obligations. When these products are obtained at fixed prices through a competitive auction, these products provide electric utilities with all of the necessary services for meeting their default service obligations, including management of the risks inherent in energy markets, at competitive prices. De Castro *et al.* have failed to properly analyze these fixed-price full-requirements load-following products and arrive at meaningless conclusions regarding their appropriateness in the electricity sector.■

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Endnotes:

1. In regions where retail competition has been introduced, default service is the power supply that a utility provides to customers that do not elect to take power supply from an independent retail provider or to customers who elected to take power supply from an independent retail provider, but subsequently need power supply because their independent retail provider has failed to deliver. Other common names for default services include: provider of last resort (POLR) service, supplier of last resort (SOLR) service, standard offer service (SOS), and basic generation service (BGS).

2. See New Jersey Statewide Basic Generation Service Electricity Supply Action: Overview, available at http://www.bgs-auction.com/bgs.auction.overview.asp.

3. Joseph Cavicchi and Andrew Lemon, *Power Procurement: What's in Your Mix?*, PUB. UTIL. FORTNIGHTLY, Nov. 2006, at 50.

4. Load-following products are typically solicited in units called ''tranches'' where a single tranche represents a fixed percentage of the load.

5. In this sense, the proposal by de Castro *et al.* resembles a managed portfolio. See National Association of Regulatory Utility Commissioners, *Energy Portfolio Management: Tools & Resources for State Public Utility Commissions* (2006).

6. Of particular note is the fact that the ownership of generation assets in New England has become less concentrated following the use of load-following products that accompanied the introduction of retail competition.

7. De Castro *et al.* arrive at their faulty conclusion because their flawed logic violates the law of iterated expectations. See WILLIAM H. GREENE, ECONOMETRIC ANALYSIS, 2nd Ed. (Macmillan Publishing, 1993) at 69.

8. While it is more natural to think of a supplier as selling a load-following product, we continue with de Castro *et al.*'s awkward example in which a supplier buys a load-following product (the economics work in both cases). Consider a load-following product for 1 percent of the load to be delivered during a specified future month. Also assume that the current price is $20/MWh and that the electric utility estimates that 1 percent of the load during the specified future month is 100 MWh. Suppose a supplier believes that tomorrow's price will be $25/MWh and that this supplier estimates that 1 percent of the load during specified future month is 80 MWh. For this supplier, there is a profitable arbitrage opportunity to buy the load-following product at $20/MWh because they would pay $1,600 today (i.e., $20/MWh × 80 MWh) for a product that would be worth $2,000 tomorrow (i.e., $25/MWh × 80 MWh). If other marketplace participants similarly believe the price tomorrow will be $25/MWh then demand for the load-following product will increase until the price today is $25/MWh, regardless of what quantity of MWh each marketplace participant prescribes to 1 percent. The economics decision facing each supplier is tied to its own beliefs regarding what the price will be tomorrow relative to today (in terms of $/MWh) and its own beliefs regarding the quantity of MWh represented by 1 percent (not the electric utility's or any other marketplace participant's belief). Basic economic forces apply to load-following products.

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De Castro et al. Respond: Our Analysis of Ill. Market Was Thorough, in Context

When academic professionals – as we are – write about a subject, we aim to reach sound, logical, and objective conclusions. We also expect that readers will read the work from such a perspective. We are therefore very disappointed to read the negative remarks of Cavicchi and Lemon's letter, with the profligate use of the adjectives

''flawed'' and ''faulty'' but without any factual or logical basis for the statements. We are very open to criticism but we are unable to find much insight in the unsubstantiated claims by the authors. In this reply, we will explore their ''appropriate framework'' and their ''thorough analysis'' and show that the accusations that they leveled at our article are baseless and incorrect. We reinforce the arguments previously provided in our article and add new points to further clarify the claims made.

