems can be resolved to enable China to make significant progress with its energy and resource industries, in terms of both quantitative and qualitative indices.

Chapter Two presents the structural relationship between China's energy and its economic growth. This chapter introduces the relationship between China's economy and its energy consumption, which has become a focus of international studies since its economy started to reform and implemented its opening-up policy in the late 1970s. Even though its economy has achieved continual and rapid growth, China's energy consumption has maintained a low momentum of growth. The coexistence of the fast-growing Chinese economy and the slow increase in energy consumption has thus attracted extensive attention.

Numerous factors can shape the future economy of China, and many fundamental questions need to be addressed properly, regarding, for instance, whether the reduction in China's energy intensity will continue, how the annual growth target of 7 percent will affect China's energy demand, and whether the energy consumption controls will have an impact on China's economic growth target. The study of these topics can open another window of opportunity for the Chinese government to reconsider its energy strategy and policy.

Focusing on these fundamental issues, Chapter Two provides empirical results in three paradigms. In the first section, the cointegration and causality in the study of China's energy economy are introduced and the relationship between the economy and the energy consumption during the period of 1970–2003 is discussed. The outcome of this section shows that there was no cointegration relationship between economic growth and energy consumption in China during this period.

In the second section, a study of the impact of the economic structure's change on energy intensity is conducted. The authors apply a structural decomposition analysis (SDA) model to decompose the change of energy intensity into an efficiency share and a structural share using data from 1980–2000. Their study provides clear evidence that China should focus primarily on the high-tech industry using the benefit of technological advancement. Using advanced technology, the economy can keep pace with its development using lower energy intensity and reducing its massive energy consumption.

In the third section, the study develops a model to analyse the impact of energy structure and energy efficiency using the data from 1978 to 2003. The conclusion of this study shows that it is mandatory for China to design an energy strategy and policy to shift the production and consumption of petroleum and electricity. By implementing this policy, it will encourage industries to reduce their usage of coal.

The economy of China's socialist market has taken shape and is undergoing significant development. This transformation process from a planned economy to a market economy has in-

duced fundamental changes in how energy strategy and policy are imposed. The change is towards the market system to sustain the demand and supply of energy, which was fully controlled by Chinese state planning. Chapter Three uses scientific and accurate analysis to forecast the energy supply and demand in China. Applying an input–output method, this study investigates a scenario analysis of China's future energy demand and consumption at both the national and the regional level for the years 2010 and 2020 based on the level of gross domestic product (GDP) in that period. The sensitivity analysis in this study shows that technology improvements in each region could generate "apparent" intraregional energy-saving effects. To alleviate the pressure caused by high economic growth on energy and the environment, the energy end-use efficiency in all regions should actively be improved.

Rapid urbanization and industrialization in China have resulted in the current Chinese domestic oil production being unable to cope with the demand; thus, imports are increasing dramatically. The heavy reliance on imports has threatened not only the domestic fuel market but also Chinese national energy security. Chapter Four describes the resulting fluctuation of the oil market in China and the world based on six paradigms. First are the characteristics of international oil price fluctuations, which are useful for exploring the formation mechanism of oil prices based on the change in rules over the past periods. Historical oil price fluctuation is also considered to forecast the oil price trend at the present and in the future and provide important information for the design of a future oil strategy. Second is the strategy for interaction between the international and the domestic oil price by enlarging oil production, widening oil import methods, and adopting an international co-operation strategy. Third are the price relationships between crude oil and Chinese oil products investigated through price correlation analysis. This study offers valuable information for predicting and managing price risks for domestic oil companies and oil-pricing reforms through a better understanding of these relationships. Fourth is the impact of international oil price changes on the Chinese economy using a computable general equilibrium (CGE) model to simulate different scenarios, such differing oil price increases and their impact on China's macro-economy (e.g., GDP, gross investment, consumption, imports, and exports). At the same time, this section analyzes soil risks and uncertainties by consider technology advances in crude oil extraction and refinement along with changing shares for various transport fuels. Fifth is the forecast of the international oil price, its trend is crucial information for policy makers to design strategies. However, its forecast is fraught with difficulty as a result of numerous complicating factors including the world economy, disasters, climate, government policy, military actions, OPEC policies, oil and product stocks, and speculation.

