Energy Economics 32 (2010) 751–757

Contents lists available at ScienceDirect

Energy Economics

journal homepage: www.elsevier.com/locate/eneco

Restructuring electricity policy and financial models

Leonard S. Hyman *

Black & Veatch Corp., 898 Veteran Memorial Highway, Suite 430, Hauppauge, NY 11788, United States

ARTICLE INFO

Article history:
Received 25 August 2008
Received in revised form 25 February 2009
Accepted 8 June 2009
Available online 17 June 2009

JEL classification:
L51

Keywords:
Electric utilities
Deregulation
Electricity market
Financial model
Risk

ABSTRACT

The old, regulated electric industry provided reliable service, not necessarily in the most economic manner, at a declining real price. The semi-competitive electric industry model now operating in the United States and the UK has shown that electric companies can operate more efficiently than before, but it has not delivered significantly greater benefits to consumers than the old model. Financial modelers and policy makers should address those issues whose solution will provide the most bang for the buck, in order to bring about greater benefits to consumers.

Scene: A semi-lit hotel ballroom in Washington, DC, more than a decade ago. A banker completes a PowerPoint presentation that promotes an elaborate, multi-billion dollar transition-to-competition securitization bond that, purportedly, will benefit consumers by reducing risk and cost of capital to the selling utility. Shimon Awerbuch rises and says, "You haven't reduced the risk. You've just shifted it from the utility to the consumer." Silence.

The old, regulated electric industry provided reliable service. Real prices declined. Rarely did the industry lose money or encounter difficulty in raising low cost capital. During the post war period, the industry's management made only one egregiously non-commercial decision, the plunge into nuclear power. Admittedly, the old industry had weak incentives to operate efficiently, but if customers paid too much, they also knew what to expect, and that certainty had value.

The now popular semi-competitive model should have provided something better for electricity customers. So far, though, in the United States and in the United Kingdom, the model has shown that electricity suppliers can operate more efficiently than before, but not that consumers will reap benefits significantly greater than they would have under the old model. The new model, however, has yet to prove its ability to attract capital for long term payback investments; or for investments that the industry might have to make in order to meet the national security, fuel security or environmental requirements of the future, without fixes that reintroduce elements of regulation.

The new framework might have increased the cost of capital to investors and uncertainty and risk to consumers, a seemingly improbable combination. Clearly, any recalibration of the model should take into account the welfare of consumers, in the sense that it considers the risks to consumers as well as the prices that they pay, and it should consider how a shifting of risks might produce a safer and more efficient electricity market.

The present structure of the industry, in many places, and the commonly proposed solution to problems, demonstrates the triumph of Rube Goldberg over William of Occam. The electricity sector will have to raise more capital than in recent years, and, perhaps policy makers and financial model builders should concentrate on how to do that, rather than on further modifications of the present, semi-competitive model. The sector should have less difficulty attracting low cost capital with a simple business proposition. Perhaps the next model will provide consumers with a better deal, too.

1. Chasing customer benefits

The deregulation or restructuring of the financial, telecommunications, transportation and natural gas industries produced dramatic reductions in operating costs. New firms entered the markets. Some competitors thrived. Others failed. Consumers, however, reaped the benefits in the form of lower prices and new products and services (Global Business Networks, 1995). Electricity restructuring has produced a murkier picture.

In the UK, the restructuring (privatization) demonstrated that the industry could operate in a dis-integrated mode via a central market;

* Tel.: +1 631 348 4090; fax: +1 631 348 4097.
E-mail address: judithhyman@earthlink.net.

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doi:10.1016/j.eneco.2009.06.008

that it could then operate without a pool auction, that electricity suppliers could cut their costs, that strict regulators could follow *laissez-faire* regulators, and that smart, incentivized participants would learn quickly how to take advantage of rules in order to achieve their goals.

In the United States, market participants manipulated without the diffidence exhibited by their British counterparts and lobbied for advantage; the government encouraged the formation of numerous new operational and regulatory entities to regulate deregulation, the generating industry went through a boom and bust cycle, and half the country refused to restructure in light of what happened in the other half (Joskow, 2006a).

This is not to say that restructuring has failed, just that its achievements seem less impressive in the electric sector than in others. Not for want of trying.

