# Securing investment for electricity markets

## How to design the demand side of capacity remuneration mechanisms

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# Why do we need capacity markets ?

We need to have sufficient investments to produce electricity when needed (mostly during peak demand).

Relying on private and uncertain incentives (e.g., wholesale prices) is sometimes inefficient to provide sufficient investment:

- Missing Money : pice caps + uneconomic interventions
- Missing Market : externalities + incompleteness + risk
- Market power

Capacity markets can be one of many solutions: a producer sells the 'availability' of its investment in return for a certain additional remuneration.

# But how to design a capacity market ?

**Consumers do not willingly buy electricity and capacity**. During peak periods, investments (availability) are a public good with positive externalities.

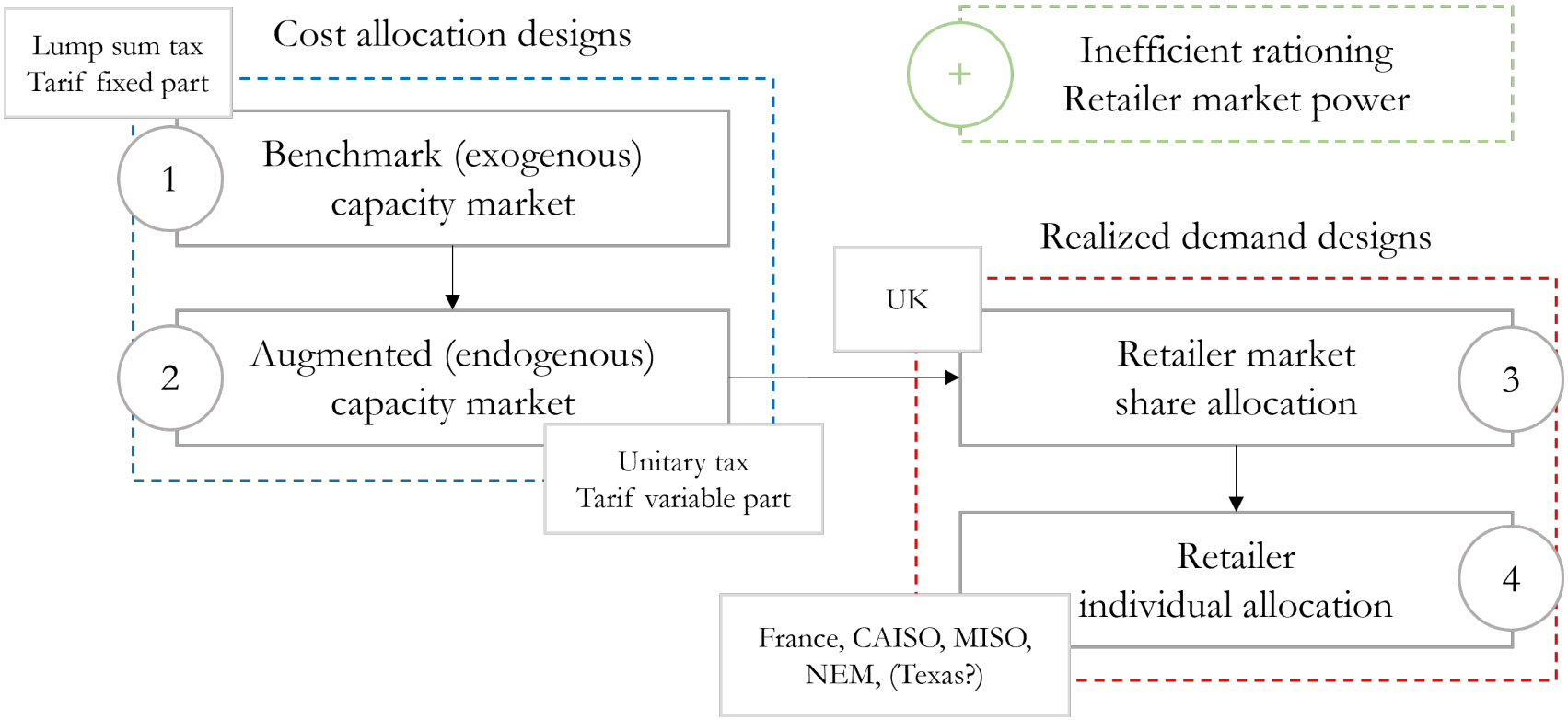
**Two topics** when we implement the demand function administratively