I. Setting the Stage

We show in our article that the tranche-based contract defined as percentage of the load is the root of all the problems in the 2006 Illinois Electricity Auction. The definition is the source of the large uncertainty that the suppliers must bear and consequently one of the sources of the high prices that resulted. The primary objective of the Auction was to ensure that adequate capacity and energy will be available to meet the unknown loads, no matter what they will be and not withstanding how different they will be from the historical past. As we present in our article, the tranche-based product cannot capture in any way the salient characteristics of power systems, such as the fact that *not all* MWh are produced by the same generating units and that a MWh produced at the peak load hour will have a very different cost than one generated during the night. Baseloaded units have *completely* different physical and economic characteristics than cycling and peaking units. For example, a nuclear unit is typically baseloaded and operates more or less at a flat output level due to the complexities of ramping up[1] and down such a unit. Therefore nuclear units cannot provide a tranche product since these units are not load-following entities. In contrast, the expensive peaking units are used sparingly so as to rein in total production costs. It falls on the cycling units to provide the load-following capability and they are cycled to operate as the load changes. Thus, the tranche product can be produced by aggregating the outputs of different technologies to produce the appropriate supply to exactly match the demand. In the state of Illinois, with almost 50 percent of electric generation energy[2] coming from the largest nuclear fleet in the nation, a predominant fraction of the capacity *cannot* directly provide the tranche product.

Clearly, the only way to get such a product to adequately meet the demand is by bringing in middle men to package the various outputs.

Clearly, the only way to get such a product to adequately meet the demand is by bringing in middle men to package the various outputs – a responsibility traditionally borne by the load-serving or the distribution companies, which bear the obligation-to-serve requirement and not by using the unnecessarily expensive services of the middle man. The Illinois customers are therefore prevented by the use of the tranche product from benefiting from the economic outputs of the generating units in their state and must depend on the middlemen and pay the expensive fees to obtain the needed electricity supply. It makes much more sense to define a product in terms of blocks, as our article proposes, to effectively use the resources that the majority of the rate payers have already paid for and to bypass the need for the middleman. In such a way, we are much more likely to obtain the lowest costs to meet the demand by harnessing the fruits of competition.

Another important point discussed in our article is the fact that these contracts provide an expensive insurance to distribution companies. About this, the authors claim that ''. . .because these full-requirements[3] load-following products are obtained at a fixed price, these products provide risk management services that address the inherent uncertainty in energy

markets.'' Since the authors choose to completely ignore the extended discussion in our article about risk management issues, and how the tranche-based products provide an overly expensive ''insurance'' for end users, any reiteration will fall again on deaf ears. The statement that the tranche products ''provide risk management services that address the inherent uncertainty in energy markets'' is correct, as we said above, but these services are too expensive for the customers to bear. In fact, the experience to date clearly indicates that the customers would have fared far better being subject to the volatility of the markets than paying the high fixed prices that emanated from the Auction.

The authors claim that ''By procuring load-following products through auctions, electric utilities are able to obtain the supply necessary to meet their default service obligation at competitive prices.'' With the experience of a full year behind us, we know that for 2007, the prices of the Illinois Auction were higher than the market prices 90 percent or more of the time.[4] One of the main reasons for the use of a fixed-price auction was to find a source of supply so that the distribution companies would not need to be dependent on the volatility of the markets and be subjected to the price spikes. Thus, to have a result where the fixed prices are more than 90 percent higher than the spot prices is to completely miss the intended objective of the Auction.

The authors claim that ''... the suppliers who are awarded contracts bear the risks associated with price and volumetric uncertainty'' and ''...these suppliers use their expertise in the marketplace to assess future market conditions and answer relevant questions...'' Notwithstanding the fact the restructuring of the electricity industry has brought financial participants,[5] the key players of the industry are, and will still be, generation companies with physical assets. No matter how much financial players contribute, the reliable supply of electricity must depend on the players with the actual physical assets. No option, no matter how exotic, has been shown to produce a single MWh of electricity. Hence, it is not clear than shifting all the risk into suppliers, even if they have the expertise to effectively manage it, can lead to an *improved* market design for *reliable* and *cost effectively priced* electricity.

The contracts are designed to explicitly respect the physical and technical considerations and constraints of power systems.

We believe load-following or tranche-based products do not distinguish between financial and physical players. Our proposition aims to effectively harness the abilities of both physical and financial players to bring about lower prices to the end users. The block products, which do not carry any volumetric or capacity uncertainty, are the natural outputs that the physical units can efficiently produce without requiring the intervention of the financial players and the payment of their transaction fees for the packaging of the unit outputs. In this way, the contracts are designed to explicitly respect the physical and technical considerations and constraints of the power systems. Financial players may have advantages on dealing with the uncertainties associated with the difference between the block supplied load and the actual load.

