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Did Enron Pillage California?

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Revelations this summer about Enron Energy Services' byzantine electricity-trading practices have fueled charges that merchant power producers and traders artificially engineered the California electricity crisis of 2000–01. A careful examination of the suspect trading practices, however, reveals that there's less to those charges than meets the eye.

The trading strategies in question all involved the pursuit of arbitrage opportunities, which arise when price discrepancies exist for a commodity in different locations or time periods. Exploiting arbitrage opportunities generally enhances economic efficiency by ensuring that electricity is reallocated where it is needed most. While some of the arbitrage opportunities were artificially manufactured by the companies themselves (in ways that may or may not have violated the law), most of them arose as a natural consequence of the market structure imposed by the California political system.

In any case, it's unclear whether the trading strategies in question actually served to increase prices on balance. Even economists who are convinced that they did contribute to the increase in electricity prices attribute only about 5 percent of the alleged overcharges to the strategies at issue. Most of the price spike of 2000–01 is explained by drought, increased natural gas prices, the escalating cost of nitrogen oxide emissions credits, increases in consumer demand stemming from a hot summer and then a cold winter, and retail price controls that prevented market signals from disciplining producers or consumers. The price collapse in the summer of 2001 stemmed from a reversal of those conditions, not the imposition of federal price controls or the elimination of the trading practices in question.

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The recent release of various internal Enron memoranda[1] has reignited the firestorm of controversy about that company's role in the California electricity crisis of 2000–01. Colorful Enron business practices with sinister code names like "Fat Boy," "Ricochet," "Get Shorty," "Load Shift," and "Death Star" look to many observers like a series of smoking guns placing responsibility for much of the crisis at the company's doorstep in Houston. Although Enron might be the perfect political fall guy for California politicians desperate to lay blame outside the state capital, there's less here than meets the eye.

Arbitrage 101

Enron's strategies all involved the pursuit of arbitrage opportunities, which arise when price discrepancies exist for a commodity in different locations or time periods. Traders who engage in arbitrage make money by buying low in one place or at a given time and selling high in another place or in the future. Despite what newspapers might lead you to believe, arbitrage is a good thing; it reallocates commodities from places where or times when they are plentiful to places where or times when they are scarce.

In competitive markets, arbitrage opportunities do not persist for long. In poorly functioning markets—to which entry barriers are high or about which good information is extraordinarily hard to come by—arbitrage opportunities can persist for some time. Good information about California's restructured electricity market was hard to obtain for two reasons: it was a new market, and it was three markets rather than one.

New markets present arbitrage opportunities not found in established markets because some participants know a lot more about supply and demand than others at the beginning of the game. It takes time before all participants are on an equal footing.

Learning was made more difficult because the California electricity market was really three markets—a "day-ahead" market, a "reserve" market, and a "real-time" market.[2] The existence of three venues for the sale of electricity created uncertainty about which of them would deliver the best price and, thus, even more arbitrage opportunities than would exist in a typical new market.

The day-ahead market was managed by the Power Exchange (PX), which solicited hourly output bids (amounts and prices) from all generators a day in advance of production while also soliciting estimates of hourly demand (quantities only) from the three incumbent utilities (Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric), as well as from independent marketers of electricity, like Enron, which had contractual obligations to serve customers. The PX accepted supply bids in order of price (cheapest bids first) until the supply equaled the expected demand. The cost of the most expensive unit of energy needed to meet expected demand in any given hour established the price for all the power bought through the PX for that hour.

After the PX produced hourly prices for the next day, the Independent System Operator (ISO)—the hands-on manager of the California transmission system—solicited bids for reserve, or standby, power, that is, electricity that would be used by the ISO if shortages occurred as the electricity was generated and consumed, the day after the PX auction. Shortages could and did arise because of unexpected changes in the weather or transmission-line or generator failure. This was the second market in which generators could participate.

Instead of supplying reserve energy in the reserve market, generators could supply reserve power "accidentally" by generating more in real time than they said they would in the day-ahead PX auction. The generators would receive the ISO real-time price for the differences from the day-ahead schedule. This price was different from both the PX price and the reserve-market price. The real-time market was the third market available to producers.

An additional source of arbitrage possibilities was transmission-line congestion, which sometimes prevented lower-cost electricity from entering high-cost areas. Generators that submitted bids to the PX also submitted prices that indicated their willingness to incrementally increase or decrease output to relieve transmission congestion.[3] If simultaneous adherence to generator schedules would congest a transmission line, the ISO adjusted the schedules to relieve the congestion at least cost, which could be done either by rerouting power off a congested line or by increasing the flow of power against the direction in which the line was congested.

