

## BOOK REVIEWS

*The Economics of Electricity Markets*, by DARRYL R. BIGGAR and MOHAMMAD REZA HESAMZADEH. (IEEE Press. Wiley, 2014) 409 pages, hardcover, ISBN: 978-1-118-77575-2

Darryl Biggar and Mohammad Hesamzadeh have written a clear and insightful textbook for students interested in learning the economic theory of electricity markets. Their presentation follows the standard path, which starts with unconstrained, short-run economic dispatch problems and continues with long-run capacity expansion problems using constrained optimization. After presenting the fundamental theory with concrete examples, the authors delve into three additional topics: risk management, market power, and contemporary issues. The emphasis is on understanding the fundamentals with simple (not simplistic) models using a consistent economic approach, which recognizes that actual electricity markets depart from the theoretically ideal model. The book also refers to existing electricity markets, primarily the National Electricity Market of Australia.

Two contemporary issues that the authors examine are regional or zonal pricing and pricing on distribution networks. As the authors explain, zonal pricing has theoretical and practical problems that are well known; nevertheless, it is still used in many places like Australia and Europe. On this topic, their discussion would benefit from additional analysis of U.S. organized wholesale electricity markets (i.e., RTOs/ISOs) because California, New England, PJM, and Texas all experimented with zonal pricing and transitioned to locational marginal prices (LMPs). Although beyond the scope of the text, understanding why some regions persist on using zonal systems, while other electricity markets move away from it is an important illustration of the non-economic considerations that occur in market design.

In their discussion of smart grid and distribution networks, the authors offer a proposal to extend LMPs to the distribution level. They note the theoretical possibility of this process and identify some practical issues emphasizing the benefits of smart grid devices that facilitate such efforts. One of the practical problems, which leads to some theoretical challenges regarding distributed optimization, is the complexity of dispatch that arises from the scale of optimizing the generation and consumption decisions of millions potential retail customers as opposed to hundreds of wholesale market participants. The authors outline how decentralization of dispatch can work using a hierarchical structure, at least in principle.

As with any book on the breadth and depth of electricity markets, there will be topics that deserve more coverage. This text discusses market power in three chapters and includes a guide on how to detect it in practice. The focus, which is common among many such discussions, is on generators in the energy market. There are at least two other areas of market power that deserve additional attention. Recently in the U.S., there has been a major debate regarding whether states are attempting to exercise monopsony power through the subsidy of new generation if these generators submit offers that are below costs in wholesale capacity markets. Another important market power topic is the issue of the ability to exercise market power across markets, such as between the market for financial transmission rights (FTRs) and energy markets.

The authors conclude that the jury is still out whether day-ahead markets are needed. Unfortunately, their discussion is truncated and does not consider the following line of reasoning. If the system operator conducts day-ahead unit commitment, which is done both for reliability and efficiency, then both day-ahead and real-time markets are needed. The text does acknowledge that without a day-ahead market (but with day-ahead unit commitment), there is an opening for generators to exercise market power by not committing all of their units that the system operator requested day-ahead and then selling fewer megawatt-hours in real-time at the price set by high-cost peaking units. The incentive to exercise market power via this (but not other) mechanism evaporates with a day-ahead market because now the generator is a buyer and not a seller in real-time. There is, however, more to consider. Without a day-ahead market and a financially binding

commitment, the system operator does not have to pay for start-up costs, making it tempting to over commit day-ahead for reliability reasons without having to recover associated start-up payments from other market participants.

Finally, the book does not discuss climate change and how different possible policy interventions, such as carbon tax, cap-and-trade system, or requirements for renewable resources, interact. In fact, the push for smart grid, distributed generation, and responsive retail electricity customers is being made partly due to concerns with climate change. Readers should not, however, be too concerned with the limited coverage in some areas. For these topics, the text provides the “first-best” economic and associated engineering foundation along with the necessary mathematical fundamentals that interested readers can employ to tackle the more advanced and “second-best” topics that challenge the industry and make this area of energy economics so fascinating to analysts and important to society.