Sixth is the study of the Chinese oil price mechanism. In China, there are still some problems with the oil-pricing mechanism and domestic oil prices. This oil price mechanism is determined at present by the international oil market, which cannot completely reflect the value of products or allocate resources rationally. To minimize oil price risk, the Chinese government has to reform and guide the oil-pricing mechanism and the oil market to make the system more rational and complete. Finally, policy recommendations are given based on these studies at the end of each section in the chapter.

The Kyoto Protocol was agreed on 16 February 2005. This policy alerted China's government to CO_2 emissions mitigation and its commitment in future agreements to reducing greenhouse gases. Chapter Five analyzes the relationship between global climate change and CO_2 emissions reduction, economic development and CO_2 emissions, and the current level of China's CO_2 emissions. The chapter studies the change in China's carbon intensity. It argues that in such circumstances, if the government does not rationally harmonize the relationships among all kinds of consumption behaviours, such as home energy use, food, education, culture, and recreation services, then it could make the future energy supply more insecure. Therefore, sustainable and environmentally friendly consumption behaviour should be encouraged.

The increasing industrialization in China caused its fuel import dependency to rise by more than 40 percent in 2004. China depends mainly on oil imported from the unstable Middle East

region. Any destruction in world oil production, such as international geopolitical conflicts, or failure of the market to keep up with burgeoning consumption growth can certainly disrupt the oil supply or raise oil prices to China and make its economy vulnerable. Chapter Six defines energy security, presents its contemporary status, and analyzes China's potential energy security in light of its energy resource reserves and demand. One of the primary issues in this chapter is China's establishment of a national strategic petroleum reserve (SPR). Its purpose is to help deal with any petroleum crisis thereby ensuring energy and economic security as the Chinese Government seeks to minimize the economic and social damage resulting from any oil shortage. The chapter also applies an optimization model based on the decision tree method to quantifying the optimal SPR level to meet China's economic development in 2005, 2010, and 2020. The outcome of this study shows that an international oil price has a direct impact on the SPR level.

In this chapter, a few policy recommendations are made, which are extremely useful for Chinese policy makers to minimize oil import risk. The authors recommend that China should implement energy diplomacy policies to gain advantageous positions in new energy producing regions; strengthen oil import risk management through the market and diplomatic means; accelerate the pace of the national strategic petroleum reserve system to prevent its citizens from experiencing psychological panic from an oil crisis; encourage the development and application of energy conservation technologies; make full use of renewable energy; and protect the maritime transport of oil, gas and other energy resources.

In the development of economic, energy, and environmental systems, energy technology plays a critical role. Chapter Seven documents issues relating the world's energy technology system to China's energy policy. In the history of a specific industry, different factors that drive technological progress can vary over time. Applying the concepts of paradigm-based theory, this chapter identifies three paradigms in energy technological change. These are Phase I (before 1859) or so-called natural transitions, Phase II (1859–1992) or so-called hydrocarbon lock-in and induced innovation, and Phase III (1992–?), moving toward clean energy and a sustainable 3E system. Identifying these different energy development stages and the main determinants of energy technological change certainly helps in optimizing the energy structure, assuring energy supply, and providing more technology options to fight global climate change.

Chapter Eight presents China's future energy outlook. The chapter suggests guidelines to help China achieve sustainable energy development, guarantee energy demand for building a harmonious society, and ensure its energy safety. Facing the fierce competition of the world market, China should implement energy strategies and policies that focus on international cooperation, diversification, and sustainability.