If arbitrage worked well, congestion relief prices and electricity prices would be the same. But once price controls for electricity were introduced in the California market in the summer of 2000, those prices could and did frequently diverge, and that divergence presented another arbitrage opportunity.

Price controls created additional arbitrage possibilities because prices outside California were not controlled. Generators withdrew power from the California market and sold it in other western states at higher prices and then sometimes reimported it to California.

Under ideal conditions—and in the absence of transmission congestion and price controls—prices for day-ahead, reserve, and real-time energy during each hour would be equal in all areas of the West including California. No arbitrage opportunities would exist. But because the ISO auction was conducted after the PX auction, and real-time prices were determined still later, uncertainty existed about which venue would have higher or lower prices.

The Skinny on Trading Strategies

The trading practices pursued by Enron were essentially attempts to take advantage of discrepancies between prices in the three markets, prices in California and other states in the West, or electricity and congestion relief prices. Consider, for instance, "Load Shift," whereby Enron scheduled power deliveries in the day-ahead market that it never intended to execute through an important north-south often-congested California transmission corridor known as Path 15. The idea was to create a bottleneck in the electricity delivery system. Enron would then cancel the transaction in real time and collect payments for relieving the congestion it had "created." The arbitrage opportunity existed because the payments for alleviating congestion (up to $750 per megawatt-hour according to one Enron memo) could exceed electricity prices under price controls ($250 per mWh).

Another congestion-related arbitrage opportunity was known as "Death Star." Enron would schedule transmission along Paths 15 and 26 to relieve congestion, thereby collecting congestion relief fees from the ISO. But Enron would not really generate additional power. Instead, it would import the electricity along lines outside the ISO's regulatory purview elsewhere in the West and then ship it back along Paths 15 and 26 in order to collect the congestion relief payments. Again, Enron discovered it could make more money by moving electrons around strategically than by selling power directly in the California wholesale market.

A shadier variation on the "Death Star" strategy saw Enron scheduling to relieve congestion, collecting the congestion charge for doing so, and then failing to provide the promised electricity. The arbitrage opportunity existed because the ISO paid the congestion relief charge in advance and didn't ask for its money back if the company failed to deliver. The congestion relief charge, moreover, was greater than the penalty paid by Enron for not delivering the scheduled power. The ISO quickly realized that companies were taking advantage of this loophole and ordered them to cease this practice in August 2000, and Enron apparently complied.

With a strategy termed "Fat Boy," Enron traders would try to exploit discrepancies between demand in the day-ahead and real-time markets. This happened frequently because the incumbent utilities, particularly

Pacific Gas & Electric, would often underestimate demand in the day-ahead market in order to reduce and then lock in prices in the PX. When the demand in real time was greater than the PX forecast, the ISO would buy additional power at prices higher than those in the day-ahead market.

When Enron traders suspected that demand in real time would be higher than the demand estimate in the day-ahead market, they would overstate the anticipated demand of Enron customers and schedule generation to meet that demand in the day-ahead PX market. In real time, Enron would use less than it had scheduled in the PX and would be credited for its "excess" generation at the real-time price, which would be higher than the PX price.

"Get Shorty" was a strategy employed when Enron guessed that the real-time price would be lower than the day-ahead price. Traders would sell power into the overpriced day-ahead market, cancel the planned generation the next day, and purchase relatively cheaper electricity in the glutted real-time market to cover the commitment to deliver. Nothing wrong with that.

Other less flashy trading strategies included buying California electricity in the day-ahead market at the regulated price of $250 per mWh and then exporting that power out of state where prices were unregulated and two to five times higher than the controlled California price. That Golden State politicians are shocked—shocked!—that price controls could backfire in such a manner is more a reflection of the economic illiteracy of California politicos than of the underhandedness of Enron. "Ricochet" took this strategy one step further by turning around and selling exported California power back into the state's real-time market, thus evading the price controls.

Another deceptive strategy traders employed involved the procurement of reserve or standby power for Enron's retail customers. Enron would tell the ISO not only that had it obtained generation to satisfy the demand of its retail customers but also that the company had obtained "reserve" power through contract so that the ISO would not have to obtain standby power for Enron's portion of the daily load. Claiming that it had obtained reserve power allowed Enron to avoid having to pay the ISO for standby generators.

In reality, Enron had not contracted for its own reserve, although the ISO did not know that. Usually, this was not a problem, but on at least one occasion, an out-of-state generator of electricity for Enron cut off Enron and the ISO had to replace the electricity with reserves in real time. Although this strategy appears to involve fraud, it probably resulted in more supply coming into the state than would otherwise have been the case because many of those sales would not have been profitable had Enron had to pay the ISO for obtaining reserves.