The authors claim that our comparison of the Auction prices with the LMP is ''fundamentally flawed.'' We regret that we must strongly disagree with this statement because, as we stated above, the desire to escape from the high volatility of these LMPs was the driver to adopt a mechanism to establish contracts for supply. The LMP at a node is the costs to supply an additional MWh at that location and is determined for a specific snapshot of the system. The LMP represents the energy component,[6] the congestion component, and a loss component. Ancillary service

costs are not component on the LMP; however their costs constitute a rather small portion of the total electricity costs. Absent congestion, the LMPs at the different system nodes would be equal in a lossless network. In addition, to provide some averaging of the results, we report the LMPs in our comparison not at a physical node, but at a ''composite node'' constructed using the information from a collection of about 150 nodes in central Illinois. The huge differences between the LMP and the Auction prices that we found reflect the shifting of the risk onto the sellers' shoulders and the high associated insurance premiums. These are needed to overcome the artificiality or impossibility of any single generating unit to effectively provide tranche-based load-following products. Indeed, the definition forces each seller to become a mini-distribution company serving a scaled down version of the system load.

II. Cavicchi and Lemon's ''Appropriate Framework'' and ''Thorough Analysis''

In the first section of their comment, Cavicchi and Lemon begin by claiming that the ''load-following products have been used successfully for years to supply default service in numerous jurisdictions,'' with a list that includes ''Connecticut, Delaware, the District of Columbia, Massachusetts, Maine, and Maryland''. In any paper, the reader may expect an objective source for such a wide-ranging claim. Unfortunately, the authors only offer their own paper, ''Power Procurement: What's in Your Mix?'' published in *Public Utilities Fortnightly* in November 2006. However, the conclusions reached in that article are very different than the statement above. Their classification of the experience of various states for the procurement of electricity supplies leads to two basic approaches – one that is roughly a competitive acquisition mechanism of what they now call ''load-following'' products and the other a procedure used in states where retail competition has not been introduced. Their conclusion states that: ''no current studies suggest any one approach is preferable.'' The reader may be a little confused – as we were at the beginning – how such an indeterminate finding becomes a statement of unqualified success.

We cite four jurisdictions - Illinois, New Jersey, Ohio, and Maryland - where the results were anything but successful.

Unfortunately, the veracity of the statement that ''load-following products were successfully used in many states'' is questionable given the sequence of problems with such auctions. We cite four jurisdictions – Illinois, New Jersey, Ohio, and Maryland – where the results were anything but successful. Indeed, the motivation for our involvement in this research was the complete and utter failure of the 2006 Illinois Electricity Auction. Its one-time used was followed by its abolishment as the resultant high prices pushed the entire state into a political crisis that took nearly a year to resolve. Electricity rates in New Jersey have increased considerably since the adoption of the auction. Regulators in Ohio rejected the results of the auction in 2004 due to the high prices of the auction outcomes. The second attempt was canceled because few bidders were interested. In Maryland, the implementation of the auction in 2007 resulted in a 72 percent increase of the electricity rates over the previous rates, the firing of the PUC commissioners and the election of new commissioners. This short list suggests less than an unmitigated success.

But let us return to Cavicchi and Lemon's ''appropriate framework.'' This consists in observing that the contracts used to solve the problem of procurement of *electricity* need to be analyzed considering the whole set of services they provide. They claim that ''beyond electrical energy, these full-requirements

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load-following products provide congestion management, capacity, ancillary services, and in many instances renewable energy credits.'' We focus on the energy component for being the principal cost causation factor in the contracts. Moreover, on the Post-Auction report[7] of the Illinois Commerce Commission (ICC), based on recommendations of the independent auction monitor of the 2006 Illinois Electricity Auction, it is clear the cost associated with ancillary services is a small component. It considers that ancillary services contribute less than $2/MWh to the final Auction prices that ranged from $65 to 90/MWh.

