For an exchange of roles in the capacity remuneration mechanism

Exploring the link between the auction scheme and the counterparty risk

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Abstract

This short paper wants to assess the suitability of the capacity remuneration mechanism (CRM). The solid financial background of the author helped in going deeper into this regulatory conundrum to propose a less intrusive and more market-sounding perspective. We suggest a paradigm shift that might reveal particularly beneficial in terms of aggregate welfare and systemic risk.

1 Introduction

This short paper wants to assess the suitability of the capacity remuneration mechanism (CRM). The solid financial background of the author helped in going deeper into this regulatory conundrum to propose a less intrusive and more market-sounding perspective. We suggest a paradigm shift that might reveal particularly beneficial in terms of aggregate welfare and systemic risk.

In an energy production market that is increasing competitiveness and decreasing the loads, production companies are asked to receive adequate financing for building their plants to renounce their relevant profits coming for moments when the market shows excess demand. Unfortunately, these are the few moments where producers can make relevant gains suitable to cover investments. As a result, this scheme prevents the development of some assets in renewable energies or even in highly efficient traditional plants. In the few moments of instability, where markups are relevant, producers are asked to sell to the dispatching operator at a fixed strike. The dispatching operator is asking, basically, as a penalty for participating in the mechanism, to renounce a relevant share of the producer's profits. Note that the dispatching operator is not obligated to pass part of the profits he makes in peak demand moments to final consumers. We propose to switch the option scheme: to shift from a call to a put option, switching even the sides of the options market. The producers buy a put option while the dispatching monopolist sells the put in terms of overall counterparty credit risk. There is a general decrease in aggregate risk levels, as the credit risk of public (o quasi-public) monopolists is significantly lower than that of a private firm. This will be, for motivations given more extensively in the following pages, improving the aggregate welfare. Furthermore, the auction's object will no longer be the upfront cost of the (previously) call option but instead the strike of the put. The lower the strike, up to the lower bound, the higher the social welfare.

2 The rationale behind the capacity remuneration mechanism

The share of energy coming from renewable energies is significantly increasing in the Italian and EU energy supply basket. Unfortunately, solar, wind and ocean energy are more variables than traditional energy sources. It means that the supply becomes more variable over time. The probability of a market failure caused by excess demand is becoming more consistent. This is also due to the shifts in demand composition (electric cars, more public transportation, and industrial demand) that will contribute to the increase in the probability of excess demand in the future. Since a misfunctioning market is associated with a lower (null) social welfare, it is optimal to remunerate additional capacity to the suppliers.

Suppliers are, in this market, not only remunerated by the energy they sell but also for their readiness. The impact of the nuclear plants on the market design between CRM and the price-only market should be adequately considered: in fact, the presence of this fixed component of supply (the time required to switch on/off a nuclear plant is particularly long) seems to significantly decrease the need for such a regulated market, driving to a more *laissez-faire* approach, relying on the almost sure supply by nuclear energy. Nuclear energy efficiently solves the capacity problem if combined with pumped storage. The night excess supply works to reverse the water cycle, the best capacity accumulator nowadays. In these markets, the distribution operator pays some producers to be ready to supply a certain amount of electricity. Countries that are not so lucky in terms of mountains and are unwilling to use nuclear power, in general, create a capacity market.

Suppose this mechanism prevents relevant market failures. There is a public interest in having a seamless and functioning electricity market. In that case, however, consumers carry the cost of covering this market failure. Therefore, it is essential to adequately design and dimension the capacity market: exceeding in parsimony might result in some market failures, i.e., externalities that will negatively affect the level of the consumer; by contrast, exceeding in dimensioning the capacity market will result in a higher electricity price to the consumers that still will negatively affect the welfare.