- **The cost allocation** between capacity buyers and final consumers
- The degree to which **the realized electricity demand** is accounted in the market designs

We analyze **the implications of different designs options** for capacity market demand functions and **their indirect effects** in terms of welfare and equilibrium.

For different market conditions? (i) Market structures (retailers) (ii) Market inefficiencies (price cap, rationing, and market power)

# Paper organization



# Methodology

We build on the canonical model [Crew and Kleindorfer, 1976, Zöttl, 2011, Léautier, 2016, Holmberg and Ritz, 2020] of investment decisions given :

1. **Homogenous good**.
2. **Uncertain demand** at the time investment decision is made.
3. **Capacity constrained** producers in wholesale market.

Three stages analytical model : (i) investment and capacity market; (ii) wholesale market; (iii) retail market.

Main technical takeaway:

1. We capture **the indirect effects of each capacity market design** at every stages.
2. **Endogenous capacity market supply function** based on the marginal opportunity cost of capacity;

# Exogenous vs Endogenous capacity market

With only a **Missing Money** created by a binding price cap.

**Exogenous** capacity market

- **Canonical model in the literature** : no effect of the capacity price on the final demand of electricity.
- **Capacity markets are neutral**, always efficient and the first-best optima are the same as the energy-only optima ( price vs quantity instrument)

**Endogenous** capacity market

- **Lump sum allocation vs Variable allocation** : final demand for electricity is depressed due to the effect of the capacity price.
- **VS the exogenous market design** : with only a missing money issue, **the expected social welfare and the optimal investment level are lower.**