These colorfully named Enron operations are just the latest in a list of industry practices that have come to light, some of which seem less than kosher and some of which are just clever. An example of the former is some power suppliers holding back electricity from the price-controlled day-ahead and reserve markets in hopes that the ISO would pay exorbitant prices in real time to keep the lights on. An example of a clever strategy is companies taking advantage of the rules in the day-ahead market that allowed them to break up their output into 16 price-quantity segments. Under the rules of the auction, as noted earlier, the most costly unit of electricity needed to meet demand set the price for all electricity sold into the market that hour. Generators bid the 16th, smallest, and last segment of their output at very high prices because, if those prices were accepted, all generators would receive a high price for their output.[4]

At this time we do not know whether any of Enron's trading behavior actually broke the law. There's a fine and uncertain line between "market manipulation" (of which there was a vague blanket prohibition in the California regulatory code) and clever arbitrage. But that's largely beside the point for

California politicos because federal regulators are fully empowered to order refunds for "unjust" and "unreasonable" prices whether lawbreaking was involved or not. With the California state government facing a $20 billion budget deficit, the pressure is on to take back what appear at first glance to be ill-gotten corporate gains.

The Crisis Reconsidered

The broader point made by the critics of electricity markets is that this corporate behavior, even if legal, demonstrates that power companies created a crisis out of thin air. While this charge resonates politically—particularly given the accounting shenanigans that have come to light with regard to this industry—it is not an accurate economic characterization of the California electricity crisis of 2000–01.[5]

The Pacific Coast drought, which reduced hydroelectricity production in the West by the equivalent of 7 to 10 nuclear power plants, was real. Likewise, the 10-fold increase in wholesale natural gas prices in the West, a product of an unusually hot summer and cold winter, which increased the cost of electricity, was real. Similarly, the fixed quantity of nitrogen oxide (NO_X) emission credits—which were required in order to run power plants legally in the Los Angeles basin—contributed greatly to the increased cost of power. And the retail price controls—which gave no one an incentive to reduce consumption—were real. The combination of natural gas prices and NO_X emission restrictions alone takes us from 5 cents per kilowatt-hour to 16 cents per kWh in the summer of 2000 and 48 cents per kWh in December 2000 without having to discuss any of the trading strategies described in the Enron memoranda.[6]

MIT economics professor Paul Joskow, perhaps the most credible proponent of the idea that market manipulation played a major role in the crisis, concedes that about half the price spike was the result of this "perfect storm" and had nothing to do with bad behavior by Enron or other firms.[7] Severin Borenstein and his colleagues also conclude that prices in the summer of 2000 were about 50 percent above the marginal cost of the most expensive generating unit.[8] Still, the Enron documents are silent on the main charge that Joskow and others have made—that suppliers purposefully shut plants down to increase prices. But Harvard professor William Hogan and consultant Scott Harvey observe that "electricity prices [were] consistently high both inside and outside California, which strongly suggests that the problem [was] not the exercise of locational market power inside California but a widespread shortage of energy and/or capacity" in the West.[9] They conclude that little if any of the spike remains to be explained once you factor in the supply and demand shocks that hit the system.

Given that many of the strategies revealed in Enron documents had a negligible effect on the price paid for electricity, served to reduce congestion, or increased supply when the state needed it most, it's hard to lay much of the blame for the spike on Enron traders. Stanford economics professor Frank Wolak—another academic who argues that market manipulation was ongoing and serious—concedes that the practices revealed in the memoranda had only a minor effect on prices (at worst, $500 million out of $10 billion in overcharges the state wants back by his estimate).[10]

Still, Governor Davis & Co. relentlessly remind us that the crisis broke once federal price controls were imposed on the western power grid. Doesn't that prove that the suppliers engineered the crisis? No more than a rooster crowing proves that the sun comes up only at the behest of barnyard fowl. Just as price controls were imposed, natural gas inventories in the West became normal again after reaching levels more than 50 percent below the five-year average during February 2001.[11] Electricity demand and thus natural gas demand were already reduced because of the recession in the spring of 2001. With less natural gas used to generate electricity and

no place to store it, prices for natural gas plummeted.[12] And lower natural gas prices reduced electricity costs.

Had federal price controls been imposed before or after those events, the correlation between intervention and the price collapse would disappear. Luck, however, was on the governor's side.

Who's to Blame for Manipulation?

California politicians didn't allow electricity market structures to arise naturally. Instead, regulators thought that they knew best how the electricity market should work and then mandated industrial structures and convoluted economic institutions to make that vision a reality.

