

# Retail price regulation in the British energy industry

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## Abstract

In this paper, we revisit the 2009-2012 episode in which Ofgem imposed a non-discrimination clause on large retailers in the UK energy market. The Standard Licence Condition 25A (SLC 25A) was introduced to prevent suppliers from charging their incumbent customers higher prices than their out-of-area customers. The SLC 25A included a “sunset clause”, to allow the condition to lapse three years after its implementation. Several IO economists protested that the prohibition of spatial price discrimination would eventually lead to competition weakening. At the end of the three-year period, Ofgem decided not to renew SLC 25A for any period. To further our understanding of Ofgem’s motives and its opponents’ arguments, we build a model where two local monopolists compete on a third market. We determine conditions where the obligation to set the same price in and out of the local market can result in a better or a worse situation for consumers. We show that even when the ban on price discrimination weakens competition, the average consumer can be better off.

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# 1 Introduction

Starting in the Thatcherian era, the liberalization of the UK energy industry was supposed to be accomplished by opening the retail market entirely to competition, including for residential consumers, in 1999. Yet, fifteen years later, Ofgem (Office of Gas and Electricity Markets), the industry regulator, seemed highly dissatisfied with the way retailers were behaving, especially with regard to the pricing schemes they applied. In June 2014, Ofgem referred the retail energy market to the Competition and Market Authority (CMA)<sup>1</sup> for full investigation, with a view to making the market simpler, clearer and fairer, to encouraging more new entrants, and to increasing competitive pressure on prices. The CMA report, published in June 2016, proposes a series of remedies to the adverse effects to competition identified in the gas and electricity retail markets.<sup>2</sup>

The CMA enquiry follows a series of unsuccessful attempts by Ofgem to improve competition by restricting retailers' freedom.<sup>3</sup> This paper focusses on one of these regulations, the non-discrimination condition between regions (Standard Licence Conditions SLC 25A). This regulation was implemented in September 2009 for a three-year test period and withdrawn in 2012, primarily because of a campaign by economists and practitioners opposing it on the grounds of anticompetitive effects.<sup>4</sup>

The Industrial Organization literature does not provide clear-cut answers about the effects of a ban on price discrimination. Knowing whether price differentials are harmful for consumers and welfare actually depends on the degree of discrimination, the cost of switching from the current supplier to a new one, and the structure of demand and supply in the markets under scrutiny. In his literature review, Armstrong (2006) notes that: "*price discrimination exists when two similar products which have the same marginal cost to produce are sold by a firm at different prices*". In the case we are considering in this paper, namely a combination of spatial and behavioral differentiation of energy consumers, neither products nor consumers are entirely similar. Price discrimination can therefore not simply be assessed on the fact that energy prices vary among regions. But how to judge a 10% difference? And even if discrimination is established, should it be condemned?

The degree of competition plays an important role in assessing the effects of price differences. In the monopoly case, using price discrimination cannot be bad for the firm, except in a dynamical framework where the seller cannot commit to a freeze on future rebates (e.g. Dobson and Waterson, 2005). On the buyers' side, Thisse and Vives (1988) show that there is no such clear-cut statement since some consumers may be better off

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<sup>1</sup>From 1 April 2014, CMA took over most of the functions of the Competition Commission (CC) and the Office of Fair Trading (OFT).

<sup>2</sup>The final report is available at <https://assets.publishing.service.gov.uk/media/5773de34e5274a0da3000113/final-report-energy-market-investigation.pdf>

<sup>3</sup>Littlechild (2014) and Pollitt and Haney (2014) provide a summary of the Ofgem's interventions in energy retail.

<sup>4</sup>One of the most virulent opponents to Ofgem's interventions in the retail segment is Stephen Littlechild (2012) who was Director General of Electricity Supply and Head of the Office of Electricity Regulation (Offer) during the period 1989-1998. After merging with the Office of Gas Supply (Ofgas), Offer became Ofgem in 2000.

while others may be worse off.