# Extension - And with inefficient rationing ?

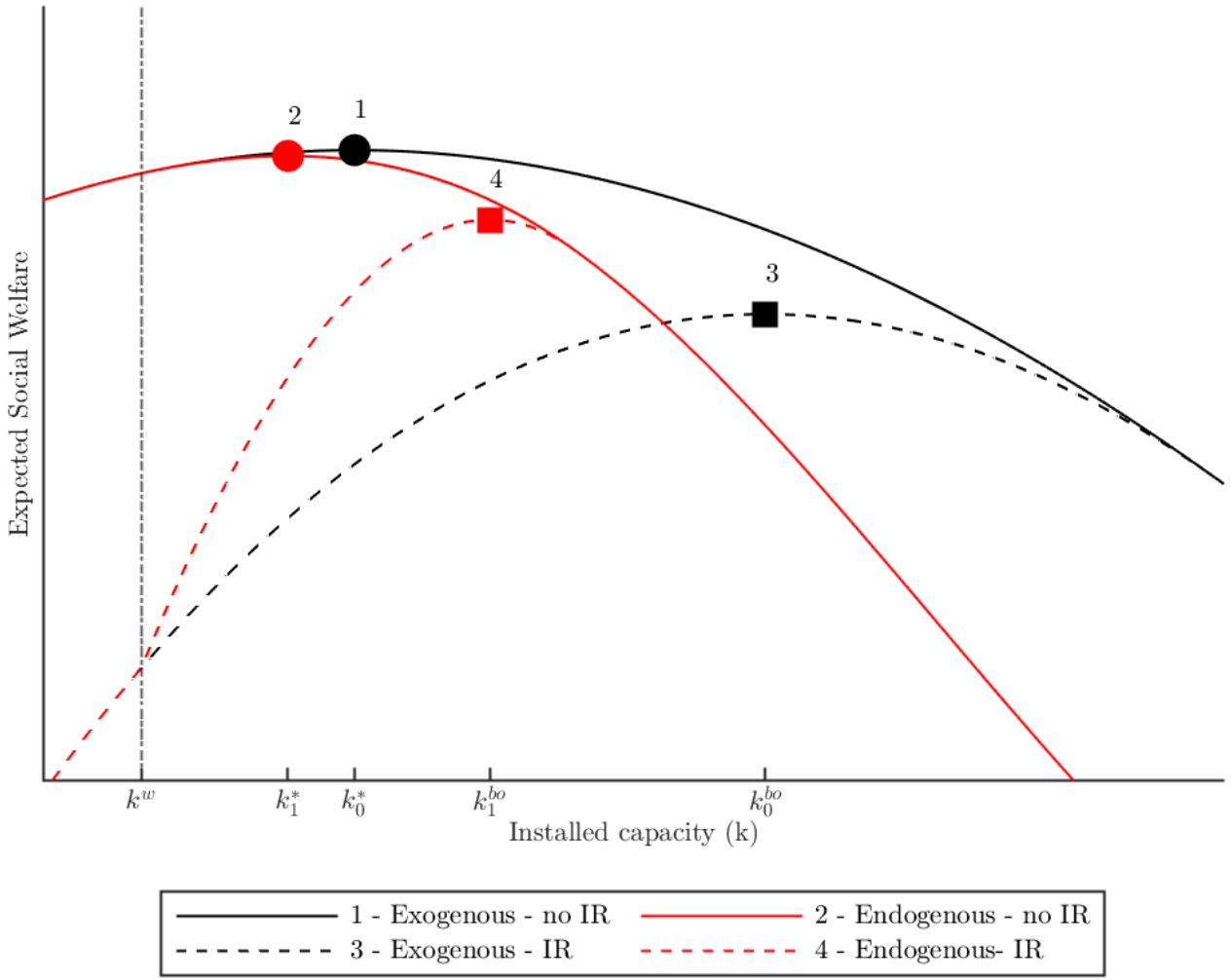
We represent this specific nature by assuming that when **demand exceeds capacity and prices cannot reduce demand** then inefficient rationing exists (rolling blackout).

**Allocating the capacity price on a variable basis can increase the optimal social welfare while having a lower investment need.**

The tradoff between a lower surplus vs lower rationing cost :

- (-) Lower the quantity sold during off-peak periods
- (-) Lower the expected revenue because more off-peak periods
- (+) Lower the occurrence of inefficient rationing because the price cap binds less often
- (+) Lower the consumer surplus during rationing hence the cost

# Illustration



# Retailer market share allocation

We allocate the capacity cost ( price $\times$ quantity) on each retailers using an endogenous ratio of **their realized market share**.

- The allocation is similar to an **increase of the retailer marginal cost**.
- The degree of competition determines the magnitude of the cost pass-through
- An increase of competitiveness tends to increase the cost pass-through
- **Beware of the indirect effects of $n^r$ with respect to first-best solution**
- **Redistribution properties**

# A fully decentralized capacity market

Retailers need to choose the level of capacity without knowing the future level of demand **and given a penalty** $S$

The indirect effect of retailer individual allocation can be decomposed:

- Case (1) Business as usual
- **Case (2) Demand lowered by the implicit demand response**
- Case (3) Demand lowered by the penalty + expected penalty

We build the endogenous demand function in the capacity market.

We find that it is possible that given a specific value of the penalty, **decentralized market can provide more expected social welfare at a lower investment level**.

# Conclusions - extensions

We wanted to open the discussion on those overlooked issues for the capacity market design: (i) how the price is allocated, (ii) and how the realized demand is accounted for.

We propose a grounded theoretical model to highlight the indirect effects of each possible market design and their implications for the system.

**Stress the endogeneity between the optimum a policymaker wishes to attain and the instrument used to reach it.**

**Possible extensions** : Final consumer heterogeneity + Cause of underinvestment + Information

# Biblio



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