Studies show that the introduction of competition into U.S. markets has led to as much as a 3% to 5% reduction in generator operating costs (Lien, 2008; Fabrizio et al., 2007; Mansur and White, 2008) and, internationally, the introduction of competition and privatization has brought about operating benefits as well (Zhang et al., 2002). A 3% to 5% reduction in generator operating costs, if passed on to consumers, would work out to only a 1% to 2% price reduction for the ultimate customer. Joskow, who did not undertake an analysis of actual operating savings, appears to estimate a higher level of savings to ultimate consumers, perhaps 5% to 10% (Joskow, 2006b).

The legendary management consultant, Peter Drucker, wrote that "The Customer is the Business" (Drucker, 1964). To succeed, businesses in most sectors must deliver the goods to customers. How have electric companies done so in the restructured market place? The United States and the United Kingdom have had restructuring in place for long enough to provide some answers.

2. Seeking efficiency in the United States

Unleash competition into a market. That should force down costs, and then prices. Prices in the competitive (restructured) jurisdictions should decline relative to those in regulated (unrestructured) markets. In the United States, however, prices to consumers in the restructured jurisdictions (usually high, which is why the local governments decided to restructure) remained high relative to nationwide averages or to prices in unrestructured jurisdictions. In other words, according to Pfeifenberger et al. (2008), restructuring seems not to have changed the relative position of consumers.

Policy makers tend to brush off those discouraging results by attributing the poor performance to higher natural gas prices. That is, they assert that the restructuring process produced operating savings, but higher gas costs (the restructured states, supposedly, depend more on natural gas as a fuel) offset the savings. McCullough et al. (2008) not only confirmed the persistent price gap that restructuring could not narrow, but also called into question the argument that the price of natural gas was the culprit. Assuming that restructured companies operated more efficiently, what happened to the savings?

Table 1
Real energy prices in the USA 1945 to 2007 (1992 = 100).

	1945	1965	1992	1996	2007
Electricity	255	124	100	93	97
Coal	75	70	100	91	99
Natural gas	31	44	100	102	195

Notes:
GDP deflator.
Electricity—Average price to ultimate customers.
Coal—Producer Price Index.
Natural gas—City gate or wholesale.
Sources: Energy Information Administration (EIA), American Gas Association (AGA) and Edison Electric Institute (EEI).

Table 2
Real price of electricity to ultimate customers and fossil fuel costs in USA 1945 to 2007 (Real 2007 cents per kWh).

	1945	1965	1992	1996	2007
Electricity price	17.29	8.46	9.50	8.76	9.14
Fossil fuel costs	2.14	1.28	1.51	1.38	2.56
Fossil fuel costs fixed at 2007 price	2.84	2.28	2.32	2.20	2.56
Electricity price less fossil fuel costs	15.15	7.18	7.99	7.38	6.58
Electricity price with 2007 fuel prices	17.99	9.46	10.31	9.58	9.14

Sources and Notes: See Table 1.

Blumsack et al. (2008) examined that question by comparing prices and costs in regulated and restructured jurisdictions, on a company by company basis. They found that companies in restructured jurisdictions earned higher mark-ups over costs, and concluded that "restructuring has been beneficial to companies that restructured, but the evidence is far less clear concerning consumers".

Of course, consumers consider quality of product in conjunction with price. The United States does not compile national standards for quality of service. If the number of blackouts were to serve as a proxy for service quality, though, then quality of service may have deteriorated from the regulated to the restructured period. As Hines et al. (2008) put it, so neutrally, "the frequency of large blackouts in the United States is not decreasing". The capacity margin (the difference between peak demand and generating capacity as a percentage of capacity) provides a rough indicator of the ability of the electric network to withstand generating emergencies. In 1992, the year of the first Energy Policy Act, the margin stood at 20.5% (down from higher figures in the 1980s), then at 17.5% in 1996 (when states began to restructure), 16.5% in 2007, and it could fall to 12.3% in 2012, a low not touched since the early 1950s (Energy Information Administration, 2007). Thus, using generating margin as a measure, it does not appear that the restructured industry has offered or will offer more secure service as part of its package to customers.