They continue by stating that ''the price of default service obtained through load-following products purchased through auctions reflects all costs associated with such supply as determined by competition in the marketplace.'' Since an auction with a relatively small number of participants, some of them with considerable market power, will not have all the good properties of a perfectly competitive market, this statement reflects unreasonable hope. In fact, as we argue in our article, these contracts favor big players, reducing the competition, with negative effects to the competitive forces that would lead the prices to the true costs.

Then, they discuss our proposal and state that it ''will not necessarily provide such supply in a fashion that is low cost (. . .)''. This seems to indicate that the authors have no argument leading to the conclusion that our proposal is bad.

III. Review of the ''Flaws'' in Our Analysis

For the sake of effectiveness, we are going to go point by point in Cavicchi and Lemon section about ''Flaws in the Analysis by de Castro *et al*.''

We are unaware of any scheme that allows us to know the ''expectations'' in the minds of the market participants.

• The authors claim that ''the 2006 Illinois auction are forward prices and cannot be compared to subsequent spot market prices which are real-time prices'' and ''Comparing *ex ante* future prices with ex post spot prices is meaningless.'' Such a statement is really difficult to understand, because in the following page the authors cite the *law of iterated expectations*, which implies, under standard conditions, that the price of an asset today is the expectation of the price in the future. Since they quoted the law, we are convinced that they know this. Therefore, the only explanation that we have for these apparently contradictory statements is that they think that expectations about prices have nothing to do with actual prices. If expectations are rational, they will be close to the average of actual prices and this allows us to make the comparison. Of course we would like to make the comparison of the prices in the Auction with the actual *expectation* about the prices, but we are unaware of any scheme that allows us to know the ''expectations'' in the minds of the market participants.

• The authors claim that ''de Castro *et al.* fail to recognize that fixed-price full-requirements load-following products can be inappropriate for supplying certain types of default service customers.'' Clearly, the authors failed to read the section about ''migration risk'' in our article. Indeed, their statement misses completely the fact we give the explanation that the source of the higher prices for the commercial customers than those for the residential ones. We explicitly discuss in the article the way large customers with the possibility of switching service providers further exacerbate the volumetric and capacity uncertainty inherent in the tranche-based contracts to produce additional uncertainty arising from migration.

• The authors claim that we ''incorrectly portray fixed-price full-requirement load-following products as being provided by generating units'' and explain that this is not the case because ''load-following products include

other services that are of no consequence to generating units.'' Thus, they are saying that because of a small part of the contract obligation, there is no reason to believe that the sellers of contracts in a procurement of *electricity* should be generating units. It is interesting to observe that the main players and winners of the Illinois Auction were companies with large physical capacity. In fact, the big winner of contracts, with 35 percent of the total number of products for one of the distribution companies was Exelon, the owner of large nuclear capacity in Illinois. From this, we simplified our discussion by referring primarily to generating units, but this expository choice is not central and has no importance for the points that we made about the bad properties of the tranche products.

• According to the authors, we ''conclude that load-following products *will inevitably* lead to consolidation among generation suppliers'' (emphasis is ours). We searched our article for such a strong statement, but we found instead the title of the subsection: ''the artificiality of the contracts *favors* a concentrated market structure.'' The change from ''favors'' to ''will inevitably lead to'' illustrates how careful the authors are in reflecting our points of view.[8] In addition, they offer as a counter-argument to our analysis their Table 1 to show that many financial institutions did offer load-following products in the Auction. We appreciate greatly the support that the Table 1 provides to effectively illustrate our analysis. The reader shall remember, from the previous paragraph, their explanation for why the suppliers of the contracts are not only generating units, but also financial companies: this occurs because the contracts include other services, such as congestion management and ancillary services. In other words, they are saying that financial institutions, e.g. J.P. Morgan and Morgan Stanley, participate in the Auction because they may have an expertise in ''providing'' congestion management or ancillary services. In comparison, our analysis of the concentration of the market is so much more mundane that we are almost ashamed by the fact that it can offer a better explanation for the participation of financial companies. In our article, we explain how difficult it is for small companies to provide the tranche product. With a small and/or non-diverse set of generating units, small companies face huge costs to produce energy in the actual shape of the demand, as the tranche products require. Therefore, big companies that can provide energy in the shape of the demand have a competitive advantage. The alternative for small companies is to negotiate contracts among themselves or, alternatively, with another entity that will deliver the aggregate of their outputs to provide the tranche product. Of course this is what financial companies are doing, acting as middleman for selling these products. Thus, Table 1 of the authors' reply indeed is a strong confirmation of our analysis. To be fair, we failed to explicitly mention in our article that the negotiators of the contracts between generators may be financial entities.

