GAEL Grenoble Applied Economics Lab

The supply of energy services : Do local service providers use DSO's or Communications'network?

François-Noël Bernal and Cédric Clastres
University of Grenoble-Alpes, GAEL

EM 2018, Rueil-Malmaison, June, 18-19, 2018

Introduction (1)

- Higher pressure on the electricity sector in a global context with limited access to storage technologies

- Demand flexibility and energy savings as part of solutions but they need to send and to receive a lot of data :

  ¤ Require meters allowing at least more intervals.

  ¤ Potential need for information gateways in case of RTM/PTR, local sensors patched up on appliances and the smart meters (communicating mainly through radiofrequence or PLC).

  ¤ Reliable ways to send and receive data with short intervals : user's Internet access / DSO's PLC access.

Introduction (2)

- With Smart Grids deployment, at least broadband networks are expected to play a key role enabling the supply of energy efficiency services at a global level :

¤ lowering entry costs (no need for a by-pass communication system).

¤ facing more and more aggregated data at the individual level.

¤ facing scales economies asking about profitable by-pass solutions.

¤ but could also lead to a retribution for the bandwidth use.

Introduction (3)

- Two main broadband networks :

  ¤ Optical fiber : mainly developed by ISPs.

  ¤ Broadband over power lines owned by DSO.

- According to this consideration, we could ask a question :

Do Local Service Providers uses Broadband Over Power Lines, i,e DSO network, or Optical Fiber, i,e Internet Service Providers'network or consumers'Internet contract?

Motivations

Objectives

1. To study incentives to supply energy services with DSO or Internet networks, considering the welfare impacts.
2. To show the necessary efficiency gains to use DSO's network.

Approach

A simple Hotelling model with two Local Service Providers (LSP). They use to supply services the DSO's network at regulated price or another informational infrastructure.

First results

1. Regulator has incentives to apply a trade-off between the two LSP setting the access price higher than DSO's costs to improve welfare.
2. Efficiency gains must be high enough to make incentives for LSP to use DSO's network.

Literature (1)

Two kinds of literature could be related to our research field :

The first one is on the downstream electricity market organization :

- Energy firms try to develop ICT firms competencies (Erlinghagen and Markard, 2012).
- Difficulties to apply experiments stages into reality due to uncertainties on value creation, delivery and capture (Shomali and Pinkse, 2016).
- Focusing on the level of price for these energy services and proper insights to supply them (Weiller & Pollitt [2013] with a two-sided market approach).

Literature (2)

The second one is the access network literature considering network's choice :

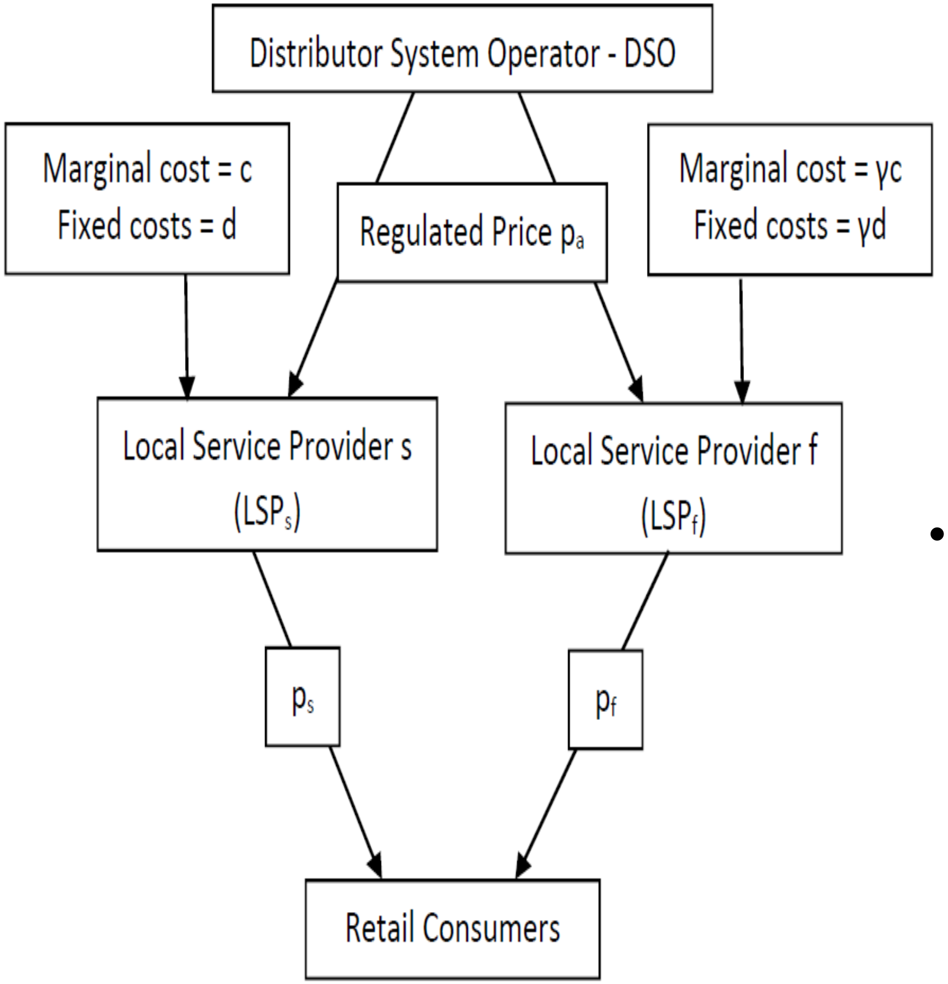
- Network interconnection and pricing rules (Armstrong 2002, Vogelsang 2003).