Tables 1–3 examine the real price of electricity for seven time periods:

- 1945–1965—Postwar period of fast growth, increasing economies of scale, improving efficiency. Heat rate improvements topped out and industry finances began to deteriorate in 1965.
- 1965–1992—Slower growth, financial and nuclear difficulties and introduction of non-utility generators.
- 1945–1992—Regulated era.
- 1992–1996—Passage of Energy Policy Act in 1992 opens door to competitive wholesale markets. Cost cutting in run-up to restructuring by the states.
- 1996–2007—State by state restructuring begins. Regional markets organized. Last year of complete data.
- 1992–2007—Restructured era to date.
- 1945–2007—Postwar period to date.

Even if restructuring has not delivered clear benefits to consumers in restructured jurisdictions, and the reliability of the network has not improved, at least restructuring, with its focus on efficiency and competitive pricing, must have had a discernible impact on prices,

Table 3
Annual rate of change in real price of electricity in USA 1945 to 2007 (%).

Years	Real price	Real price less fossil fuel costs	Real price with fossil fuel at 2007 price levels
1945–1965	−3.5	−3.6	−3.1
1965–1992	0.4	0.4	0.3
1945–1992	−1.3	−1.3	−1.2
1992–1996	−2.0	−2.0	−1.8
1996–2007	0.4	−1.0	−0.4
1992–2007	−0.2	−1.1	−1.0
1945–2007	−1.0	−1.2	−1.0

Sources and Notes: See Table 1.

overall. Surely, electricity producers and utilities, whether in states that planned and instituted restructuring or in others that contemplated the possibility, would have taken steps to dramatically reduce costs in order to prepare for competition, or reduce prices in order to forestall its advent.

The real price of electricity (average revenue per kWh) fell between 1992 (the year that Congress passed the Energy Policy Act, which opened the door to competitive generation) and 1996 (when the states started their own efforts), and then rose into 2007. For comparison, in the same 1992–2007, period, the real price of coal (the primary fossil fuel) fell slightly, and the price of natural gas (the fuel favored by competitive generators) rose sharply (See Table 1). Of course, the real price of electricity fell, as well, during the regulated era, at an even faster pace.

Tables 2 and 3 show the real price of electricity as paid by ultimate customers in the United States, the price after subtracting fossil fuel expenses from the bill, and the price as if the price per unit of fossil fuels purchased by the electric company remained fixed in real terms at 2007 levels. These calculations do not take into account the fact that changes in operating efficiency over time, modification of the fuel mix, plant outages, weather conditions, strikes and other factors affect fuel usage and costs, and that a reduction in fossil fuel costs may simply reflect the substitution of another resource for fossil fuel. They serve, rather, as cross checks for the changes in the real price of electricity as paid by consumers to flag unusual circumstances that might mar the year to year comparisons.

The tables show two periods during which real prices fell at a greater than nominal rate, 1945 to 1965 when the electric companies enjoyed increasing economies of scale that translated into lower costs, and 1992 to 1996, when companies took steps to cut costs to prepare for competitive conditions. Beyond that, price reductions to consumers were little different in regulated and restructured eras.

The reductions in costs and prices that followed restructuring probably did not exceed those predicted by consultant Mitchell Diamond, who assumed that competition would force all companies to follow best practices in the industry (Diamond, 1997). That is, the industry did achieve savings, but not savings beyond what it could have accomplished applying superior management to the existing situation. In short, it is difficult to quantify significant benefits to consumers from restructuring in restructured jurisdictions or in the country as a whole.

3. The UK restructures

The picture in the UK is similar. For most of the period since privatization, academics and consumer groups have issued papers arguing that restructuring led to exceptional profits for industry players and that much of the benefit of restructuring came about because the industry ended its subsidy of British Coal rather than from change in industry structure. Politicians, to this day, step into the picture to correct market imperfections (Parker and Crooks, 2008).

Did consumers in the UK benefit from restructuring, compared to consumers in other European markets, many of which were slow to allow for competition? Table 4 indicates no discernible advantage gained by British consumers, especially after taxes are stripped out of the price. Basically, before privatization British industrial customers paid more and household customers paid less than their European counterparts. Two decades later, nothing much changed. Price, however, does not tell the full story. The British consumers who had the foresight (or had money) to buy shares in the privatized companies made exceptional profits on those investments.

That is not to imply that British consumers never received monetary benefits from privatization and restructuring. In the first 10 years, they did, thanks to (choose your favorite): cost cutting on the part of the electricity suppliers, pool purchasing of power, falling fuel costs, regulatory push back against high profits, or the breakup of the generators. After the turn of the century the real price of electricity rose because (take your choice): fuel costs rose, the government terminated pool pricing, electric companies ran out of big cost reduction opportunities, or the retail supply companies learned how to collect oligopoly profits.