*Frank A. Felder*

*Center for Energy, Economic and Environmental Policy  
Bloustein School of Planning and Public Policy, Rutgers University*

\* \* \*

***The Price of Oil***, by ROBERTO F. AGUILERA and MARIAN RADETZKI. (Cambridge University Press, 2015) 252 pages. ISBN: 978-1-107-11001-4 Hardback, ISBN: 978-1-107-52562-7 Paperback.

This entertaining book presents a view somewhat contrary to what many hold on world markets. Aguilera and Radetzki see oil prices as not necessarily recovering from the current slump and then moving ever higher and higher as increasing demand and depleting reserves meet in the market. Rather in the race between resource depletion and technology, they put their odds in favor of technology in the coming decades. With increasing oil production only recently recoverable from shale and the same technology applied to tired old conventional oil, they see oil production as up to 2 to 3 times higher at about half the price of other conventional forecasters such as IEA and EIA by 2035. With this more plentiful oil supply, they expect oil prices would remain in the double digit range and could settle at \$60 per barrel for decades to come.

The book is divided into three parts: the first looks at the history of oil prices from the 1970s with a discussion of the forces that shaped those prices, the second, and my favorite, considers the technology revolution in producing oil, and gas, from shale, and the third considers the implications of a lower priced oil future on the global macro economy, the environment, and global politics.

Part I of the book, chapters 2–6, focuses on the historical price of oil from 1970 and explores why oil prices increased in real terms by over 8 times from 1970 to 2014, while metal and mineral prices have less than doubled. Besides tracing this evolution in chapter 2, they discard speculation as a cause and downplay demand, arguing that supply has been a stronger causal factor. After reviewing literature on cartels and OPEC’s pricing activity and production, in chapter 3, they are less than satisfied with conventional arguments on cartel pricing being the primary cause of the price increases. Nor do resource scarcity, depletion, or cost increases cut the muster as a reason in chapter 4. Rather they largely attribute price increases to crippling fiscal demands on companies and inefficient state ownership that increasingly have come to dominate in world oil markets depressing capacity expansion (chapter 5) and to resource curse issues (chapter 6). Both of these issues support their contention that the price increases are heavily influenced by the supply side failure to provide enough capacity. What I found most intriguing in this part of the book were the comparisons with other mineral and metal markets for the insights they could impart to the oil industry.

Part II of the book, chapter 7–12, focuses on the recent technological changes that have made it possible to extract oil and gas from shale rock. This rock is too tight to allow oil and gas to flow through it to the well bore unlike conventional oil and gas typically found in carbonate and

sandstone. However, horizontal drilling and hydraulic fracturing (together referred to as fracking) have allowed stunning increases in U.S. oil production since 2010 as chronicled in chapter 7. The authors include, as well, some discussion of the effect of this boom on the U.S. economy, employment, tax revenues and what effects relaxing the U.S. crude oil export ban would have.

Chapter 7 looks at the past, while chapter 8 extrapolates to the future. The authors argue the conventional forecasts such as EIA are too pessimistic. They note impressive productivity gains in the technology already made that might keep many of these resources profitable at \$40/barrel and expect ingenuity and low prices might squeeze out even more improvements. Further, they question whether the current reserve estimates for oil in shale might not be too pessimistic as reserve additions (still to come for shale oil) have traditionally far outweighed initial reserve estimates.

Chapter 9 gives a nice geology lesson to convince us that the same technology can be applied to conventional oil reserves with equally stunning results. Although the authors are bullish on the shale revolution, they do acknowledge things that could thwart or even shut down this activity. For example, in chapter 10, they discuss environmental issues (e.g. water pollution, fugitive methane emissions, earthquakes, etc.) some of which have gotten much press and likely contributed to fracking bans in some places. However, they are optimistic that proper procedure, regulation, and more maturity in the industry will be able to cope with these issues.