In the oligopoly case, it is even more difficult to state whether allowing price discrimination will harm consumers as it changes the nature of competition by extending the set of strategic tools.<sup>5</sup> Thisse and Vives (1988) analyze price discrimination in an oligopolistic market structure where firms play strategically. Using a Hotelling model with two firms, they assess alternatively simultaneous and sequential price choices. In the simultaneous case, firms always choose to price discriminate as long as the competing market (i.e. consumers that are in the subset common to the delivery zones of the two firms) is large enough. In the sequential case, when each firm can commit to a pricing policy, price discrimination is a dominant strategy because it allows firms to respond better to any strategy of the rival. However, Thisse and Vives show that, when firms choose price discrimination, it may result in lower profits. In other words, in some circumstances, a ban on price discrimination may protect sellers from rivals' assaults.<sup>6</sup>

Corts (1998) finds that the effect of discrimination on prices depends on the firms' judgment on markets, i.e. whether they consider that a particular market is strong or weak. In a two-market framework, consumers belonging to a "strong" market are more captive than those of the "weak" market. Therefore, the strong (resp. weak) market is the one where firms want to charge a higher (resp. lower) price compared to the case of uniform pricing. When strong and weak markets are the same for both firms ("best-response symmetry"), the price rises in the strong market and falls in the weak market due to an increase in competition. By contrast, if firms disagree on the market evaluation ("best-response asymmetry"), all prices may fall and firms would prefer to commit to any form of non-discrimination.

Cooper *et al.* (2005) examine the antitrust implications of the former analysis. They argue that the perfect competition case used by antitrust authorities as the optimal market structure is a theoretical, and in some way imaginary, case. If perfect competition is the benchmark, price discrimination is an evidence of market power. Actually, in real-world markets, products are not perfect substitutes because of some form of differentiation. Even if this differentiation allows firms to charge different prices to different consumers, it does not mean that it hampers the market's competitiveness. As Levine (2002) writes, "*price discrimination alone is not evidence of market power and should not be used to justify regulatory intervention*".

Price discrimination can also be implemented thanks to indirect means. Bester and Petrakis (1996) study oligopolistic competition thanks to rebate and coupons. In their paper, consumers differ due to their location or brand loyalty. For instance, retailers may use couponing to attract rivals' customers. In this case, coupons or rebates are used to compensate for "transportation costs", i.e. to modify consumers' preferences in the horizontal differentiation space, then to increase the retailer's market share.

Our analysis is based on both spatial and behavioral differentiation which allows to replicate the retail electricity market where each supplier benefits from the loyalty of its

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<sup>5</sup>Corts (1998) provides a good summary of the main studies in competitive price discrimination.

<sup>6</sup>"Denying a firm the right to meet the price of a competitor on a discriminatory basis provides the latter with some protection against price attacks." Thisse and Vives (1988) p. 134.

historical consumers and only competes against the other sellers for versatile customers. This framework differs from the Cort's two-market framework because, even in the duopoly case, the British retail market comprises at least three markets: two inert markets composed by historical captive customers and a dynamic market composed of active consumers in which retailers compete. We also address an institutional question: should *ex ante* regulation be favored to constrain pricing strategies in the retail market or should this be the exclusive task of the competition authority checking *ex post* whether retailers abuse their dominant position?

The paper is organized as follows. In the first section, we present the UK energy retail market and the attempt by Ofgem to constrain sellers' pricing strategies. The second section provides a basic model of price competition in a framework that reflects the main features of the UK market. We show that, even in a drastically simplified model where competition is severely harmed by a non-discrimination clause that provokes a competitor's exit, it is very difficult to know *ex ante* whether price discrimination is good or bad for consumers. We then explain why, even though it appeared *ex post* that Ofgem was wrong with regard to its non-discrimination condition, it was right *ex ante* in checking the consequences of a ban accompanied by a sunset clause. It maybe was not the initial Ofgem's motivation, but SLC 25A should be viewed as a social experiment.

## 2 Pricing on the British retail market for energy

To understand Ofgem's offensive against the big energy retailers' pricing policy, we first consider the state of the industry and its history. We then explain the arguments used by Ofgem to identify anti-competitive practices and to apply price control remedies. Finally, we introduce the counter-arguments of the opponents of the price regulation that was implemented.

### 2.1 The Six Large Energy Firms

The retail market for gas and electricity is dominated by six firms, often referred to as the Big 6, that share over 90% of the domestic market: British Gas, EDF Energy, npower, E.ON UK, Scottish Power, and SSE. These companies are the heirs of the 12 Regional Electricity Companies (RECs) created in 1988 by the reorganization of the nation-wide Central Electricity Generating Board and the Area Boards that purchased electricity (almost all of it from the CEGB) and distributed and sold it to customers within their designated areas.