Table 5 shows indices of the real price of electricity for industrial and domestic customers compared to the prices of other fuels.

Tables 6 and 7 examine the average price of electricity in real terms for seven time periods:

- 1948–1965—From nationalization to the installation of the first of the large power stations.
- 1965–1991—Operation of large power stations, nuclear power, and preparations for privatization.
- 1948–1991—Era of nationalized electric industry.
- 1991–2001—Privatization of electric industry, operation with a mandatory pool market for power, winding down of fuel subsidies.

Table 4
Price of electricity in the UK vs. prices in Europe 1985 to 2007 (%).

UK price as % of average price in:	1985	1990	1996	1997	2000	2001	2007
Germany, France							
Industrial	112	96	70	83	87	104	114
Household	81	75	66	78	78	76	67
EEC 11 countries							
Industrial	105	111	–	–	82	100	101
Household	80	80	–	–	90	84	79
EU 15 countries							
Industrial	–	–	75	84	–	95	103
Household	–	–	71	78	–	79	83
EU 15 countries							
Industrial—excluding VAT	–	–	75	84	–	95	103
Household—excl. taxes	–	–	80	90	–	103	104
EU 15 countries							
Industrial—medium size	–	–	–	89	–	103	114
Household—medium size	–	–	–	90	–	97	104

Notes: Years selected based on availability of data on a continuous basis.
EEC 11 excludes UK.
Sources: Eurostat, International Energy Agency.

Table 5
Real price of electricity and other fuels in the UK 1970 to 2007 (1990 = 100).

	1970	1980	1990	2000	2007
Industrial customers					
Electricity	128	128	100	68	100
Natural gas	157	168	100	59	115
Coal	102	155	100	61	77
Oil	91	247	100	123	218
Domestic (residential) customers					
Electricity	103	105	100	79	101
Natural gas	172	87	100	78	125

Sources: BERR, *UK Energy in Brief July 2008*, pp. 30, 31.
Electricity Council, Statistics of Electricity Supply, 1987.

Table 6
Real price of electricity and fossil fuel costs in UK 1948 to 2007 (2007 pence per kWh).

	1948	1965	1991	2001	2007
Electricity price	13.18	9.96	9.05	5.27	7.99
Fossil fuel costs	4.92	4.07	2.13	1.38	2.07
Fossil fuel costs at 2007 real prices	4.54	3.96	2.27	1.97	2.07
Electricity price less fossil fuel costs	8.26	5.89	6.92	3.89	5.92
Electricity price with fossil fuel at 2007 prices	12.80	9.85	9.19	5.86	7.99

Notes: GDP deflator used.
Sources: Electricity Council, *op. cit.*
Digest of United Kingdom Energy Statistics.
Annual Abstract of Statistics.

Table 7
Annual rate of change in real price of electricity in UK 1948 to 2007 (%).

Years	Real price	Real price less fossil fuel costs	Real price with fossil fuel costs at 2007 price levels
1948–1965	−1.6	−2.0	−1.5
1965–1991	−0.1	0.6	−0.2
1965–1991	−0.4	−0.4	−0.7
1991–2001	−5.2	−5.5	−4.5
2001–2007	7.2	7.2	5.3
1991–2007	−0.9	−1.0	−0.9
1948–2007	−0.8	−0.5	−0.7

Sources: See Table 6.

- 2001–2007—Operation without mandatory pool, consolidation of ownership, to latest year of complete data.
- 1991–2007—Privatized era.
- 1948–2007—Post war period of nationalized and privatized electricity.

Fuel costs have played a significant role in the pricing of electricity. Before privatization, fuel accounted for 40% to 50% of the electric bill, mostly for overpriced British coal. The changes in the price of the two favored fuels, coal and natural gas, accounted for a large part of the movement of electricity prices. Table 6 shows the price of electricity compared to other fuels. Table 7 examines real changes in price, and shows that customers fared well in the initial decade of privatization, compared to the nationalized era, but not after the turn of the century.