To date the shale revolution has been largely a U.S. phenomenon. In chapter 11, the authors ask, “Will it spread?” They believe it is quite likely and only a matter of time before the revolution spreads not only to shale but conventional resources worldwide. They believe the technology spreading will be slower than in the U.S. and discuss the most likely candidates to join the revolution with a low, medium and high forecast of oil production in 2035. They follow in chapter 12, with a discussion of the implications of their three production scenarios on the price of oil and the effects on other energy markets

In Part III of the book, chapters 13–15, the authors consider broader implications of lower oil prices and more diversification of oil supplies. In chapter 13, the author’s do not find the literature on oil price shocks and the economy useful for their purposes as such analyses look at price increases, not price decreases, and only consider the short not long run implications. The authors concede that it is not possible to quantify the effects of their predicted low price trajectory on the broader world economy but generally discuss the effects including those on exporting countries.

In chapter 14, the authors acknowledge stringent climate policy could shut down the shale revolution or even the whole oil industry. However, they do not see that as likely given consistency of government forecasts of continued fossil use and the impotency of much of the policy to date. They, however, give no acknowledgement to the consequences of what an absence of such policy might do to the climate, the global economy and, consequently, to oil markets.

In chapter 15, the authors speculate on what oil prices in the \$60 range, plentiful oil production, and increased diversity of supplies would have on global politics. Market power for suppliers might diminish, fights over oil rents might decrease, importing countries feeling less insecure may be less inclined to military intervention, among other things.

I found this book to be well argued, thought provoking, and fun to read. The authors have presented both statistical data and literature studies to support their case while acknowledging alternative points of view that they think less likely. Those with professional interest in energy markets as well as the general public interested in energy issues are likely to enjoy this book. Those with deep concerns about climate may not find the optimism in the book so optimistic. Ruminations of uneconomic quality reserves in China and Poland before the price drop of 2014 point out the uncertainty of how big and often are the hotspots. Only time will tell whether these author’s unconventional price and production trajectories come to pass.

*Carol A. Dahl*  
*Colorado School of Mines*

\* \* \*

***The Global Coal Market: Supplying the Major Fuel for Emerging Economies*** by MARK C. THURBER and RICHARD K. MORSE. (Cambridge University Press, 2015), 702 pages, ISBN: 978-1-107-09242-6.

Although coal is considered to be a “dirty” fuel, it is still widely consumed in many emerging countries, such as China and India. Since their huge demand for coal can’t be satisfied totally in their domestic markets, the balance is made up by imports from other coal rich countries, such as Australia and Indonesia. This makes international coal trade around the Asia-Pacific area the main arena for global coal trade. This huge international coal trade triggers some important and interesting issues, including what drives this fast growth and how to describe and forecast it? Does it weaken endeavors to mitigate climate change, and if so, how can we harmonize the voracious need for energy with climate target goals?

For these reasons, I appreciated this book edited by Mark C. Thurber and Richard K. Morse. After a brief introduction by the editors, in part II of the book they select six papers on China, India, South Africa, Australia and Indonesia as the key importing or exporting countries to carry on detailed case studies. Wuyuan Peng considers the evolution of China’s coal institutions; Huaichuan Rui, Richard K. Morse and Gang He look at the development of large coal-power bases in China; Jeremy Carl focuses on India’s coal production shortfall; Anton Eberhard analyzes challenges for South African coal; Bart Lucarelli does the same for Australia’s black coal industry; Bart Lucarelli does an additional paper on the Indonesian government’s role in its evolution as a steam coal supplier to Asia.

By tracking the evolution of coal industries in each country, the authors interpret how the reserves, geography, geology, infrastructure, climate change, government regulation, the economy, technology and politics act together to influence the development of the coal industry. As a coal industry researcher, I focus on market demand, market supply, government regulation, climate change and available technologies and found these issues carefully analyzed as discussed below.

