Strategic Interaction Via Derivatives: on the use of swaps in electricity markets

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Electricity spot prices are highly volatile and may expose market participants to substantial price risk. To mitigate this risk, market actors typically insure against price volatility by signing forward contracts. As a consequence, electricity generating companies can take financial positions on derivatives markets while at the same time being active on the "physical" power market. This paper discusses how derivatives markets can be used as a commitment device for generating companies to lock into collusion-like strategies in the physical market.

A case in point has been observed in the New York power market, more specifically, on the ISO capacity market in New York City, where two major electricity producers, KeySpan and one of its largest competitors, Astoria, both engaged in a financial arrangement. Each month, both firms bid their available generation capacity into the New York City capacity market auction and, if procured, must offer energy during the next month's electricity spot market.

In 2006, KeySpan and Astoria signed opposite swaps with Morgan Stanley – based on a strike price in the capacity market they were active in. KeySpan signed a swap contract specifying that, for a quantity of 1800 MW, Morgan Stanley will pay KeySpan the difference between the realized market price and the strike price of $7.57. Payments would reverse for market prices below $7.57. Astoria signed the opposite swap contract, paying to (be paid by) Morgan Stanley the difference of any price above (below) $7.07. Putting aside Morgan Stanley's $0.5 margin, these opposite swap contracts constitute transfers between Keyspan and Astoria.

Drawing from this particular case, below we provide an analytical framework to understand how such financial schemes may affect competition in electricity spot markets (and capacity markets, as in the example above). We focus on uniform price auction markets, which constitute the dominating auction format in electricity wholesale markets. Following Fabra and von der Fehr (2006) and Schwenen (2015), we consider a multi-unit auction framework in which two capacity constrained bidders with constant marginal costs compete in electricity auctions. As most power markets feature price or bid caps, we assume that a ceiling price exists in the physical electricity market. Prior to the electricity wholesale market stage, the two firms may sign opposite swap contracts with a financial intermediary. We argue that swap contracts may be used as a commitment device to either increase market prices or, alternatively, to lock-in one of several possible pricing equilibria on the physical market.

Note that in the physical market, each firm is pivotal when both firms' capacities must be deployed to satisfy demand. In these cases, all pricing equilibria are characterized by one firm being inframarginal and its rival firm submitting a high, market clearing price (that both firms receive). Due to its market power vis-à-vis residual demand, the price-setting firm can charge a high, supra-competitive price. It might however compromise on selling parts of its capacity. If its inframarginal competitor is bidding low enough, undercutting is, however, no profitable option for the price-setting firm, so that it in equilibrium prefers to serve the remaining demand left by its competitor.

How can derivative contracts change these market outcomes on the physical market? Suppose the contract is specified as in the example above from the New York power market, a market that can indeed be characterized as a very concentrated market. Further suppose that the price cap is not binding for the price-setting firm's optimal bid on the spot market. Lastly, assume that the two firms have clearly assigned who will be the price-setting bidder. Then, signing an opposite swap increases both firms' profits. The intuition is as follows. The price-setting bidder specifies a contract that creates transfer payments for higher prices than the strike price and is consequently willing to offer a higher bid. The firm thereby increases the market price. Crucially, this firm gets the higher price not only for its dispatched units, but also for the swapped quantity specified in the financial contract. Moreover, the increased spot profit (due to the higher market price) for the inframarginal firm may be large enough to more than offset the swap payment it has to make to the price-setter via the financial intermediary.

However note that this result holds only if the price cap is not binding ex ante of the swap, and therefore higher market prices can indeed be realized. Otherwise, when the price cap is already binding prior to the swap, such financial agreements, of course, cannot trigger a market price increase and cannot generate and allocate additional profits among the contract parties. Interestingly, before KeySpan and Astoria signed their swaps, the market price had constantly been equal or close to the price cap.