As for levels of service, most of the regulator's service indicators remained stable or showed improvement after a bad first year. Looking again at the capacity margin as an indicator of quality of service, the UK's electric industry actually improved its numbers based on raw data published by the government: from 11% in 1986 to 22% in 1991, 20% in 2001 and 21% in 2007. The latest survey numbers from National Grid, the British transmission company (only counting plants under construction in October 2008 as in service in fiscal 2014–2015) show the capacity margin at 21% in that year, indicating a stable situation, at least superficially (National Grid Electric Transmission, 2008).

Back in 1994, Alex Henney, a prominent industry consultant, asked, "Is the Customer King?" (Henney, 1994a). After analyzing the situation several years after privatization, he concluded, "the king is still waiting to be crowned" (Henney, 1994b). Fourteen years later, the customer still waits. The privatization and restructuring of the UK electric industry achieved many noteworthy successes. How much consumers gained from the process remains an open question.

4. A hypothesis about price, profit and productivity

After more than a decade of operating in a competitive market, power producers and retailers should have squeezed out excess costs and taken all steps to assure high profits. Unregulated entities associated with regulated utilities would have as well taken whatever steps they could get away with to shift costs to the regulated utilities, and thereby maximize unregulated profits. Without sufficient competition in the unregulated sector, the benefits of deregulation would translate into high margins and returns for the energy firms, rather than lower prices to consumers.

Assume that inadequate competition (or poor market design) has led to excessive margins and returns that have inflated prices to consumers in the United States and UK. By how much might additional competition and better market design drive down prices before the industry reached a level of substandard profitability that would hinder its functioning? An examination of the 2006 and 2007 reports of five large companies (Constellation, NRG, Public Service Enterprise Group, Centrica, and Scottish and Southern) provides enough information to make these rough estimates:

Operating margin	
Retail supply	6%
Generation, trading and retail supply	9%
Generation	30%
Return on equity	25%
Price reduction needed to reduce return on equity to 10%	6%

If invigorated competitive forces in the market drove prices and revenues down to the point at which the energy suppliers could earn no more than 10% on book equity (a level that could discourage both new entrants into the market and additional investment), customers' bills for the competitive portion of electricity service might fall only 6%.

This analysis leads to a discouraging conclusion. Just as electric restructuring produced modest benefits to consumers, although nothing like the 40% price reductions predicted by enthusiasts (Hyman, 1999), efforts to squeeze excess profits out of the existing industry might produce no better than modest benefits to consumers, and not even that if they hamper the industry's ability to raise capital in order to maintain service standards, and expand or meet environmental challenges.

5. Rewards, risks and responsibilities

The unimpressive record of achievement (as seen by consumers) produced by electricity restructuring may reflect a lack of dramatic cost cutting opportunities within the industry, or a reluctance of consumers to embrace new products (to the extent there are any), or an absence of new technologies that might affect costs, or inept restructuring that imposed market structures that did not properly assess risks or provide incentives designed to encourage industry participants to reach for desirable goals.

In the old days, the electric industry in the United States operated within a simple risk apportionment framework. Utilities made all investments. They earned modest returns because they shifted most risk onto captive customers, including the risk that service failures would cause inconvenience or financial loss to the customer. Low risk deserved low return. Investors, however, did take risks, and they lost billions of dollars on so-called "imprudent" investments. In the UK, the government owned the utilities, but required them to collect enough revenue to cover costs. The nationalized electric industry earned profits—sometimes substantial—in most years. In effect, the British government put the risks of running the electric industry onto consumers.

For most of the post war period, utility shareholders in the United States earned returns higher than those of bonds and lower than those earned by shareholders in riskier industrial firms, as might be expected. In most of the post war years, utilities could raise money whenever they needed it (Hyman et al., 2005). State ownership and political policies make judgment of returns more difficult for the U.K. industry, but, at the end of the day, the electric utilities did manage to pay their interest obligations and earn a small profit reasonably consistently.

Although the consumers were exposed to risks, they had protection. Government agencies monitored the utilities, held their shareholders responsible for egregious errors, protected consumers from wild fluctuations in prices and assured that the utilities had the wherewithal to continue service in the future. The regulatory framework, however, rarely included incentives that encouraged innovation or efficiency. In the United States, it encouraged capital intensive solutions to problems even if other solutions were more economical. The pricing structure, furthermore, cross-subsidized some users thereby encouraging inefficient use of society's resources. In the UK, at times, the consumer might have needed protection from

the government, which used the electric bill to subsidize coal mining and to promote nuclear power.