The improved performances of solar and wind plants suggest that the dimension and the need for a capacity market might decrease even thanks to the new storage systems. Storage systems will open the market to storage operators: firms that buy electricity when there is an excess and sell electricity in opposite contexts, reducing the need for additional capacity. It could even happen at the prosumers levels, with local storage plants and hopefully, result in a decreased demand peak. The prosumers will only ask for energy from the network when solar production is insufficient and when the storage is exhausted. The reliability of the proposed solutions will depend on the cost of carrying: incentives to the capacity market should cooperatively compete with the alternative explanations of storage plants.

Furthermore, all capacity schemes place some obligation on availability (reliability options). However, some also impose a cap on achieved spot power prices, e.g., Italy & Ireland. Under such contracts, capacity holders must pay the difference when spot prices exceed a pre-set strike price. Such a cap can undermine an investment case by reducing energy revenue upside for peaking flex—the length of these payments and the destination of these incentives.

3 Market power in the electricity market: how do we measure it?

The question of measuring the market power in the energy market is relevant due to the high cost of collective failures and operating leverages. Index as HHI and N-firms' concentrations (even first firm concentration) have resulted, in past observations, in an unsolvable dyscrasia concerning the actual market situation, derived by the Lerner index, the share of markup on the price. By far, the HHI resulted in an inelastic final price load. Even in cases where the first firm concentration was below 20%, significant markups were present.

The instability of the energy market shows relevant peaks in demand and bottlenecks in supply. Unlike other markets, increasing capacity in a medium-short time is substantially impossible. Each firm's maximum output should be exogenous in the short run. PSI has been the first attempt to catch this mechanism. It corresponds to a Binary variable: whether a supplier is pivotal in the market given the hourly supply and demand situation. Or, without this supplier, can the residual supply meet the demand? Empirical results show significant improvement in predicting market power over traditional indicators. Which rationale for this shift and the widely observed economic explanation of the effective empirical results? Speaking about market shares, as in the previously quoted index, implicitly assumes a seamless and functioning market- because there is the assumption that all the market demand will be satisfied. Furthermore, concentration indexes mean the needs share, so the quantity produced is fully transferrable between producers. Unfortunately, this assumption is not consistent in the electricity market.

The previous optimism, however, does not entirely hold. There is market power when the pivotal supply index is close to (but less than) the desired outcome. Even the Zpivotal indicator shows its limits, like all the binary variables: it is immediate. Indeed, it eases calculations but leads to a loss of information. There are quasi-pivotal suppliers, i.e., suppliers that, when missing, lead to a highly precarious equilibrium. When working with the pivotal supply indicator (i.e., a dichotomic variable), it seems these operators are 1, so they do not hold market power. In this model, some producers might decide to become pivotal or quasi-pivotal. Energy consumption has been, in fact, the opportunity for consumption cooperatives to flourish, first in the US and then in Europe. It is not unlikely that some of these mutualistic institutions might turn into producers or prosumers cooperatives to gain relevance in the equilibria of the national energy market.

An evolution of the pivotal supply indicator is the residual supply index. Defined as the residual supply divided by the overall demand, it represents the aggregate supply deducted from the pool provided by the specific producer we are considering.

$$\text{RSI (i)} = \frac{Total\ supply - supply(i)}{Total\ demand} = \frac{residual\ supply\ (i)}{Total\ demand}$$

RSI(i)>1, the operator is NOT pivotal; else (RSI lower or equal to 1), the operator is PIVOTAL. The higher the RSI, the lower the market power of the specific operator. The lower the RSI, the higher the market power.

Please note the connection with the previous chapter, which we try to summarize: the cost of carrying electricity is exceptionally high and unstable, as linked to the originating moment. Of course, when the cost of carrying will be negligible and the market will be functional and efficient almost surely, more traditional indexes may return interest. However, please note that the process through the decreased cost of carry will be extremely gradual and not seamless.

4 A modest proposal for simplification

After this short essay, we would like to introduce a reform proposal for the functioning of CRM derived from some economics and finance considerations. In the actual context, placing some price obligation on the producers asks these private sector firms to sell (write) some call options. Instead, the option buyer is the public or quasi-public dispatching operator. The standard capacity auction of the CRM has the following form: the dispatching operator determines the quantity (capacity) he wants to be delivered in a determined time. Furthermore, he sets even option's strike price, i.e., the maximum price he is willing to pay for the energy.

