



BOOK REVIEWS

The Econometrics of Energy Systems, edited by JAN HORST KEPPLER, REGIS BOURBONNAIS, and JACQUES GIROD with an introduction by JEAN-MARIE CHEVALIER. (London: Palgrave Macmillan 2007), 266 pages, ISBN-13: 978-1-4039-8748-8.

This book offers an interesting mix of econometric tools and techniques applied to selected energy topics. Some chapters can be easily understood by anyone who has had an introductory econometric course; others require a good understanding of time-series analysis. (This review must assume similar familiarity because of space limitations.) The book presents econometric tools and techniques that could supplement studies in econometrics or could easily be applied elsewhere. It also serves as a reference for research topics in energy, although some of the studies are limited to certain industries in selected countries. Some chapters cover traditionally researched topics such as modeling electricity prices and the long-term price of oil, while other chapters present unique studies such as the effects of energy-company integration on energy-equity returns.

Chapter 1 by Nathalie Desbrosses and Jacques Girod covers the measurement of energy and how properly to construct prices and datasets more accurately to carry out studies. Often, data are obtained and used without questioning their derivation. This unique chapter demonstrates the importance of understanding the data-collection process. It is very constructive for the book, not only to include this topic, but also open up with it. The chapter serves as a good starting point for those interested in properly constructing data sets or for those who have not yet been exposed to the data-collection process and would like to develop this skill.

Chapter 2 by Jacques Girod mathematically develops the well-known partial-adjustment model and applies the model to industrial energy consumption in France with data from 1978 to 2002. Since the model is dynamic, both short and long-run elasticities are estimated. Unfortunately, none of the elasticities were found to be significant, thus, limiting the empirical usefulness. However, the technique could be easily followed by anyone with a basic understanding of econometrics and who has an interest in estimating a simple demand model and elasticities.

Chapter 3 by Regis Bourbonnais and Sophie Meritet and Chapter 9 by Carlo Pozzi cover different aspects of the electricity market. Chapter 3 applies univariate time-series analysis to model electricity spot prices. Chapter 9 applies more sophisticated techniques to model the relationship between spot and forward prices and argues that electricity prices might have a “convenience yield.” Chapter 3 considers the challenge of modeling electricity prices in less regulated and more

competitive markets within the electricity supply chain. The two electricity-price data sets used are for the Pennsylvania-New Jersey-Maryland (PJM–U.S.) and the Elspot (Nord Pool) in Europe. The authors begin by determining that the spot electricity price is a mean-reversion process and that “spikes” present in the data also need to be modeled. They provide a review of stationary processes and white noise as well as introduce trend stationary (TS) and difference stationary (DS) models. An explanation of the Dickey-Fuller (DF), augmented Dickey-Fuller (ADF) and Phillips-Perron tests for stationarity is also provided, although not in very much detail. The authors perform stationarity tests on the PJM electricity spot price and conclude that the process is non-stationary with a deterministic trend. The authors mention the necessity of modeling volatility via an auto-regressive conditional heteroskedastic (ARCH) or a generalized auto-regressive conditional heteroskedastic (GARCH) model, but the explanation of these processes was limited and not very intuitive. The authors only explain the Nord-Pool results but do not show any actual forecasted model results. I would have preferred reports of both price-data set results to be able to compare, contrast, and gain insights into both electricity markets. Moreover, no in-sample or out-of-sample forecasts were conducted to test the validity of either model.

In Chapter 9, the limited or non-storability of electricity and the dispersion between spot and forward electricity prices is used as the basis to model electricity prices via an implicit factor like power reserves. The paper describes how inventory levels of a storable commodity, such as oil, affect the relationship between spot and forward prices of oil. Underlying power reserves such as water levels, for instance, can be used as a potential inventory factor that can affect the relationship between spot and forward electricity prices as for storable commodities. The author explains how abrupt volatility often experienced in electricity prices creates difficulties in modeling prices and how the use of an instrumental variable can correct the model. However, he suggests that the generalized auto-regressive conditional heteroskedasticity (GARCH) model is even better for correctly modeling volatility.