- On the behalf of firms when facing interconnection charges (Schniewindt, 2001).

- Networks choice with cost asymmetries and market share, using Hotelling models (Hoernig, 2014)

There is not so much researches on metering/energy services communication and implications.

The Model (1)



- **Upstream**
  - LSP_i, i={s,f}, could use the DSO network at regulated price p_a.
  - They incur further downstream costs : marginal cost c or γc and fixed costs d or γd, γ≥0.
  - If DSO is not used, LSP_i remunerate the consumer for connecting to its Internet box.

- **Downstream**
  - The two LSP compete in prices, p_s and p_f.
  - We assume uniform retail consumers with the same skills (same utility and switching costs).

The Model (2)

First step : Regulator sets the access price p_a according to its regulation scheme and to maximize the welfare.

Second step : The two LSP compete in prices on the retail market in a Hotelling game.

$$p_i^* = \underset{p_i}{Arg\ Max}\ \{\Pi_i\},\ i = \{s,f\} \text{ with } \begin{cases} \Pi_s = p_s D_s - p_a D_s - cD_s - d \\ \Pi_f = p_f D_f - p_a D_f - \gamma c D_f - \gamma d \end{cases}$$

Benchmark: Both LSP use the DSO network.

$$(p_s^1, p_f^1) = \begin{cases} \underset{p_s}{Arg\ Max}\ \{\Pi_s^1 = p_s D_s^1 - p_a D_s^1 - cD_s^1 - d\} \\ \underset{p_f}{Arg\ Max}\ \{\Pi_f^1 = p_f D_f^1 - rD_f^1 - \gamma c D_f^1 - \gamma d\} \end{cases}$$

Case 1: Only LSP_s uses the DSO network. LSP_f pays fixed fee r to connect to consumer's Internet.

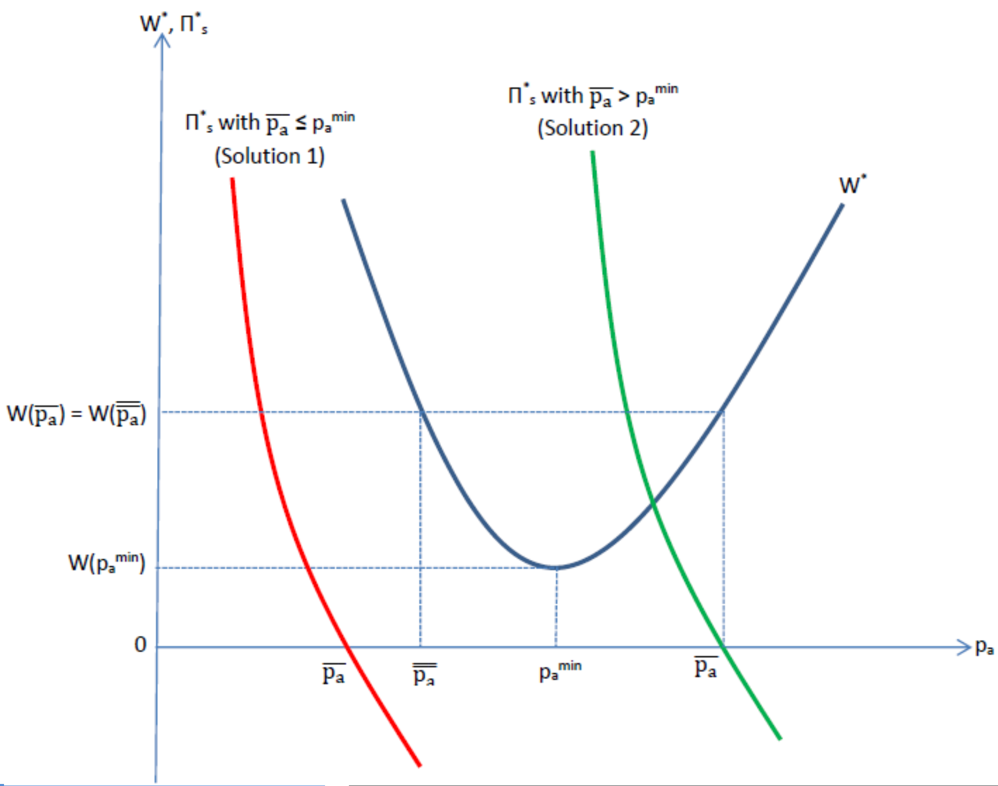
Third step : Consumers buy the energy services to one of the two suppliers according to their switching costs and LSP's prices. Their demand to LSP_i is D_i, i={s,f}.