As the market was deregulated, firms considered it more secure and profitable to integrate production and supply activities vertically through a series of mergers. The partial or total acquisition of RECs by power generators gave them supply capability. The result of a long series of take-overs and mergers (initiated by American utilities, then completed by French, German and Spanish utilities) is an oligopoly consisting of six producers/retailers, each with medium market power at the national level. Figure 1 shows that in the nation-wide electricity retail business, each big firm has a 10 to 25% market share, whereas together, small suppliers hardly reach 5%.

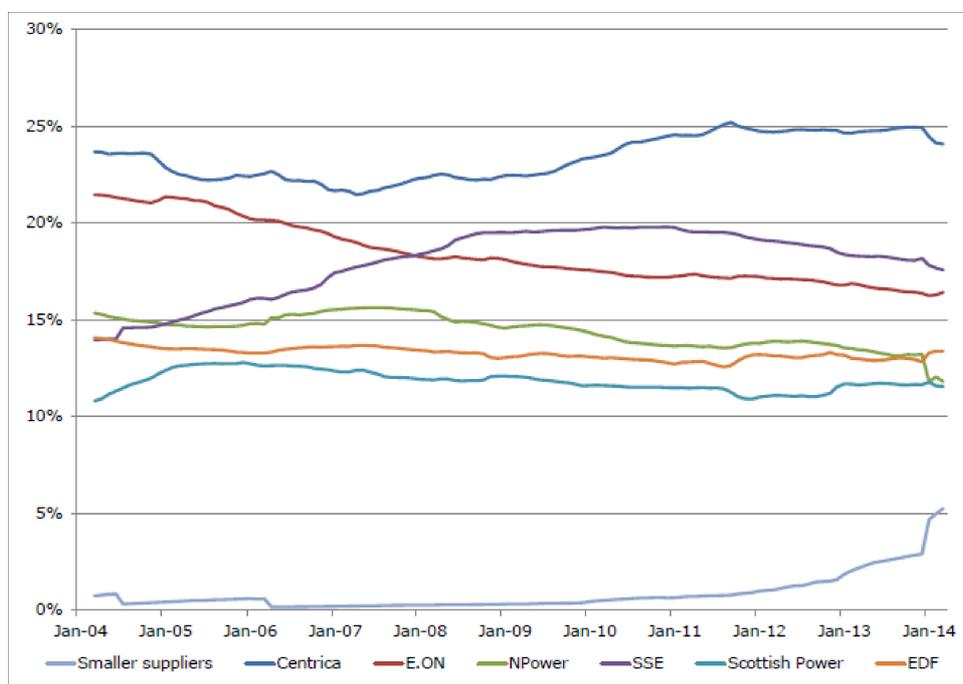


Figure 1: Domestic electricity supply market shares.  
 Source: Ofgem (2014), “State of the Market Assessment”.

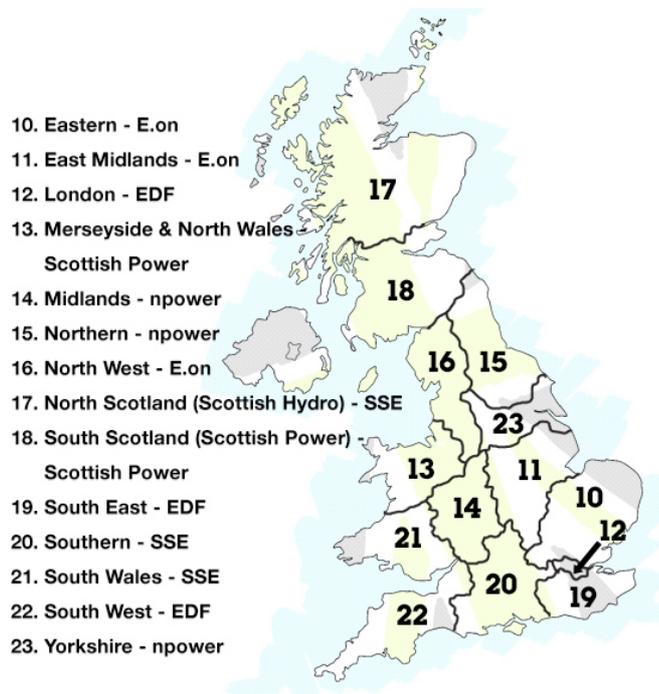


Figure 2: Dominant regional suppliers.