After explaining the operational intricacies of the European Energy Exchange (EEX), the author applies estimated generalized auto-regressive conditional heteroskedastic (EGARCH) and autocorrelation theory using almost three years of German daily prices. The author concludes that available residual capacity to cope with demand swings among other things drives the electricity spot-forward price basis. Understanding “convenience yield” is important to follow this chapter, but the methods used to detect correlation and heteroskedasticity in the data and choosing the model are well explained. The uniqueness of the study is debunking the notion that storage theory is never applicable to electricity prices.

Chapter 4 by Jan Horst Keppler studies Granger bilateral causalities pertaining to gross domestic product (GDP), energy consumption, electricity consumption, and oil consumption in developing countries. The methodology for constructing a data set for ten developing countries (Argentina, Brazil, Chile, China, Egypt, India, Indonesia, Kenya, South Africa, and Thailand) for 1971-2002

is well explained. The authors find limited causality with GDP causing oil and electricity in India and conversely oil and electricity causing GDP in China. Next they focus on China and consider co-integration among GDP, electricity, and oil. Their explanation of cointegration and the use of the error-correction model (ECM) are well communicated. However, their lag selections appear to be rather ad hoc and not based on statistical testing. Johansen tests identified two cointegrating relationships at the five per cent level. Choosing one of them, the authors find that increasing electricity consumption has a positive effect on GDP while increasing oil consumption has a negative effect. The ECM for this long-run relationship finds that the impact of any shock will persist roughly for only a year and half. In general, this chapter well serves anyone interested in researching the relation between economic growth and energy consumption in developing countries. It explains the econometric techniques to model cointegration and how to interpret the results. It also lists sources where some of the data can be obtained for personal research.

Chapter 5 by Ghislaine Destais, Julien Fouquau and Christophe Hurlin defines the energy-GDP ratio, or the ratio of total national primary energy consumption to GDP, which measures the energy intensity (EI) of an economy. The authors explain some of the challenges faced when measuring EI among various countries, primarily due to heterogeneous energy use. The authors articulate the advantages of panel data vs. cross-sectional or time-series data for modeling the relationship between economic growth and energy consumption. For panel data, the fixed effect model (FEM) is introduced to allow parameter heterogeneity present from country to country, while a Hausman test is used to indicate whether individual effects are fixed or variable, thus indicating whether ordinary least squares or generalized least squares is preferable. Two additional and more complex tools presented are the panel threshold regression (PTR) model and the panel smooth threshold regression (PSTR) model. After model specification and testing, the results and a comparison across models are shown and interpreted for 44 countries from 1950 to 1999 to determine income elasticities. The paper also reports country specific time variability of the income elasticity of energy demand. In the latter part of the paper, the concepts presented are a bit advanced for those with only an introduction in econometrics, but the paper offers much insight into how to apply the techniques for those interested in modeling country specific income-elasticities.

Chapter 6 by Marie Bessec and Sophie Meritet considers how energy prices, technology, and energy intensity may all be inter-linked for 15 Organization for Economic Cooperation and Development (OECD) countries from 1960 to 2002. The chapter specifically focuses on the oil market due to the importance of oil in the total energy consumption of OECD countries. The authors assume structural breaks in 1973 and 1979-1980 but perform no formal structural-break tests. The study starts with unit-root tests (augmented Dickey Fuller) to assess the order of integration for the three variables and finds all three variables to be integrated of order one $I(1)$, and then tests for co-integration among the variables. The paper explains why a Johansen and Juselius technique is best in this case to

test for co-integrations instead of the Engle-Granger. Specifically, a vector error-correction model (VECM) and a vector auto regression (VAR) model are used to perform Granger-causality tests among the three variables. The authors find evidence of cointegration among 12 out of the 15 countries studied with causality from real oil prices to fuel rate (fuel consumption divided by mileage of a motor vehicle and used as a proxy for technological progress) and from real oil prices and fuel rate to oil consumption in most of the 15 countries. The paper offers some policy implications and serves those interested in learning more about causality and cointegration among multivariate models.

