Electricity and long-term capacity adequacy

The quest for a regulatory mechanism compatible with electricity market

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Introduction

- General problem: evaluation of current and proposed generation adequacy mechanisms
  - Booming topic among researchers after having been neglected during the first times of liberalization
  - Some of the solutions proposed imply significant changes in current market designs
    - involves uncertainty as long as the market designs have not stabilized
  - Hot topic from a political point of view with possibly significant consequences on market participants
    - especially those who were explicitly responsible for generation adequacy and security of supply in the monopolistic framework

Introduction (2)

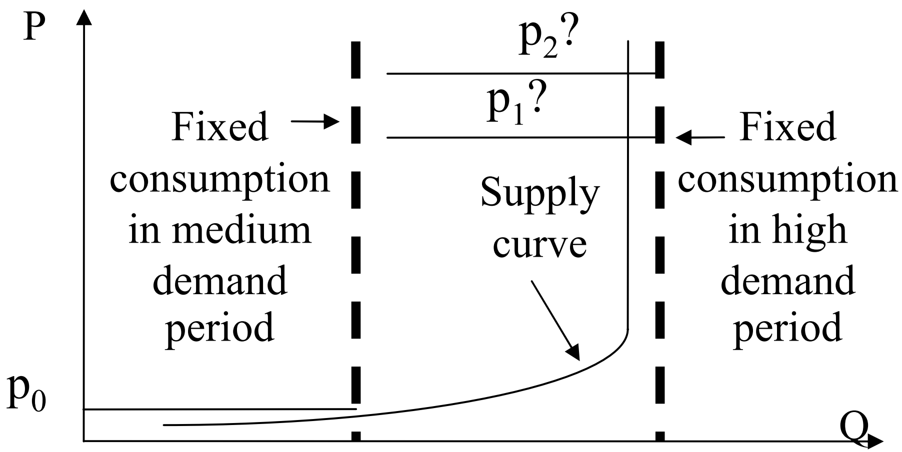
- Identify the sources of electricity market failures regarding investments in peak generation units
- Propose a framework to assess generation adequacy instruments
- Apply the assessment criteria
  - to current instruments
  - to instruments that have recently been proposed but have not yet been implemented

Capacity adequacy problem

- Regulated monopoly framework
  - Hypothesis of an undifferentiated demand to be served
    - Consumers suffer the same utility loss (VOLL) from a supply disruption, which impacts the target duration of supply disruption at the scale of the control area
    - Investment such that marginal generation cost equals this target on average
    - Random load shedding in case of unfavorable events
- Transposition to a pure competitive market framework
  - Investments are realized according to market signals
  - Marginal willingness to pay selects consumers that will not be served
    - Differentiated VOLL

Capacity adequacy problem (2)

- Price elasticity of offer and demand for electricity is currently rather low
  - Market prices are unknown by most consumers
  - Electricity is non storable
  - New investments are not instantaneous
- In some situations, a competitive equilibrium price may not exist