If Enron or others went outside the law to make a buck, they should be prosecuted. But the responsibility for the games played within the system rests not with the players but with the politicians who crafted the rules of the game in the first place. They didn't trust markets—they trusted regulators, power exchanges, nonprofit grid operators, and state-mandated prices even when many people cried loudly that such rules and price controls create perverse incentives and cripple the market.[13] There's blame enough to go around.

Notes

1. The memos are available on the federal Energy Regulatory Commission website, www.ferc.gov/electric/bulkpower/pa02-2/pa02-2.htm#memo. The memos are under the heading: "Follow-up questions with respect to Enron memoranda discussing Enron trading strategies in California whoesale energy markets and California ISO sanctions for such strategies." The memo of December 6 and the "Enron Status Report" (not dated) are the source of the trading strategies discussed in this paper.

2. Scott Harvey and William W. Hogan, "Issues in the Analysis of Market Power in California," October 27, 2000, http://ksghome.harvard.edu/~.whogan.cbg.ksg/HHMktPwr_1027.pdf.

3. Severin Borenstein, James Bushnell, and Frank Wolak, "Measuring Market Inefficiencies in California's Restructured Wholesale Electricity Market," University of California, Center for the Study of Energy Markets Working Paper 102, June 2002, pp. 19–20, www.ucei.org/PDF/csemwp102. pdf.

4. Tim Brennan, "Questioning the Conventional 'Wisdom,'" *Regulation* 24 (Fall 2001): 65.

5. See Jerry Taylor and Peter VanDoren, "California's Electricity Crisis: What's Going On, Who's to Blame, and What to Do," Cato Institute Policy Analysis no. 406, July 3, 2001, for a discussion of the causes of the California crisis.

6. The rate at which the energy contained in natural gas is converted into electricity is called the "heat rate." A standard heat rate for an older plant is around 10,000 British thermal units per kWh. The most inefficient plants, whose costs determine the market price, require 16,000 Btu per kWh. The rate of 10,000 Btu per kWh is often used for rough calculation because natural gas prices in dollars per million Btu become electricity prices in cents per kWh. For example a $10 per million Btu natural gas price results in 10 cents per kWh electricity costs in a 10,000 Btu per kWh electric generating plant. See Edward Krapels, "Was Gas to Blame? Exploring the Cause of California's High Prices," Public Utilities Fortnightly, February 15, 2001, p. 32, for an example of use of the rough calculation for an average and an inefficient plant. Thus the $5.00 per million Btu natural gas price in the summer of 2000 translates to 8 cents per kWh cost (5×1.6) of the output from an inefficient 16,000 Btu per kWh plant and the $25 per million Btu natural gas price results in 40 cents per kWh from the same plant (25×1.6). By the summer of 2000, NO_X credits were selling for $30 to $40 per pound. Carl Levesque, "Emissions Standards: EPA, High Court, and Beyond," Public Utilities Fortnightly, January 1, 2001, pp. 46–47. Because an inefficient gas-fired plant emits about two pounds of NO_X per mWh, NO_X credit prices of $30 to $40 per pound necessitate an additional cost of $40 to $80 per mWh (4 to 8 cents per kWh). Krapels, p. 29. Adding 8 cents per kWh to the previously calculated 8 and 40 cent figures gives the cost estimates of 16 and 48 cents per kWh.

7. Conversation with Jerry Taylor, February 8, 2002.

8. Borenstein, Bushnell, and Wolak, pp. 2, 29.

9. Harvey and Hogan, p. 69.

10. Cited in Patrice Hill, "Regulators Say Enron Drove Up Prices," *Washington Times,* May 16, 2002, p. A3.

11. The Energy Information Administration estimated that for the week ending February 23, 2001,

natural gas stocks in the West were only 32 percent of capacity (less than half of the five-year (1995–99) average). See Energy Information Administration, *Natural Gas Weekly Update,* March 5, 2001, www.eia.doe.gov/oil_gas/natural_gas/data_publications/natural_gas_weekly_market_update/ngwmu.html. Inventories reached normal levels by mid-July and as of June 6, 2002, were 27 percent above the five-year average.

12. The spot price at the Southern California City Gate decreased from $14.51 per million Btu on April 30, 2001, to $3.24 on August 13, 2001. See *Natural Gas Weekly Update* May 7 and August 20, 2001.

13. For an alternative restructuring proposal without those drawbacks, see Richard Gordon, "Don't Restructure Electricity; Deregulate," *Cato Journal* 20, no. 3 (Winter 2001): 327–58.

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