Chapter 7 by Patricia Renou-Maissant covers interfuel (coal, electricity, natural gas, oil) substitution in the industrial sector for France and the United Kingdom from 1978-2002 and includes a good introduction to applying the well-known translog and linear logit models. The chapter starts with a brief review of the neoclassical production and cost functions, explains why more flexible models are preferred to the traditional Cobb-Douglas or CES models and covers the underlying econometric theory for the two models. The author concedes that both models (translog and logit) give poor results in determining the long-run mean price elasticities and redefines the models by excluding coal, since coal was a low-consumption energy source in both countries. According to the author, the results for the three-fuels (electricity, natural gas, and oil) are also disappointing and do not help explain the substitution that occurred in the French and British industrial sectors. However some experimenting with data sources and sample size found results more aligned with the literature.

Chapter 8 by Regis Bourbonnais and Patrice Geoffron provides an econometric analysis of European gas-market integration using a vector error correction model (VECM). The authors point out some of the challenges faced when modeling energy integration from inefficiencies still present in the gas market. The pre-tax gas-price data used are biannual from 1991 to 2005 taken from Eurostat. Six main national markets (Belgium, France, Germany, Italy, UK, and Spain) were analyzed. The authors found the gas-price series to have an order of integration of 1 or $I(1)$. Since the gas-price series are $I(1)$, they employ a Johansen-Juselius cointegration test for prices across markets. They find some evidence of co-integration, but the authors' statistical tests given in tables and the text are not consistent. Further, I would have liked the authors to have mentioned how gas prices in Euros were converted from local currencies since the Euro was not in existence prior to 2000. They mention using correlograms to verify white noise in the error terms, which would have been complemented with the actual correlograms. A lack of proper editing left unclear results, contradictory findings, and missing levels of significance occasionally confusing the reader.

Chapter 10 by Sophie Chardon studies the topic of forecasting oil price over the long run. The data include the real price of oil over the 143-year period (1861-2004) taken from *BP Statistical Review of World Energy*. A structural model (using supply and demand fundamentals) is not used, but rather a stochastic process model of price. The author models price in a variety of ways: as a quadratic

function of time, using a Hodrick-Prescott filter, as an Ornstein-Uhlenbeck process, and testing for unit roots and unit roots with break. She uses a Kalman filter and forecasts oil to be \$80/bl (constant 2005 dollars) in 2025. The author believes that the price-data series is U-shaped over time and is mean reverting to a trend. With the debate in the literature on how deflators might change the results or alter the specification of the model, I would have liked the author to have revealed which deflator was used and why. This chapter presents some interesting alternatives for structural models but would be a challenge without familiarity with stochastic modeling in general and the use of the Kalman filter.

Chapter 11 by Carlo Pozzi and Philippe Vassilopoulos includes a financial twist by studying the impact of both vertical and horizontal integration on equity value of U.S. energy firms. A well thought out discussion is presented on the authors' methodology of classifying and constructing equity energy portfolios made up of different size categories of energy firms. The addition of fuel risk to the model enhances the study. The resulting stock data used are high frequency (daily returns) data over a 14 year period for 681 energy firms listed in the U.S. equity markets for four energy industries (oil, natural gas, power, and coal). The authors conclude that only vertical integration in the oil industry adds value, while horizontal integration adds value in none of the industries. Integrating fuel prices and using a rolling regression the authors also conclude that firms fail to add value to shareholders by diversifying. Anyone interested in portfolio allocation of energy-equity returns could definitely gain from reading this paper.

The level of sophistication in most of these papers could be followed by anyone who has taken an introductory graduate course in econometrics that encompassed some time-series methodology. However, a few chapters require more advanced mathematical statistics. The writing is fairly straightforward aside from a few grammatical errors and some inconsistencies in certain equations and tables, such as the use of a decimal point or a comma as a separator between whole and decimal numbers. Although this book is not an all encompassing book in the econometrics of energy systems, it gave me a good review and some practice in basic econometrics while also introducing me to some new and more challenging methodologies. The interesting array of energy topics and comprehensive bibliographies for all chapters should be worthwhile to practitioners in energy markets.