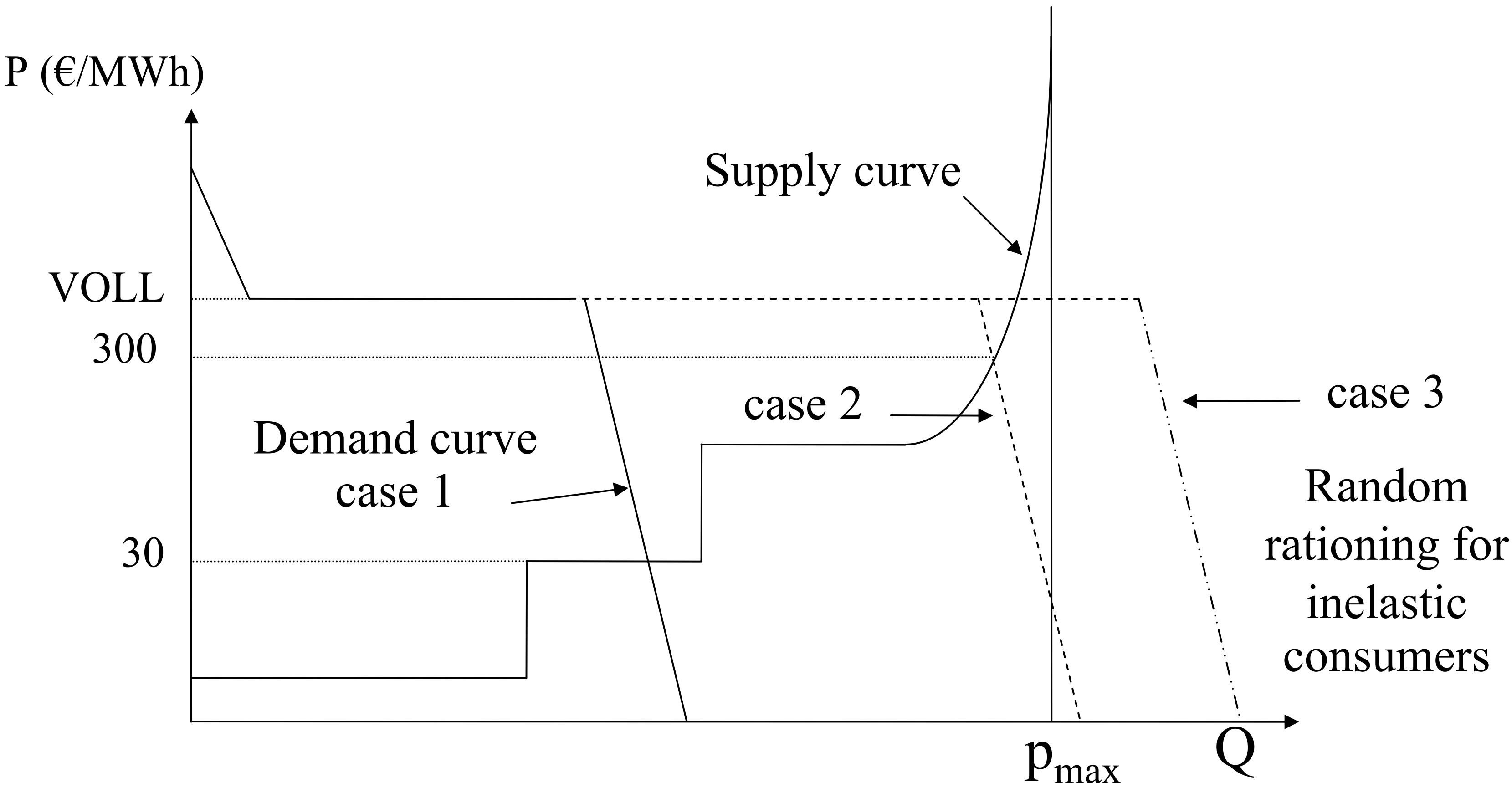
Capacity adequacy problem (3)

- Even if an equilibrium price exist, it can be very high in a market situation
  - A peak unit with investment costs of 250 €/kW, amortized over 5 years, and with a fuel cost of 10 c€/kWh will not run unless the price reaches at least 10000 €/MWh during 5 hours/yr on average
    - High profitability risks for episodically used units
- This high level may last a relatively long time
  - building durations
  - difficulty to anticipate prices which generally show a very high volatility
- It triggers a problem of social acceptability and gives an incentive to cap prices
  - Although price caps contribute to decrease investment incentives in peak units by reinforcing their profitability risks
    - Prices capped at 1000 €/MWh or 500 €/MWh to be compared with the price level needed for a profitable peak unit

Decentralized insurance contracts

- Correcting market failures through decentralized insurance contracts
  - Option contracts bought by retailers with a strike price on the price for electricity & a premium
    - should reveal the marginal willingness to pay for being served « in priority » (Oren, 2001; 2003)
    - and cap energy prices for consumers according to their preferences
- Requires to transfer electricity wholesale prices variations, to put in place control and command infrastructures, to generalize real-time metering and…social acceptation
  - Learning costs for consumers, transaction & political costs
- The problem persists if some parts of the demand curve remain inelastic (Joskow and Tirole, 2004)

Decentralized insurance contracts (2)



Reliability as a public good

- Unless the whole demand becomes price elastic (with the equipment needed to take advantage of this elasticity), an additional generation unit presents public good features and external effects
  – Non rival: an additional unit increases the probability of demand to be met
  – Non excludable: without specific infrastructures, it is not possible to exclude a consumer from the benefits of an additional investment

Reliability as a public good (2)

- A public intervention is needed to guide the realization of these investments
  - Responsibility of government/regulator
    - TSO acts as advisor (system programming)
  - It should determine a global reliability target
    - Reserve margin level, LOLP
  - & design an implementation mechanism that should meet several criteria

Assessment criteria

- A generation adequacy instrument should
  - Guide towards the target reliability level
    - Prices versus quantities
    - Administrative commitment of the units
  - Secure the profitability of new peak units
    - less volatile revenues for generators compatible with pay-out time
    - early anticipations of investment needs
  - Be consistent with the functioning of the energy market
    - the capacity compensation should depend on energy prices
    - it should not alter the technology mix (base load, peak load)
  - Be robust to strategic behaviors
  - Be institutionally feasible
  - Be efficient in an open interconnected market