What seems strange to a finance practitioner and is, effectively, far enough by industry standard is to have the buyer fix the strike independently from the seller. Consequently, when buying energy from CRM auction obligations, the dispatching operator incorporates a profit equal to the difference between the spot price and strike price (as every call buyer). Consequently, the auctions concern the option's price. Suppose the contract is deeply far from the at-the-money behaviour. In that case, relevant issues will emerge in pricing and managing the incremental risk carried from this contract. The following are the critical issues of the following setting:

- High agency costs for the dispatching operator: since the producers do not receive the total spot price in moments of high excess demand but only the predetermined strike, they lose part of their interest in a functioning CRM
- High counterparty risk, as private firms are asked to sell call options. Consequently, the public dispatching operator is asked to underwrite a relevant counterparty risk exposed at default entities.
- Suppose the menace of excluding a producer not compliant with CRM obligations is not credible. It is not clear how much the moral suasion of the dispatching operator might serve as collateral. The supply shortage could prevent the monopolist from excluding the defaulting counterparty from the system. In that case, it will lead even the dispatching operator not to correspond to its obligations concerning its customers.
- The default risk increases in selling an option, while it reduces when buying a protective option (i.e., a protective put).

The proposed reversal engineering mechanism is the following: the dispatching operator should sell a put option to the producers, eventually limiting the first X quantities produced each year. The previous buyer of the option is now the seller. Concerning the strike, a maximum price should be defined by the seller. At the same time, a diminishing auction between CRM participants should now take place. As the price diminished through the auction, the cost of the option (and, consequently, the risk of selling it) decreased. As a result, the distortion caused by CRM should gradually lessen. In addition, the counterparty risk is now borne by a public monopolist, the dispatching operator, making this burden probably more affordable and less exposed at default (and at speculative movements).

This system recovers the genuine incentive for an efficient and effective capacity market, especially from the producer's side. Consequently, the buyer becomes the seller: the option switches from a call to a put option. The collateral now is represented by the put option: default in CRM by the producers will result in the counterparty of the put not buying at the strike price the energy that, at the same time, is being sold at a lower price in the spot market. Note that the counterparty risk was spread between the different producers in the previous scenario with a possible room for a risky contagion mechanism: the first default occurs with operator X, but this first default leads to increased counterparty risk for all the other operators. By contrast, in the proposed modification, the whole counterparty and default risk linked to CRM is born by a single entity, reducing contagion risk. Finally, this different mechanism prevents the payment of an upfront cost for the public leg, thus leading to a less variable outflow during the years for the dispatching operator. From the producers' point of view, this form of hedging on the spot energy price should be regarded as particularly beneficial, decreasing the required return on capital. The overall systemic risk should be reduced, as the at-default agents are now efficiently hedged. At the same time, the riskier position is carried over by a quasi-public monopoly that shows virtually no default probability and counterparty risk.

Let's define the time interval t=[1,2...T] on which the reliability option is set. Let's define N as the number of producers participating in the scheme. We assume that the costs of the default are pre-defined ad lump-sum C, independentof the number of firms defaulting. The risk-free discounting dynamic is r. $1_{producer_t}$Indicates the default of the producer at time t. We assume that ruins are independent in time, i.e. an operator that defaults at time t might return reliable at time t+1. This is realistic since we are discussing counterparty risk and not credit risk. Furthermore, we equally split the reliability auctions between entirely homogeneous producers

In the *status quo*, the overall counterparty credit risk is defined by the cost of default:

$$FD_{Cost} = \sum_{t=1}^{T} \frac{1}{(1+r)^t} \sum_{producers=1}^{N} C 1_{producer_t} = \sum_{t=1}^{T} \frac{1}{(1+r)^t} NC\boldsymbol{E}(1_{producer_t})$$

That yields to

$$FD_{Cost} = NC \sum_{t=1}^{T} \frac{1}{(1+r)^t} \boldsymbol{E}(1_{producer_t})$$