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Les Controverses de L'énergie: Fossile, Hydroélectrique, Nucléaire, Renouvelable, by FRANCO ROMERIO. (Lausanne: Collection Le savoir suisse, Presses polytechniques et universitaires romandes, 2007) 142 pages, ISBN-978-2-88074-590-5.

This book, appearing in the collection *Le savoir Suisse*, provides a synthesis of current issues in energy consumption and supply. It is similar to the UK's "Very Short Introductions" or the French "*Que sais-je*," which make academic research accessible to non-specialists in a pocket book format.

Given the present turmoil in petroleum markets and public concerns about climate change, such a synthesis could not be timelier. By presenting basic information on the functioning of energy markets and on their foreseeable development, this book can help the reader to develop a well-informed opinion on the current challenges of environmental and energy policies. To this effect, the book spans a large spectrum of topics, such as the links among energy, economic growth, sustainable development, security of supply, the establishment of an energy policy, competitive electricity markets, and future technological options for electricity generation.

Some of the topics, such as electricity market restructuring or energy policy, are treated mainly through the Swiss experience. But this experience is always grounded in the worldwide context and turns out to be of great interest to readers of all nationalities. For instance, one is amazed by the number of popular votes on energy matters that have been held in Switzerland as well as the complexity of the subjects involved. The need for Swiss citizens to take positions on such complex matters probably explains the origin of this book.

The author displays great pedagogical skills. For instance, an illuminating analogy is made between electricity transmission and blood circulation. He clearly defines the "rebound effect" and "backstop technologies" and gives a good explanation of the structure of the electricity market." He explains that relocation of energy intensive industries can reduce energy intensity of one country but that country will then import "gray energy", i.e. the energy incorporated in imports. Overall, the author is able to describe the topics in simple terms while conveying their full complexity.

However, the clarity found in each topic or component does not permeate the book taken as a whole. The book lacks structure, so that it is hard to extract the promised "synthesis" out of it. The introductory chapter is a case in point. In a mere 9 pages, the author narrates the September 2003 black-out in Italy, lists and comments on Swiss popular votes on energy, offers interesting discussions on the credibility of experts and on risk assessment, and presents the different measures of energy (KWh, J) as well as the first and second laws of thermodynamics. Although each of topics is a good and independently well explained teaser, the reader is left to herself to bridge the links among them and to guess on how this puzzle will be assembled in later chapters. In fact, it remains difficult to relate these introductory topics to the other chapters even after one has read the

whole book. For instance, the 2003 black-out is presented in the introduction as a proof that it was “time to rethink the whole organization of the network and its operators.”¹ But the 2003 black-out is not directly referred to in the chapter on competitive electricity markets, not even in the section “Critical Appraisal of 20 Years of Trials.”² Similarly, the last chapter does not attempt a wrap up, but rather opens a series of discussions on ideology, sustainable development and governance. Although these discussions are interesting, they are not obviously linked to the mine of information given in the book. A passage of the conclusion even includes the idea of markets of CO₂ permits, which, except for a brief mention of related green certificates in the chapter on electricity generation technologies, is not treated elsewhere in the book.

Maybe this lack of unity comes from the stated aim to present facts and to let the reader come to an opinion about them. But the result is that it is not clear how to gather these facts to make an opinion. I believe that it would have been interesting if the author offered more guidance, based on the information he provides, on the course of policy that he thinks should be taken. Even though the reader would be free to disagree, this would have the pedagogical feature of providing readers a key on how to use the author’s expertise. This would also convince them of the value of understanding the concepts presented. The amount of information to assimilate and the fact that this information leads to rather weak statements that often look superficial (such as “The idea is to provoke good ruptures and avoid bad ones”)³ can make the reading rather tedious sometimes.

Despite this fact, this book is highly recommendable for the non specialist. My perceived lack of unity and purpose does not hinder the fact that each topic treated brings, in simple terms, rich insights on complex contemporary issues related to energy markets. This is a rare accomplishment.