Comparison of capacity instruments

- Current generation adequacy instruments
  - Public procurement for long-term strategic reserves
  - Capacity payment
  - Capacity obligations and market

	Public procurement for strategic reserves	Capacity payment	Capacity obligation and market
Country	France, Portugal Sweden, Norway, GB	Spain, Italy, Latin American countries	PJM, New York, New England

Public procurement

MT to LT capacity reserves contracts between TSO & generators
selection by call for tender or bilateral negotiation
give the right to mobilize a capacity to meet energy demand

1. ensures that the peak-capacity reserves ratio targeted will be met with the risk of a relatively high target
2. secures the profitability of the concerned investment (capacity compensation & energy price)
3. may alter the technology mix, needs precise dispatching rules but difficult to define optimally (DeVries, 2004)
4. limits short term market power through the threat of public intervention (Finon and Meunier, 2006) but it can lead to a competition for public contracts in case of risk averse generators
5. is feasible in most market designs
6. Depend on the contractual clause; risk of having to call up strategic reserves sooner if base load units bid somewhere else (DeVries, 2004)

Capacity payment

Capacity price added to energy price
ex ante version : on the basis of the investment cost for a peaking unit
ex post version : on the basis of a VOLL and LOLP

1. no commitment and no control of the availability of the unit (relies on market incentives)
   errors in the optimal payment may be costly
1. in its ex ante version, uncertain additional profitability (LOLP, VOLL)
   in its ex post version, the secured income may be fixed in advance
1. in its basic ex post version, lack of interdependency between energy and capacity which may be improved through marginal changes (Italy)
2. strategic behavior possible in the ex ante version
3. easiest to implement in mandatory markets; difficult to reform once the instrument has turned into a rent for stranded costs (rent-seeking behavior)
4. no commitment

Tradable capacity obligations

Capacity obligations imposed on LSE

On the basis of forecasted peak load & reserve margin

Capacity credits obtained through VI, bilateral transactions, organized markets which fix a capacity price

On TSO signal, obligation to bid energy for the generators

Penalty for insufficient capacity credits and generators' unavailability

1. Should be more adapted to steer towards the reliability target
2. difficulty to secure the profitability of investments
    - short time-span of markets not compatible with amortization duration
    - volatility of the capacity price due to inelastic capacity offer & demand

1. lack of interdependency between energy and capacity
2. strategic behavior observed and not many incentives for new entrants
3. calls for a trading mechanism, implementation rules, obligations on LSE may favor specific organizational structures

1. depends on penalty and delisting conditions (Stoft; 2002; Creti, Fabra; 2004)

Comparison results

- Capacity payments and obligations suffer from theoretical limitations
  - May be mitigated by ancillary market designs (penalties, link energy and capacity…)
- Even if it less theoretically founded, long term strategic reserve presents several advantages
  - Through a joint steering of capacity and price
- New proposals have been designed without any practical implementations up to now

New proposals

Stoft, Crampton, Vasquez *et al*, Joskow

- Explicit delegation of the capacity problem to the TSO
- Auctions organized to get forward capacity contracts or reliability options
  - For a quantity = forecasted peak demand + reserve margin
  - Costs allocated to LSEs according to their participation at the system's peak load or to consumers through the transmission tariff
  - Auction's marginal bid used to remunerate the selected physical capacity
  - Penalties for generator unavailability
- With different types of contract involved
  - When exercised, reliability options entail the reimbursement to consumers of the difference between strike price and market price
  - Ex post, inframarginal rents are subtracted from the forward capacity price get by generators
- Centralized mechanisms that produce a foreseeable profitability signal and combines control by price and control by quantities

New proposals
Stoft-Crampton, Vasquez *et al*, Joskow

1. Satisfaction of the reliability target through a centralized procurement
2. Investment profitability foreseeable and closely monitored
3. Interdependence between energy and capacity through the very nature of options or through ex post intervention
4. Generators' strategic behavior constrained on the energy market and on the auctions unless the threat of new entry is not credible

   But relatively high risk of strategic behavior from the public authorities that closely control most of the generation capacity

1. Implementation easiest in a mandatory market
2. Efficiency in case of regional shortage depends on the penalty and the delisting conditions
   - double penalties with reliability options

Conclusion

- Capacity payments and capacity markets present mixed properties
- Dilemma
  - Rather complex mechanisms to deal with a complex problem?
  - Or a more pragmatic approach with some theoretical limitations?