*Demand.* The economic expansion of Korea and Taiwan from 1980 to 1995 helped create strong export markets for Australia’s black coal. Starting in 2009, strong demand by China and India strongly impacted the coal market. China’s imports of steam coal from all other countries increased by almost 300% between 2008 and 2009, and then continued to increase over the next four years. But the authors pointed out that this dramatic growth is due to the high price of China’s domestic coal, and, thus, China imports lots of cheaper coal from Australia or Indonesia. Once this price difference disappears, demand will again turn to rely on domestic coal since imports are not economically attractive any more. Contrary to China’s arbitrage incentive, the driving force of India’s import behavior is a structural shortage of coal. Though it has abundant coal resources, land rights and forest protection limit its development. In 2015, India expected its coal production would expand to 1.5 billion tons by 2020. This would make it the second biggest coal producing country and help meet its fast-growth for coal demand. Behind this target is its ambitious strategy to replace China as the fastest development entity in the world.

*Supply.* Since the 1950s, Australia has been the most important coal supplier for the Asia-Pacific market, and even monopolized this market for a long time. However, since 1995, Indonesia with an obvious cost advantage due to its favorable market location and the low stripping ratios of its deposits, emerged as a competitive opponent for Australia coal exports. Indonesian coal suppliers sold their coals to power plants located in China, Japan and India at a significant discount to the delivered prices charged by Australian producers, which help them to increase their Asian steam coal market share over time. But things will change much and quickly in the near future. Now, Indonesia is making a major shift in coal quality from medium rank sub-bituminous coals to very low calorific value (CV), high moisture coals. This switch will decrease Indonesia’s coal attraction since more and more importing countries are refusing to use low-quality coal to protect their environment. On the other hand, excessive coal production capacity has already emerged in China,

which will increase China's desire to export coal to other Asian countries like Japan and South Korea. Such exports mean China will become a powerful participant in the Asia-Pacific export coal market rewriting the map of the global coal market.

*Government regulation.* Government is like a shadow of coal industry and appears everywhere during its development. The governments of China and India deployed regulatory workarounds—including the establishment of “hybrid markets” with both controlled price and market price elements. Such changes were aimed at bypassing bottlenecks associated with state ownership of coal mines and rail networks. In South Africa, there is need for government to carefully coordinate planning and investment between privately-owned mines and state-owned infrastructure. The state governments of New South Wales and Queensland in Australia play a key role in the prosperity of Australia's coal industry. They did a good job of initially supporting the cost-effective and timely development of new mines and associated infrastructure. Since the 1980s, they decreased their direct involvement turning their attention to public affairs such as occupational health and mine safety. Indonesia's recent policy, i.e., the new mining law and associated fourteen implementing regulations issued in 2009 and 2013, bodes less well. It is leading its coal industry to an era of heightened regulatory and political risk, which will threaten foreign investment and may have a negative impact for a long time.

*Infrastructure constraints.* As the nexus where supplier-demander interfaces occur, infrastructure conditions affect the global coal market seriously. In South Africa, inadequate rail capacity is a serious obstacle for increasing coal exports. Although it has the world's largest port terminal. Indonesia has a more flexible inland transportation system based on easily expandable components like river barges, trucks and floating transshipment facilities, which help to keep transport cost lower and take more market share from Australian coal suppliers, who are faced with chronic rail and port infrastructure constraints. Since the rail network was privatized in Australia, volatile price movements have at times led to “stop-and-go” decisions on proceeding with transport infrastructure projects which will in turn damage Australia's coal competitiveness in the future. Generally speaking, rail and port capacity shortages have constrained these countries' domestic coal supply ability and export competitiveness. Such constraints generally describe the state of infrastructure conditions in the Asia-Pacific area nowadays and call for more investment in this field. Maybe, it is part of the explanation for China welcoming the proposal of AIIB (Asian Infrastructure Investment Bank).