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1. My translation. The original text is : “Ce black-out a prouvé qu’il était grand temps de repenser toute l’organisation du réseau et de ses opérateurs, nous verrons comment,” p. 10.

2. “Vision critique sur 20 ans de tâtonnements,” p. 101.

3. “L’idée doit être de provoquer de ‘bonnes ruptures’ et d’éviter les mauvaises,” p. 43.

Competitive Electricity Markets: Design, Implementation, Performance, edited by FERREIDON P. SIOSHANSI. (Amsterdam: Elsevier, 2008) 624 pages, ISBN-13: 978-0-08-047172-3.

It should come as no great surprise that electricity reform is difficult. The (very limited) quantitative cost-benefit analyses suggest that successful reforms can reduce costs by 5-10% permanently. Two consequences immediately follow from this modest potential cost reduction: a flawed reform can easily fail to reap these gains and lead to very costly outcomes. Second, redistributions from moving to market pricing may be large compared to the net gains. In many restructurings, the (possibly new) owners typically gain (otherwise they are unlikely to buy or accept), while consumers or the government (if privatising) often lose. Small wonder that such reforms are often treated with suspicion by voters. The recent windfall profits of European electricity companies granted free carbon allowances but including carbon prices in electricity prices generated billions of euros in windfall profits and did little to enhance the reputation of liberalized markets.

Two years ago Sioshansi collected together an impressive collection of 18 chapters on *Electricity Market Reform*, which examined most of the major reform examples. Joskow's masterly introductory chapter drew out the lessons from these examples, also noting that although reforms offered the prospect of significant potential benefits, they also carried the risk of significant potential costs. Two years on, this more sober volume sets out thematically the scale of the reform challenge, and why there is such a tension between arguments for completing the reforms and arguments for re-regulation to recreate the supposed benefits of the old model.

Pollitt's introduction sets the tone by asking how to get the balance between liberalization and regulation right, and why so few countries that followed the UK model were successful – increased volatility in retail prices (and subsequent rent redistributions) appear to be part of the problem. Chao, Oren, and Wilson take up that theme in their important chapter on the costs and benefits of unbundling and vertical integration. Vertical integration was the dominant structure in both investor- and state-owned electricity industries and was remarkably robust, resisting reform for nearly a century. Unbundling introduced a significant new source of wholesale-market risk, for demand and supply are such that short-run variations in the market price can be dramatic, varying from \$5-5,000/MWh over a single day; with average monthly prices in California trebling over a few months in 2000-1. When wholesale prices are high, generators gain and consumers lose, and vice versa when prices are low.

Vertical integration between generation and retailing eliminates such risks – as could contracts, but with higher transaction costs, credit risk and short time horizons. The old model typically bundled generation and transmission, while the new model bundles generation and retailing, both potentially competitive segments that might escape competition-authority scrutiny. Unfortunately, the contracts that an unbundled structure relies on to hedge risk also mitigate market power, a benefit absent from the integrated form. The political attraction

of smoothed prices may thus come at the cost of greater market power. The old model resisted reform by obscuring costs and assuring security of supply. The new model may at least bring stability with some transparency, if wholesale markets are liquid and competitive.

Allocating and minimising risks emerges as a key determinant of success, and while large consumers benefit from retail competition, it is doubtful that smaller consumers do. Markets work well where innovation and product design are important and efficiency varies between suppliers – none of which applies to domestic electricity retailing, where the retail margin should be a small fraction of the total delivered price. The case for retail competition is mistrust that regulators will determine an acceptable wholesale price, although competitive tendering for a default retail supply might work, as in Alberta.

Wholesale markets transact energy, only one of the many services supplied by the system, and the book stresses the importance of properly pricing reserve capacity, fast-response balancing services, voltage and frequency stability, and the transmission system, all of which came bundled together in the previous model. One of the disputed issues is whether a decentralised power exchange and contact market with self-dispatch can deliver the efficiency of a centrally dispatched system. Another, increasingly pressing, is whether a liberalized market can deliver timely and suitable investments in both base-load and peaking generation and transmission (although the success of different jurisdictions on transmission interconnection was lamentable before reforms). Both topics are well covered in the book.