From a general viewpoint, the book is easy to read and understand, using plain and simple language. It covers the current energy and economic development in China in great detail. Importantly, the volume addresses key energy issues in China, including the current trend of energy demand, future energy supply for Chinese society, challenges to Chinese energy policy makers in today's environment, as well as energy policy implications and recommendations for Chinese policy makers. Such recommendations include the oil price mechanism, energy research and development, characteristics of the carbon emission trend, and so on. In addition, the book includes a broad range of analyses and a systematic approach. I believe its empirical analyses using a variety of models, certainly helps to increase the understanding of and shape the views on how China can meet its energy challenges. These promising tools can also be applied in future research, particularly for researchers who are interested in studying public policies in China as well as countries in the Asia-Pacific region.

I strongly recommend this book for early-career researchers who are interested in energy economics in the Asian region. This book offers invaluable information relating to modeling, data processing, and theories for future researchers to undertake new studies in the region. In addition,

this book could provide useful supplementary material for a course in energy economics and energy policies in China.

Nam Y. Foo
Curtin University
Perth, Western Australia

* * *

Carbon Finance: How Carbon and Stock Markets are Affected by Energy Prices and Emissions Regulations by SVETLANA VITEVA and YULIA VELD-MERKOULOVA (Springer International Publishing, Switzerland, 2016). 134 pages. Hardcover. ISBN 978-3-319-25412-8.

This volume offers an excellent presentation of economic and financial attributes of carbon markets. Content development is organized into five chapters sharing a common theme on the impact of energy prices and emissions regulations on carbon securities and stock markets. The carbon price dynamics of the most developed carbon trading scheme worldwide, the European Union Emissions Trading Scheme (EU ETS), informational efficiency, joint effects of structural and institutional elements of carbon market pricing, as well as oil-to-gas price spreads and volatility of the traded carbon securities are analysed both from firm- and market-level perspectives.

Chapter 1, *Introduction* describes the concept of emissions trading as an instrument for controlling carbon pollution worldwide. It begins with an overview of the EU ETS, including market value, coverage and trading volumes, as well as informational efficiency of the market in its completeness, and the ability of market participants to accurately respond to new information about the institutional framework of the EU ETS. It then moves to examine the relationship between carbon emissions and financial performance of publicly traded German and British companies to ascertain whether investors respond to new information accurately. Also discussed is the practical significance of carbon performance of companies on market valuations. This chapter also details historical account of a variety of carbon markets and highlights their most important findings and contributions.

Chapter 2, *How Does Carbon Market Work* provides theoretical and institutional background for carbon markets. A strand of analyses deals with regulatory (the so-called "command-and-control" approach) and market-driven mechanisms for reducing carbon emissions. A market-driven mechanism, such as the EU ETS, is the most preferred approach as the overall burden of curbing total emissions gets redistributed to ensure that the largest share of emissions reduction is borne by firms that have the lowest marginal costs of reducing emissions. A carbon tax (used, for example, by a number of European countries, Japan and British Columbia) and emissions trading (most notably, employed by the EU, California and China) are the two common forms of emissions control adopted worldwide. They center on providing an economic incentive for companies to reduce their greenhouse emissions. The impacts of total amount of allocated permits, the impact of National Allocation Plan (NAP) announcements on carbon returns, monitoring and verification of events on carbon returns, as well as volatility of carbon prices are illustrated across different carbon markets in relation to efficiency provisions and reaction to regulatory announcements.

Chapter 3, *Do Regulations Affect Carbon Market Returns and Volatility?* provides the reader with empirical evidence on the ability of investors to accurately price new information based on different rules on inter-temporal banking and borrowing for carbon prices. Here the treatment is somewhat less intensive than in the other parts of the book, the goal being to provide a quick introduction to the main topics in the area. These comprise the relationship between the carbon price and its market fundamentals—the institutional framework, energy variables and extreme