Source: [www.ecotricity.co.uk/for-your-home/check-our-prices/your-regional-supplier](http://www.ecotricity.co.uk/for-your-home/check-our-prices/your-regional-supplier)

Electricity being a very homogeneous product, and given that “two is enough”, one would expect strong competition, resulting in low margins with prices more or less uniform across the UK. Actually, competition does not work as it should. This is because each of the Big 6 remains dominant in its historical selling zone, as shown in Figure 2 (except for British gas).<sup>7</sup> Ofgem “*observed differences in prices between different domestic customer groups*” (“State of the Market Assessment” p. 10, 27 March 2014). In particular, “*Customers on single fuel tariffs with their legacy supplier are likely to be paying higher prices than those who have switched to another supplier, either to single or dual fuel tariffs.*” (ibid.).

If a significant minority of consumers remain with their legacy supplier, competition is only for the others, and differential pricing is a natural outcome. But Ofgem does not like this outcome and has tried repeatedly to change it. The next section presents one of these attempts.

<sup>7</sup>The map in Figure 2 is from the website of ecotricity, one of the small suppliers that compete against the six large energy firms: “When the electricity supply industry was de-regulated in 1990 all the regional electricity companies – collectively known as the electricity board – were privatised. This move split the UK into 14 regions with a different electricity company for each. *We use these regions as the basis for our prices – and for many we now undercut the standard tariffs of the Big Six energy companies in those regions.*” [www.ecotricity.co.uk/for-your-home/check-our-prices/your-regional-supplier](http://www.ecotricity.co.uk/for-your-home/check-our-prices/your-regional-supplier)

## 2.2 Ofgem and the economists

### 2.2.1 Ofgem attacks

In “Energy Supply Probe - Initial Findings Report” (6 October 2008), pp. 8-9, Ofgem expressed concern as regards differential pricing. In particular, “*Until very recently, the five former incumbent electricity suppliers charged electricity customers in their former monopoly areas an average of over 10 per cent higher prices than comparable ‘out-of-area’ customers. (...) Based on data provided to us by the companies, we can find no cost basis for this premium, nor are similar premiums found in gas.*<sup>8</sup> [...] Overall, these price differentials mean that companies charge more to existing (“sticky”) customers whilst maintaining competitiveness in more price sensitive segments of the market. The ability to price differentially in this way means that pressure on prices in the most competitive segments of the market does not always constrain prices for all other consumers. There is evidence in the companies’ business plans and from interviews with the Big 6 that they are aware of these dynamics and take them into account in their pricing decisions.”

Ofgem therefore considered placing a new condition in the licenses of the large suppliers that would either impose a prohibition on price discrimination or introduce a form of relative price control. To address “undue discrimination”, it eventually decided to impose a license condition on energy suppliers, that would limit the differences in the tariffs they could charge their ‘in-area’ customers compared with their ‘out-of-area’ customers. This was the standard license condition SLC 25A, starting September 1, 2009. The condition included a three-year sunset clause, to allow it to lapse three years after its implementation.<sup>9</sup> Coming from an entity in charge of citizens’ welfare, we can imagine that the expected outcome of this regulation was a price decrease and/or a surplus increase for ‘in-area’ customers at a low cost for the others.

### 2.2.2 The economists’ campaign

The SLC 25A (like others of the same kind) has been strongly criticized, both by Ofgem’s members and non-members. S. Littlechild has synthesized the views of several economists experts in energy economics :<sup>10</sup>

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<sup>8</sup>Ofgem also explains that a number of the price differentials between payment types do not appear to have a cost justification, particularly for those customers who pay by standard credit. Another complaint is that suppliers compete vigorously in the online market with heavily discounted offers, the cheapest of which may be below cost.

In our paper, we focus on the spatial pricing dimension, even though the other two problems (payment mode and internet contact) can be interpreted using the same type of IO model.