Part III looks at International Coal Trade: Mark C. Thurber specifically examines transportation constraints for U.S. coal exports into Asia. Richard K. Morse and Gang He analyze arbitrage in China's coal importing behavior. In this part, I was especially interested in the last paper presenting the COALMOD-World model by Franziska Holz, Clemens Haftendorn, Roman Mendelevitch and Christian Von Hirschhausen; It was built to analyze the future evolution of the international steam coal market until 2030. It takes international trade flows and domestically produced and consumed coal in large countries as the two main pillars. The authors find that a relatively small amount of international traded coal has a major impact on the domestic markets and, therefore, plays a central role in the analysis. Under the hypothesis of profit-maximization, this model can simulate yearly market outcomes, trade flows, and price for the years 2010, 2015, 2020, 2025 and 2030 as well as investments in the coal sector value chain. Considering climate influence, they set “current policies” and “new [energy and climate] policies” scenarios and the results show annual energy related CO<sub>2</sub> emissions increase by 36% in the Current Policies scenario between 2010 and 2030 and by 20% in the New Policies scenario. All these modelling ideas and results shed some light on my current academic work—building a model of the China Coal Market System (CCMS). This spatial equilibrium model for China's domestic market model contains 30 provinces and import origins as nodes and yields shadow prices while optimizing demand satisfaction and investment in place.

*Climate change.* It will be the most uncertain factor to influence the global coal market in the future. As the only developed country among the major coal producers, Australia needs to keep

the balance of coal's contribution to the economy and its contribution to climate change. Since the carbon pricing mechanism (CPM), which was passed in 2012, created the greatest level of investment uncertainty, it was subsequently rescinded in July 2014. The intense debate on climate-related policy in Australia provides us a vivid story to illustrate how difficult the effect to mitigate environmental issues when people face the temptation of self-interest. Such things are also going on in developing countries. For China, India, and South Africa, though each takes climate change concerns seriously, their decision-making still prioritizes electricity sufficiency and development of the country. The good news is that President Xi has already committed to implement a CO<sub>2</sub> cap-and-trade scheme in 2017 that will be earlier than in America. It should result in a significant reduction in China's coal imports for the foreseeable future. So it can be imagined that if the governments of East Asia were also to implement aggressive GHG emission reduction programs, the impact on Asia-Pacific coal trade would be devastating.

Part IV focuses on how new technology can contribute to reconciling expanded coal use with protection of the climate. Bart Lucarelli discusses such new technologies in Australia. Richard K. Morse, Varun Rai and Gang He review drivers for carbon capture and storage in China.

*Technology.* New technologies to consider include coal bed methane (CBM) extraction, under-ground coal gasification (UCG), and CO<sub>2</sub> capture and storage (CCS). These technologies are at different stages of development and face different cost structures, economic drivers, and regulatory regimes. CBM extraction technology is relatively mature but scale effects are very important for its growth; UCG has significant commercial potential but remains as yet an unfulfilled promise. Advanced CCS technologies remain quite immature, but even proven technologies, such as MEA solvent extraction, face cost challenges scaling up to handle the huge volumes of CO<sub>2</sub>. Meanwhile, the authors don't think that cost reductions and improvements to the CCS system will benefit the coal industry. Conversely, the demand for solid, high-carbon fuel will decline or stagnate while demand for liquid and gaseous fuel will grow fast under this scenario. In short, many of the technology options being explored today will struggle to achieve commercial deployment even by 2030.

The editors conclude in part V with additional information on the coal value chain in China in part VI. Kevin Jianjun Tu provides more statistics on China in the Appendix and the book has an index.

Besides presenting considerable data including coal reserves, production, consumption and trade, the authors also provides rich policy-related information for each country. After reading it through, the reader would understand the state of global coal market from different views. I highly recommend this book to the specialist or non-specialist interested in coal. At this time, Chinese coal production capacity is in serious excess and coal demand has taken a dive leading to the lowest coal price in recent years. The disappearing price difference between domestic and foreign coal will encourage China's coal supplier to export their coal to other North and East Asia countries. International coal trade will be rewritten in the near future. Under this background, this book has special value through its across-the-board analysis.

*Lei Zhang*  
*Associate Professor,*  
*China University of Mining and Technology, Xuzhou, PRC*