weather—and the impact of institutional and regulatory announcements on the carbon price dynamics. This chapter introduces two alternative model specifications (univariate time-series analysis and a multifactor model) of the carbon price to account for new information about the institutional construct of the EU ETS. The authors present a variety of inter-temporal borrowing and banking of allowances and affirm that the EU ETS institutional design and disclosure have no impact on the variability of carbon returns. Dealing with the 2007/2008 financial crisis and its impact on the carbon price dynamics, the authors detail investors' response as new market-sensitive information in carbon prices becomes available—announcements related to post-2012 emissions reduction targets, expanding scope of ETS, and changes to auctioning rules. Not all announcements (e.g. the linkage announcements of the EC-run Community Independent Transaction Log (CITL) and the UNFCCC International Transaction Log (ITL) as well as news about availability of certified emissions reduction credits (CERs) for EU ETS compliance), however, lead to significant carbon price impact and the market is sometimes largely unaffected by the various regulatory announcements.

Chapter 4, *Does CO_2 Emissions Performance Matter for Stock Prices?* suggests that despite the rapid growth of the EU ETS market and the growing significance of environmental performance, there is no correlation between the financial performance of the market and the covered companies. The authors explain that the performance of carbon prices has significant implications for valuation and future cash flows of the traded-covered companies. However, applying empirical evidence to fill in the literature gap on the effectiveness of the EU ETS scheme as a mechanism for facilitating the move to a low-carbon economy, the chapter finds that at present, the signal embedded in carbon prices does not stimulate investor action and incentivise companies to transition to low-carbon operations. As such, the authors argue that the EU carbon-trading scheme is not yet fully informationally efficient. For example, the chapter models the market response of German and British ETS-covered companies over the period 2006– 2011 as a function of carbon, efficiency, electricity, market portfolio, and the foreign exchange rate. Some of the sample companies include RWE, E.ON, Bayer, Henkel, Siemens, National Grid (UK), AstraZeneca, BAE Systems, BMW, Barclays, BHP Billiton, GlaxoSmithKline, Tullow Oil, United Utilities, Rolls-Royce, Severn Trent, Carillion, Royal Dutch Shell, etc. The authors conclude that firm-specific carbon performance is not relevant to investors (i.e. no statistically significant market response).

Finally, Chapter 5, *Conclusions, Limitations and Future Research*, reviews major findings in the other sections of the book on the efficiency of the European carbon markets. The authors identify several limitations in the analysis and outline room for further improvement, namely: (i) using more sophisticated and distributed lag econometric models of the return-generating process as opposed to ordinary least square analysis to better capture the effects of past carbon behaviour and energy prices, (ii) applying co-integrated vector error-correction models by combining a structural vector autoregressive approach with cointegration to model the relationships between gas, electricity and carbon prices, (iii) re-examining the relevance of carbon performance for firm valuation with post-2012 data, (iv) supplementing the study of the ETS-covered companies over the period 2006–2011 with qualitative study, including surveys or interviews, (v) undertaking comprehensive research across the EU countries to establish if a different impact of carbon performance exists beyond the British and German markets, as well as extend the scope of the companies analysed to cover both publically traded and privately held enterprises.

The lesson of *Carbon Finance* is clear: Emissions trading schemes are deeply ingrained in the broader structural and institutional set-up that constitutes the global climate policy architecture (the Paris Agreement) and the current climate polity. Efficiency of carbon markets will continue to be an important foundational dialectric between contestation and political reconstitution, a challenge to economic, environmental, and financial performance. It not only impacts emissions trading of individual firms, but needs to be evaluated periodically to assess its impact and relevance to both publicly traded and private companies. The authors' true gift for thoughtful and lively discussions of the impact of emissions regulations and energy prices on carbon and stock markets is a timely

and important contribution. *Carbon Finance* can be read linearly, chapter by chapter, or it can be used by environmental economists, policymakers, clean development mechanism (CDM) investors, environmental finance professionals, consultants, and research students as a reference in the economics of carbon markets and a teaching resource to gain valuable insights into how to manage carbon markets as well as how to assess their challenges and efficiency.

Joseph Nyangon
Center for Energy and Environmental Policy, University of Delaware