Big companies that can provide energy in the shape of the demand have a competitive advantage.

• The authors claim that we ''ignore basic economic logic'' and presented a ''flawed'' and ''awkward example'' to argue that load-following products will not represent marketplace expectations of future prices. They claim that we arrive at a ''faulty conclusion because [our] flawed logic violates the law of iterated expectations.'' They claim that buyers ''will base their decision on their *own internally consistent expectation* of the future quantity of load represented by that percentage'' (the emphasis is ours). Unfortunately, Cavicchi and Lemon fail to see the main objective of our example, which is to illustrate problems with aggregation of information. Aggregation of information is the property of well-behaved markets

by which prices reflect the average updated belief of the different participants, buyers and sellers. With respect to this point in our article, we argue that for the market of normally defined products, negotiated in a ''well-behaved'' market, there is indeed aggregation of information. Then, we show through an example that this aggregation of information is less effective in a market of tranche products because market participants may have inconsistent beliefs about the nature – volume and shape of the demand – and still the market fails to aggregate these beliefs in a manner that brings overall consistency. Note that while the beliefs may be ''internally'' consistent as in the authors' example, they can be *inconsistent* among the participants. As the authors carefully use the expression ''own internally consistent expectation'' in their example, their comments actually mean that they agree with us.[9]

IV. A Final Suggestion

If the load-following contracts were so effective as Cavicchi and Lemon argue, we suggest to them to try to sell this idea to design future contracts of a much more common and less complicated[10] commodity such as oil. Instead of the natural contracts with dollars per barrel, they would propose the ''*very nice*'' ''load-following-type'' contracts that specify that the suppliers must sell a percentage of the (unknown) future consumption, instead of an actual quantity. We fail to see how we can apply their basic economic logic and respond to market participants who object that nobody knows what the consumption will be and that this type of contract is unnecessarily too risky. Indeed, as Cavicchi and Lemon ''demonstrate'', the attractive characteristics of the load-following contracts are so overwhelmingly strong that we look forward to seeing them convince the appropriate authorities to have their implementation in some appropriate commodity exchange.

Maybe the authors can argue that electricity markets are different from standard commodity markets and this would explain why tranche contracts are good for electricity but not for these other markets. We agree that the markets are very different, but the differences make such tranche contracts even *less* acceptable in electricity markets than in standard commodities markets. The reason is that, as we pointed out in our paper and also in the first section of this rebuttal, electricity cannot be stored, and the costs of producing energy at different circumstances (base, cycling and peak) are very different. One barrel of oil is the same of another barrel of oil, no matter when it is consumed. One *MWh* consumed at night is *different* from another *MWh* consumed during peaking hours. Therefore, as we have extensively argued, to trade 1% of the consumption is much more inconvenient in electricity than it is in standard commodity markets.

V. Conclusion

We carefully responded to each of the charges and claims leveled by Cavicchi and Lemon against our article. The explanations in this discussion serve to provide further strength to the logic of our arguments in the article and to again recognize that no matter how the electricity markets are designed by researchers or policymakers, sometimes focusing on only financial aspects, electrons will require physical generating units that cannot contravene and violate the basic laws of physics.■

Luciano de Castro
Matias Negrete-Pincetic
George Gross

Endnotes:

1. Such technical issues can have huge impacts on the market performance. See for example the interesting works by I.-K. Cho and S.P. Meyn about the impact of ramping constraints on real-time electricity markets on ''Math model explains high prices in electricity markets,'' Oct. 2005 SIAM News survey, available at http://decision.csl.uiuc.edu/~meyn/pages/publistNetworks.html.

2. In 2006, 48.9 percent of the total generated electricity in Illinois came from nuclear units, http://www.eia.doe.gov/cneaf/electricity/st_profiles/sept05il.xls.

3. The full requirements term, as used by the authors, surely has not the common meaning used by the electricity industry. The meaning of full requirements is inapplicable given the unbundling of the industry following FERC Orders No. 888–890.