Financial theory equates volatility with risk (Awerbuch et al., 2006; Brealey and Myers, 1988; Emery and Finnerty, 1991; Taylor et al., 2006). In one sense, customers were exposed to greater risks in the past, in that they bore responsibility for all prudent costs, but in another sense, they faced less uncertainty, less possibility of footing a bill for extreme events (although the regulator might impose the cost gradually), and, therefore, less uncertainty. For most of the postwar period, the real price of electricity declined. Perhaps the industry might have operated more efficiently and customers used the product more economically, but the average consumer of electricity had more pressing issues to think about.

6. Restructuring: if it worked for trucking, it should work for electricity

Despite its reasonable record of service to consumers (and only one egregious error, a blundering rush into nuclear power), policy makers decided to restructure the electric industry because:

1. Experience with other restructured markets had produced significant savings to consumers and many new products and services.
2. Private firms, supposedly, operated more efficiently than government-owned firms, and the government could always use the money collected from selling the company.
3. The economy of scale rationale for monopoly seemed to have evaporated in the fossil fuel generating part of the business and bigger nuclear power plants did not show expected economies, either.
4. Some power supply decisions had gone wrong, to the great expense of consumers. Therefore, the argument went, let merchants take the risks of making these supply investments, and earn the rewards for the right decisions. A competitive market would encourage better decisions and, if it did not, then the merchant—not the customer—would pay the consequences of the bad decision.
5. Cost-plus regulation and the imposition of societal costs by regulators on consumers raised costs to consumers. Reducing the reach of regulation would reduce costs for consumers.
6. Adherents of so-called Austrian economics, who were in positions of power, believed that deregulation would open the door to new products and concepts, to innovation, that would not see the light of day in a world of rigid regulatory guidelines.

Those who restructured the electric industry in the United States seemed to have done so without explicit consideration of risk elements, such as price uncertainty to consumers attributable to over reliance on one fuel, or from imposition of untested market procedures on a massive scale. They may have increased the risks to the regulated distribution utility, by requiring it to take on obligations out of proportion to its newly reduced capital base, and they certainly increased the risks to generators. In return for a temporary price reduction that consumers had to repay later, policy makers may have increased the volatility of the price of the product.

Shifting the risk of the generation decision to a merchant does not make the risk go away. The shift would reduce the risk involved in the decision only to the extent that the merchant approached the investment process in a new way that reduced risk. After all, *someone* would have to pay for the higher cost of capital required by the new electricity suppliers who incurred the risk.

If savings derived from operations after restructuring were not substantial enough to offset the higher cost of capital and the possibly greater risk incurred by consumers, policy makers might have restructured the industry in a way that increased the overall risk for both the industry participants and consumers, not an easy trick (Hyman et al., 2006; Hyman and Hyman, 2006). The UK government took greater care to insulate the consumer from sudden shocks by causing the electric industry and the coal supplier to implement multi-year coal contracts and the generators to sign the equivalent of contracts with the suppliers.

The restructured markets (more in the United States than in the UK) suffer from defects involving risk, responsibility and return that, probably, would not exist for long in a normal market (Kleindorfer, 2004). These deficiencies include:

- No one party has full responsibility for the delivered product; that is, its price, cost, reliability or customer satisfaction. To put it another way, no party earns a bigger profit by bringing the customer more reliable and economic service, or does any one party suffer financially (beyond minor fines imposed by regulators) for unreliable service. That is, nobody is in charge. This lack of control of, and responsibility for, the supply chain creates risks for investors, suppliers and consumers. The management of product is less of an issue in the UK in that a few large firms do control more aspects of the product offering than in the United States.
- The market's central control organization, at least in the United States, lacks incentives to reduce costs to consumers, or improve products offered to customers or market participants. It exercises control over assets for which it has no fiduciary responsibility. It does not take financial responsibility for its actions and does not have capital that would provide protection to those harmed by its actions. Analogously, a medical doctor in Florida has this sign on his waiting room wall: “My wife has all the money and I have no malpractice insurance.” Investors in other players within the electric sector might determine that this situation raises cost of capital. They might insist on a regulatory backstop before investing (Awerbuch et al., 1999, Hyman, 2006).
- To assure the availability of generating capacity during peak periods, the market must pay high prices at peak times to those generators that can supply the needed capacity, especially because those units rely on those peak payments for their profits. Regulators and market operators, in some parts of the United States, seeking to secure that peak capacity, may have put in place pricing mechanisms that created what Joskow (2008) quaintly referred to as the “missing money problem” . That is, whether by setting price caps or for other reasons, they did not provide the financial incentives necessary to persuade the generators to supply the needed capacity. In order to induce the generators to provide the needed service, they began a process to pay the generators, on a contract basis, to maintain the capacity in service, at prices set by the operating agency. Since the operating agency has no money, it will lay the burden on the load serving entity which will lay the burden on consumers. The new arrangement will have replicated the old regulatory arrangement, putting all risk on consumers, without the regulatory protections of the old model.
- Nobody takes responsibility for the costs of unreliability incurred by customers. Utilities in the United States suffer minor fines for diverging from mandated industry practices rather than penalties for major losses suffered by customers for service outages. The Electric Power Research Institute, for years, argued that losses in the United States came to tens of billions of dollars per year. LaCommare and Eto (2004) undertook a study at the Lawrence Berkeley National Laboratory that set the likely loss at $71 billion per year, more than 20% of the average electric bill. It seems likely that customers in other modern economies would suffer from similar problems. The regulator in the UK has instituted fixed penalties for supply and transmission service failures lasting over 18 h, although, as Ajodia et al. (2006) commented, “there are virtually no transmission failures that last for 18 h”. Punitive penalties for not adhering to license requirements, and a penalty/reward arrangement for meeting the service standards, are part of the regulatory arsenal, but, according to Yu et al. (2007), “the social cost of outages is considerably higher than the utilities' current incentive/penalty”.

- Market mechanisms now in place in the United States may delay investment decisions until the last minute, encourage facilities that builders can put up quickly with low capital investment, with minimal consideration for risk or ultimate cost to consumers, because, if enough suppliers makes the same mistake, and market pricing reflects that mistake, the customer has no choice but to pay. The market mechanism does not recognize the value to consumers of reduced risk that may accompany energy resources that come with higher prices but lower price volatility, either, a topic discussed in great detail by Awerbuch et al. (2006). The government may have to mandate, regulate or impose taxes to encourage capital intensive investments or those that operate at high costs but provide national security or environmental benefits.

7. Modeling for business decisions

Electricity restructuring, to date, has not produced the hoped for benefits, at least not for consumers. Slashing the returns of existing electricity suppliers may not make a big difference, either, and could prove counterproductive in that it might discourage capital investment. Policy makers seem to have missed out on how shifting risk affects the welfare of consumers. They have narrowly defined incentives, diminished or eliminated responsibility for product, and put planning in limbo, presumably because the market does it. Policy makers appear to have given little or no consideration to the possibility that conversion of an industry with a public service, cooperative orientation to a structure that attempts to commoditize every possible activity may have unintended and adverse consequences. Or, as Bowles (2008) put it, "the kinds of incentives stressed by economists may have counter productive effects" .

Perhaps policy makers and financial modelers should redirect their activities, keeping in mind the Oxford definition of a "model" as "a simplified (often mathematical) description of a system, etc., to assist calculations and predictions" (Reader's Digest-Oxford, 1996a) and the same lexicographers' definition of "plan" as a "formulated and esp. detailed method by which a thing is done") and of "planning" to mean to "arrange beforehand " (Reader's Digest-Oxford, 1996b). Then, after digesting all of that, they should heed Voltaire's admonition that "The best is the enemy of the good." In other words, policy makers need simple models that will help solve real problems, with an imperfect solution more useful than one that nobody will implement.

Consider these issues that could have a significant impact on the industry and its customers:

- Inadequate quality of service may have a greater financial importance for customers than all the industry reforms to date. Willie Sutton, when asked why he robbed banks, replied, "That's where the money is." The electric industry and policy makers need to determine the size of this inadequate-quality-of-service market, and whether the electric industry could address it more economically than its customers acting on their own. If it can, then policy makers have to devise the incentives required to encourage the activity.
- Buying electricity, now, may require consumers to take risks involving price, quality and quantity of service, which they might not have ways of hedging. Electricity suppliers may have no incentive to offer any product package other than what is required by regulators. They can claim that deficiencies in service are out of their hands because the suppliers they have to deal with are to blame. Could electricity suppliers offer a package of services that guarantee characteristics that customers want (in effect providing a risk management or insurance service to customers)? Might doing so give the electricity suppler a greater incentive to manage the supply chain and provide more reliable service, overall? Might such a concept lead to more efficient use of assets, because the electricity supplier could allocate use of assets based on customer desires—that is, willingness or unwillingness to pay? (Hyman, 2008).
- The restructured electricity market, at least in the United States, makes increasing use of market players who have no financial stake in the outcome of events. They use other peoples' money, so to speak, and gain no reward from satisfying customer needs. Other players in the market have no dealing with the ultimate customer, and receive rewards independent of ultimate customer satisfaction. This brings up the need to establish if and how much they act differently than if they had money at stake or if they received compensation based on payment directly from consumers, and how consumers might act if they had to deal with these entities.
- The old style electricity industry built facilities that were meant to produce the lowest costs over the long term, the sort of projects that I. K. Brunel would have built if he had lived long enough to get into the electricity business. Since restructuring, electricity suppliers have tended to favor projects with low capital costs and short construction times. Does that policy resemble that of a home builder who puts in a cheap air conditioning and heating system in order to reduce the price of the house, not caring about the subsequent electric and gas bills paid by the buyer of the house? Does it reflect a peculiarity of the market? Does it represent a rational choice that benefits the ultimate buyer of electricity? Has investment policy really changed, and does the new way of doing business reduce costs to consumers, on a risk adjusted basis?
- Before policy makers fell for the market as the solution, they fell for planning as the solution. Does some infrastructure require planning and government support (either directly or by creation of a sanctioned monopoly market for the infrastructure), without which it will not attract capital? Making a decision to build infrastructure involves the risk of choosing the wrong infrastructure for the future, but not building infrastructure might preclude certain developments. Policy makers might authorize and support infrastructure designed to support alternative energy structures (Geidl et al., 2007). To sum up the comments of Göran Andersson (ETN-Zurich):

> "… the industry's existing system is not suitable to meet future requirements. The industry has to forecast technology and build a system flexible enough to incorporate whatever comes along. A common carrier device could transport gas and electricity to energy hubs, for instance, which could distribute the appropriate product to consumers. The key problem is to find a way to develop a network that does not get locked into particular technologies that could become obsolete" (Hyman, 2007).

  Can financial modelers quantify the risks involved, so that investors and policy makers can make rational decisions on such projects, or do policy makers make the decisions for infrastructure in the old fashioned way—the country will need it so build it?
- The electricity industry requires large capital investment per unit of revenue. Pretax return of and on capital may equal one quarter of revenues. Capital investment in the future, such as nuclear power stations, windmills, solar power, carbon reduction, and information technology may not diminish the need for capital. Policies that increase the risk to investors raise the cost of capital. Can models determine whether the savings derived from restructuring exceed the higher cost of capital? Can financial modeling and cost of capital analysis, properly applied to each investment, help to guide policy makers and the industry toward low cost and low risk decision making?

8. Conclusion

The electricity industry once operated with a simple business proposition that permitted it to raise money easily at a low cost. Now it offers a complicated business proposition that may have increased

risk, has created new cost centers, and which has, in some places, mired needed investments in a swamp of arcane disputes.

Returning to basics, Oxford defines "businesslike" as "efficient; systematic; practical" (Reader's Digest-Oxford, 1996c) and "practical" as "concerned with practice or use rather than theory" (Reader's Digest-Oxford, 1996d). Perhaps financial modelers should direct more attention to those issues that will produce significant benefits to consumers, and permit the industry to meet new responsibilities in a business-like fashion.

The electricity industry (unless its customers do the job without it or regulators permit pricing that dramatically affects demand) may have to raise increasingly large sums in order to replace old facilities, modernize its internal communications and deal with restrictions on burning carbon (Hempstead and Hess, 2009). The capital markets, having suffered spectacularly from taking too much risk with exotic and opaque instruments, could gravitate to the simple, low risk investments that electric companies used to offer. The electricity industry needs the money. The economy needs electricity. Controlling the direction of environmental change will require major investments in the electricity sector. Huge pools of funds need places to put their money. Perhaps financial modelers could help to perfect a simple business proposition that will help to move the money from those who have it to those who need it at a price that will make electricity consumers happy, for a change.

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