First equilibria and results (1)

<u>Benchmark:</u> Simple and usual Hotelling equilibrium.

$$p_a^* = Costs_{DSO},\ p_s^* = \frac{2}{3}c + t + \frac{1}{3}c\gamma \text{ and } p_f^* = \frac{1}{3}c + t + \frac{2}{3}c\gamma$$

<u>Case 1:</u>



If DSO's costs are in $]\overline{\overline{p_a}}, \overline{p_a}]$, then $p_a^* = \overline{p_a}$.

Regulator minimizes the activity of DSO, and of LSP_s, to favor the more efficient Local Service Provider LSP_f.

First equilibria and results (2)

Intuition of Case 1: The level of LSP's downstream costs impacts the equilibrium of the game

- For high downstream costs : welfare is decreasing in p_a

  ¤ p_a must be minimized (setting at cost level for cost based regulation, considering the efficiency term for incentive based regulation)

- For low downstream costs : welfare could be increasing in p_a

  ¤ there exists an area in which regulator could have incentives to increase the regulated price to reduce the activity of DSO and associated LSPs to fully benefits from LSP_f efficiency

  ¤ Thus regulators set regulated prices to favor the demand served by LSP_f (its technology is more efficient than DSO's one)

The choice of network and welfare (1)

- We compare the two welfares : W* (benchmark case) and W_1 (only LSP_s uses DSO network).

- ΔW = W*- W_1 which is :

  ¤ positive if LSP are inefficient :

$$\gamma > 1 \text{ and } c > \frac{9t}{5(\gamma-1)}.$$

  ¤ negative if they are efficient :

$$\gamma \leq 1 \text{ or } \gamma > 1 \text{ and } c \leq \frac{9t}{5(\gamma-1)}.$$

The choice of network and welfare (2)

- If downstream marginal costs are low or if LSP_f uses an efficient technology, then it will be socially preferable that :
  - ¤ Only LSP_s uses the DSO's network
  - ¤ The LSP_f uses its efficient technology to supply the energy services
- For higher downstream marginal costs or if LSP_f technology is costly, using only the DSO network improves the welfare :
  - ¤ if DSO is efficient (lower access price) : DSO's efficiency overcomes inefficient downstream costs to supply energy services
  - ¤ If DSO is inefficient (higher access price) : using its network deteriorates the welfare because of added inefficiencies

Which efficiency in LSP costs is needed to create incentives to use DSO networks?

- We call ε, in]0,1], the reduction in LSP downstream costs when they use DSO's network

- Thus ε works as an incentive to use DSO's network

- We compute a value of ε^i such as :

  ¤ If $\varepsilon > \varepsilon^i$ then the two LSP have incentives to use the DSO's network because of greater efficiency gains in downstream investments;

  ¤ If $\varepsilon < \varepsilon^i$, then incentives always exist but they are linked with a value of p_a.

First conclusions

To maximize the welfare, regulator could set the access price above the DSO's costs to make a trade-off between profits of the two LSP

If the two LSP are not efficient, thus they both use DSO's network to benefit from scales economies

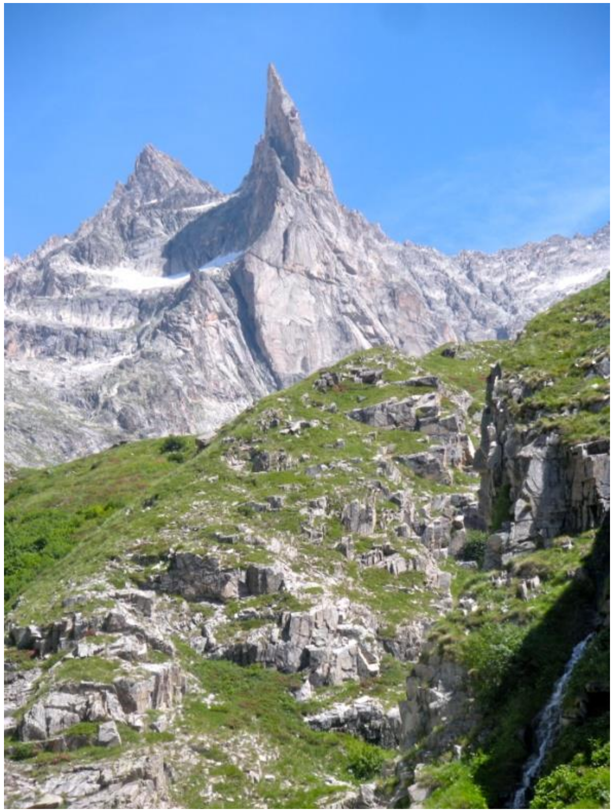
If gains in LSP costs are high, so it reinforces incentives to use DSO's network; for lower gains, DSO must be efficient enough to improve the welfare and restore the incentive to use its network.

Next steps : Introducing for consumers the choice to use energy services or not.

Introducing the ISPs and the relationship with LSP.

Introducing the regulation of IT to study the impact of information prices on the supply of energy services.

Thank you for your attention.



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