Now, we consider our proposed reform, where the counterparty credit risk is written on the dispatching operator defaults. $1_{dispatching_t}$ represents the default of the dispatching operator while $1_{Q_{demand}>NQ_{producerin\ CRM)t}}$answer the following question: is the market still complete and able to provide the demanded quantity even without enterprises taking part in CRM?

$$FD_{Reform} = \sum_{t=1}^{T} \frac{1}{(1+r)^t} NC 1_{dispatching_t} 1_{Q_{demand}>NQ_{producerin\ CRM)t}} =$$

That yelds to:

$$FD_{Reform} = NC \sum_{t=1}^{T} \frac{1}{(1+r)^t} 1_{dispatching_t} 1_{(Q_{demand}>NQ_{producerin\ CRM})t} =$$

So we have to consider, in a one-stage set:

$$\boldsymbol{E}\left(1_{producer_t}\right) ?\ \ 1_{dispatching_t} 1_{(Q_{demand}>NQ_{producerin\ CRM})t}$$

But as for each t in [1,2...T] we have that $1_{dispatching_t} = \varepsilon\left(1_{producer_t}\right)$ We have, by definition of mean that $1_{dispatching_t} = \varepsilon\left(\sum 1_{producer_t}\right)\frac{1}{N}$ And in conclusion

$$\boldsymbol{E}\left(1_{producer_t}\right) >\ \ 1_{dispatching_t} 1_{(Q_{demand}>NQ_{producerin\ CRM})t}$$

The lower the strike of the put, the more reliable our model.

QED

5 Sed Contra and Conclusion

We know which might be the main objection to the proposed reform. If the put strike is too high, there might be an incentive to produce even when there is no actual demand for energy. However, the market could reach equilibrium even without fossils. Crystal clearly, the strike price should be fixed under the ATC of the producers participating in the mechanism. Possibly, this upper bound should be neither the maximum of all the ATC nor the average, as this might be too producers-prone as a cost measure. Suitably, it might be the median or a trimmed mean excluding the upper 25% of the cost distribution: the author is not interested in stating the exact quantitative procedure as the take-home result concerning the choice of the correct cost measure, is that it should stay in between producers and the dispatching operator's *bona fide* hedging. This result was achieved, and it is not an easy jump; the put option will limit the producers' losses without giving any incentive to anti-economical and anti-environmental production. The Break-even point will not change, nor will the exercise set of the production option: producers' fat left tails will be significantly reduced by contrast. This will improve social welfare due to the high social distress costs for producers. Still, we are in front of a reverse auction, which presents some relevant advantages concerning the increasing auction. The object of the competition is now the strike of the put option producers are buying. Producers compete on accepting put options with lower and lower strikes. This means that to provide the required reliability capacity obligation, producers get lower and lower (during the auction process) hedging coverage from the dispatching operator. Decreasing the price, the social welfare increases as the profit share of the dispatching operator increases. There is even a theoretical lower bound for the decreasing strike of the auction: the average variable cost (ATC-AFC) of the producer's operator. The lower bound should be close to the minimum of all the variable costs of the different producers to allow the auction mechanism to be as comprehensive and functioning as possible. In this way, a *callida iunctura* between the auction mechanism and the counterparty credit risk is finally established.

We have presented a challenging solution to the problems of agency costs and counterparty risk in the CRM. We hope to turn to improved social welfare and decreased regulatory costs. We are incredibly grateful to the interested readers. Even if the proposed solution might appear challenging to implement or even unsuitable, the author is happy to have diagnosed the main criticalities of the current state of the art. May this proposal for cutting the Gordian knot turn into an invitation to its resolution. In conclusion, the technological improvement in the storage capacity and the storage costs, resulting even from an improved lifecycle of accumulators, will not necessarily mark *prima facie* the end of CRM. By contrast, cooperation and competition will serve as a stimulus toward a better design of the schemes and a renovated scientific interest in the topic.

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