Another message that cross-country comparisons bring out is that the European model of a Transmission System Operator (TSO), owning and managing the grid with incentives to minimise system operations costs, has advantages over the Independent System Operators (ISOs), who are forced to follow rules that can frequently be gamed by powerful generating companies.

Subsequent chapters pick up various themes. Chapter 2 by Correljé and de Vries explain the different patterns of restructuring, noting that fast growing developing countries that restructured to finance investment chose models that yielded “an ambiguous, unstable situation, particularly in the context of macro-economic shocks” while many European countries, under pressure from various Directives, suffer from ineffective regulation, lack of transparency, inadequate signals for generation and insufficient interconnection investment, among other problems. Cornwall takes up the issue of European market integration in a useful chapter that sets out the agenda of key pan-European institutions such as ETSO, Ergeg and CEER.

Part II deals with market performance with helpful details of the U.S. experiments in chapters 4-5. Sioshansi, Oren, and O’Neill address the question of self-commitment vs. central dispatch. Unsurprisingly, the central bidding processes are not strategy proof, as we know from the UK Electricity Pool, and can apparently arbitrarily redistribute rents. Such criticisms favour self-dispatch, which risks losing some of the benefits of coordination. The choice is thus between two imperfect designs.

The authors simulate the two models (assuming competitive behaviour) using data from ISO New England (ISONE). The results are instructive – profits to the generators would be 85% higher under self-commitment but commitment costs are higher by 1.4% of (centrally dispatched) settlement (or 2.1% of gross profits). This efficiency loss would amount to \$90 million annually for ISONE's 6.5 million customers, or \$15/customer, significant compared to the potential efficiency gains of liberalization. The example points to the importance of quantifying the costs and benefits of these alternatives.

Part III deals with capacity, resource adequacy and infrastructure investment, the major concerns of liberalized markets. Chapter 9 by Adib, Schubert, and Oren assesses whether capacity payments are needed to justify investment in energy-only markets, arguing that the problem of the “missing money” (needed to compensate new investment) are “a direct consequence of the fragmented oversight of electricity markets in the United States.” Other, better designed or regulated, energy-only markets do not seem to suffer from this problem, perhaps again signalling the critical difference between the ways in which TSO's are better incentivised and given more discretion outside the U.S. The authors argue for “energy price risk managed by loads and investment risk managed by generation developers” while accepting that “institutional realities of piecemeal electricity deregulation have made it seem unrealistic to many in the US.” Bowring's chapter then examines the performance of capacity markets in PJM, finding that net revenue was well below the replacement cost of generation between 1999-2006, leading to a major reform of the capacity market.

The final part of the book is a catch-all category, discussing renewable energy, distributed generation, and climate change issues which each present challenges to liberalized markets, not least because they give governments excuses to intervene again. Chapter 12 by Haas et al assesses programmes to support renewable energy sources with useful evidence on costs and effectiveness. Thus, the UK level of support to on-shore wind is about 7 Eurocents/kWh compared to 5 in Germany, but the latter has nearly three times the per capita wind generation despite a poorer wind resource, indicating that the form of support (feed-in tariffs rather than market-based instruments) matters for cost-effectiveness. Spain does even better with 2c/kWh support and nearly five times the UK penetration. Given that carbon is now priced in Europe, the case for extra support to renewables must be based on cost reductions such support will induce, ultimately encouraging deployment elsewhere to mitigate climate change. One should perhaps query why charging electricity consumers, many of whom are relatively poor, for this public good is prudent on public-finance grounds, rather than using carbon auction revenues instead.

The editor is to be congratulated for recruiting such knowledgeable experts to report on reform progress. The book is at its best when the authors quantify the costs and benefits of alternatives, offering the prospect of learning from mistakes. It also usefully reminds us that institutional and political constraints make it hard to move from the current to a better system.

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