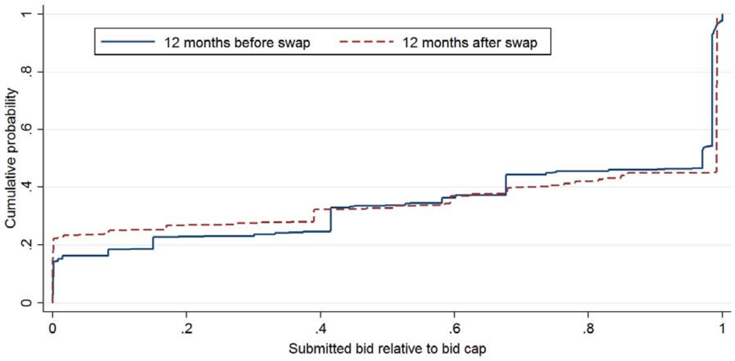

Figure 1: Cumulative distribution of submitted bids. Data downloaded from the NYISO's website.

Figure 1 shows the cumulative distribution of all bids submitted to the monthly New York City capacity market for the 12 month prior and for the 12 month ex post of the start of the swap. Submitted bids are plotted relative to the bid cap, so that a value of 1 represents a bid equal to the price cap. As can be seen, before and after the swap a mass of bids was submitted at bids equal or close to zero (about 20%). These were low bids by inframarginal firms. Importantly, before and after the swap a similar mass of bids was also submitted at the price cap (more than 50% of all bids). These are the price-setting bids. In fact, each of the 12 auctions prior to the swap cleared at or close to the price cap already. Hence, all else equal, the swap could not have been motivated by increasing the market price for capacity. Given the similarity in the bidding strategies prior and after the swap, it may at first be difficult to rationalize the reasoning behind KeySpan's and Astoria's financial positions.

So far, by assumption, the identity of the pivotal bidder had been clearly assigned. However, from previous theoretical literature it is well-known that with sufficiently symmetric firms, each firm would prefer to be the inframarginal one, sell all its capacity and be rewarded at the high market price determined by its competitor. As Le Coq et al. (2017) already point out, players in such games consequently face a severe coordination problem.

In the presence of a price cap, it is this coordination problem that may be resolved by firms signing opposite swap contracts. Here, swaps can act as a commitment device. The transfers implicitly determine what firm will be the inframarginal one and what firm will be price-setting. This is in line with the industrial organization literature that shows that side-payments may be used by firms to enforce collusion (Harrington and Skrzypacz, 2007). There is therefore a rationale for signing opposite swap contracts between two generators, even when the price cap is binding and no price effect is expected. Firms simply agree on who has to be inframarginal and who has to be pivotal. In the above example, if Astoria was price-setting, its incentives to set a high market clearing price would clearly be downward biased by the swap agreement. Therefore both KeySpan and Astoria would prefer KeySpan to set the market clearing price. It still holds that the pivotal firm, here KeySpan, then wants to price high and the inframarginal firm sufficiently low in equilibrium, but the roles in this game are clearly assigned and the coordination problem on what firm will be price-setting is solved.

It is interesting to note that in the example market above, KeySpan was always the high, market clearing bidder and Astoria the low and inframarginal bidder. Before the swap came into force, Astoria invested in new capacity and then closely matched the generation capacity of KeySpan. According to theory, becoming more symmetric makes the coordination problem more severe. Signing this opposite swap contract may have been the solution to countervail the increased symmetry between the two firms. An empirical analysis would however be warranted to fully assess the mechanism that we are suggesting.

The described swap eventually turned into an antitrust case. The corresponding complaint argued that "the clear tendency of the Morgan/KeySpan swap was to alter KeySpan's bidding" (US District Court, 2011). This paper shows that the discussed financial scheme may indeed increase KeySpan's market power but only with a non-binding price cap. Our theoretical considerations above provide another rationale for signing swaps – that is beneficial to market actors even with equilibrium prices unchanged. To conclude, if firms are (or are becoming more) symmetric, swaps may work as a commitment device towards solving coordination and free-riding problems by transferring rents via the financial market.

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