4. The rationale for the comparison of the Auction prices with location marginal prices (LMPs) is addressed later.

5. We value the participation of financial entities in electricity markets. See for example a previous work by our research group, T. Guler, G. Gross and R. Nelli, http://energy.ece.uiuc.edu/GROSS/papers/2007%20Aug-%20The%20Economic%20Aspects%20of%20Operational%20Reliablity%20in%20Elect%20Markets.pdf THE ECONOMIC ASPECTS OF OPERATIONAL RELIABILITY IN ELECTRICITY MARKETS, BULK POWER SYSTEM DYNAMICS AND CONTROL - VII. Revitalizing Operational Reliability, 2007, iREP Symposium, at 1–10, 19–24, August 2007.

6. See for example, T. Orfanogianni and G. Gross, A General Formulation for LMP Evaluation, IEEE TRANSACTIONS ON POWER SYSTEMS, vol. 22, no. 3, August 2007, at 1163–1173.

7. ICC Staff's Public Post-Auction Report of the Illinois Auction, available at http://www.illinois-auction.com/resources/ruling/ICC_Staff_Public_Post-Auction_Report_Dec_6_2006.pdf, at 15–16.

8. To be fair, we also wrote: ''If this market design persists for a sufficiently long time, the market structure will naturally become more concentrated (. . .)'' We were prudent enough to include a conditional phrase, because there are many variables affecting actual economic outcomes, especially in the short run. We should also add the comment that concentration in the market does not necessarily mean ownership. For the sake of the auction, concentration via middlemen is more or less equivalent.

9. It is interesting that the authors could have leveled a more serious criticism on this point if they had argued exactly in the opposite direction. They seem to believe that all markets perfectly aggregate all information, even if it is a one-sided auction with relatively few participants. Even at a theoretical level, this is disputable. Some recent papers analyze the conditions under which information is aggregated in markets. Despite the ''basic economic logic of the law of iterated expectations,'' Ottaviani and Sorensen (2007), among others, show that information aggregation may fail to occur even under highly favorable circumstances. [0] Therefore, they could have criticized our arguments by saying that the original market do not well aggregate information and, therefore, this point is of less relevance. But, this statement is precisely the antithesis of what they stated. Our answer to this more legitimate argument is that we are just comparing the two definitions of the products and showing that the load-following products are worse in this aspect.

10. Oil has been traded as a commodity many years before electricity and does not have any of the special characteristics of electricity such as instantaneous use, lack of big storage capabilities, and several technical constraints on the generation process.

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Cavicchi, Lemon Offer 'Our Humble Response'

We regret that de Castro *et al.* seem to have taken our modest remarks regarding their research as a personal attack. Instead of objectively reviewing their own conclusions in the light of our criticism, they obfuscate the shortcomings of their analysis by engaging in disconnected reasoning and continued misuse of economics. In essence, de Castro *et al.* indict load-following products based on the prices of Illinois's 2006 auction, which they characterize as high.[1] They contend that an alternative approach to procuring electricity would yield lower prices, but offer no analysis to substantiate this proposition.[2] Rejecting the use of load-following products cannot be based on such flimsy grounds. Indeed, de Castro *et al.* do not address our main point that an electric utility cannot be expected to achieve lower prices for default service through a managed portfolio when the electric utility faces no competition in managing such a portfolio. Any reader familiar with electricity markets and trained in economics will recognize the sound foundation upon which our criticism rests.[3]■

Joseph Cavicchi
Andrew Lemon

Endnotes:

1. High or increasing prices can arise from many factors and cannot simply be attributed to the use of load-following products as de Castro *et al.* would have us believe. In discussing of our remarks, de Castro *et al.* also find fault with the auctions in New Jersey, Ohio, and Maryland for similar reasons, but do so without examining the context and institutional details of each case (i.e., no analysis).

2. For example, de Castro *et al.* claim that the risk management services provided by load-following products are excessive and lead to prices that are higher than those that the electric utility can achieve through a managed portfolio, but they offer no analysis to demonstrate this claim. Instead, they say that ''expensive'' middlemen drive up these prices without any analysis of said middlemen or the ability of an electric utility to provide the risk management services at a lower price.

3. In our earlier remarks, we cite an article that we wrote because it