<sup>9</sup>See the text at [https://www.ofgem.gov.uk/sites/default/files/docs/2012/02/undue\\_discrimination\\_consultation.pdf](https://www.ofgem.gov.uk/sites/default/files/docs/2012/02/undue_discrimination_consultation.pdf). Also see “Guidelines on Cost Reflectivity between Payment Methods and the Prohibition of Undue Discrimination in Domestic Gas and Electricity Supply Contracts”, 7 August 2009, <https://www.ofgem.gov.uk/ofgem-publications/85032/2-19-guidelinesoncostreflectivityandunduediscriminationinsupply.pdf>

<sup>10</sup>The Littlechild’s opinion is now detailed in Littlechild (2014). The main arguments he presented during the period 2009-2012 to criticize the non-discrimination clause are summarized in <http://www.iea.org.uk/blog/ofgem-and-the-philosophers-stone>.

*“All these proposals are based on an elementary economic fallacy: the assumption that the range of tariffs available in a competitive market would remain unchanged if new obligations of the kinds proposed were introduced.”*

In the same vein, Hviid and Waddams Price (2010) wrote: *“The most likely net result of prohibiting geographical discrimination on prices is to raise them all.”*

How could the economists be so sure about the negative consequences of SLC 25A whereas the economic literature is very cautious as regards the effects of price discrimination in an oligopolistic environment? There are basically three explanations:

- First, the numerous documents and reports published by Ofgem reveal hesitations as to the expected effects of price constraints on competition and fairness. So, if the regulator itself is not fully convinced that its policy is pro-competitive, when it actually has a statutory duty to care about consumers’ well-being, one can suspect that it over-reacts by intervening just to show it is doing something.
- Second, being experts of the electricity industry with a deep knowledge of the mechanisms of oligopolistic competition, the British economists may indeed have had the intuition, or even the conviction, that price discrimination was evidence that competition was at work in an industry where the main obstacle was (and remains) the cost of switching away from the current supplier.<sup>11</sup> Consequently, limiting the possibility to price discriminate just reduced the incentive to attract new consumers by proposing them low prices.
- Third, the economic literature referred to by the economists’ group seemed to show that SLC 25A could only have adverse effects on competition in energy retail. In particular Corts (1998) uses a two firms—two markets model to analyze the results of price discrimination under competition. Hviid and Waddams Price (2010) summarize Corts’ findings as follows: *“If forced to treat markets the same, firms will retrench to the markets where they make the most money. If firms retrench to the same market (best-reply symmetry), they will start competing vigorously for it and thereby drive prices down. If they retreat to different markets (best-reply asymmetry), each will find itself facing less intense competitive restraint, will be able to behave more like a monopolist, and raise their price.”* In the UK energy market, British Gas seems to have a neutral policy as regards regional pricing. What about the other large suppliers? Since in each region there is one firm that can raise profits more easily than the others (best-reply asymmetry), banning price discrimination will push each electricity firm to retrench to its preferred market and prices will mechanically go up.

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The economists who wrote to Ofgem to express their negative opinion were Catherine Waddams Price, George Yarrow (who resigned from the Gas and Electricity Markets Authority because of the Ofgem decision) and John Vickers (a former director of the Office of Fair Trading).

<sup>11</sup>For a detailed analysis of the switching process, see Waddams et al. (2012).

### 2.2.3 Ofgem surrenders

*Ex post*, it appeared that the Ofgem’s policy actually made the retail market less competitive than it had been. Waddams Price and Zhu (2016) “*find that the nature of competition in the industry has changed, with less effective rivalry between the regional incumbents and large regional competitors following the intervention; companies seem to have ‘retreated’ to their home regions, leaving a market where pricing behaviour resembles more closely a duopoly between British Gas and the regional incumbent.*”

The non-discrimination provision expired on 31 July 2012. In advance of the expiry, Ofgem issued a consultation on whether it was appropriate to retain the condition for a further two year period. Following the consideration of responses to the consultation, the Gas and Electricity Markets Authority (the governing authority of Ofgem) decided not to renew SLC 25A for a further two-year period or for any other period.<sup>12</sup> Apparently, the latter decision was not clear enough since on 18 December 2014, Ofgem deemed it necessary to send a letter to ‘Domestic suppliers, consumer representatives and other interested parties’, reiterating that “*Standard Condition 25A is no longer in effect. The provision expired on 31 July 2012 and suppliers are not bound by it in any way. We are not considering reintroducing such a licence condition, nor would this be appropriate during the CMA’s investigation.*”<sup>13</sup>

## 3 A model of price competition with spatial differentiation

Whether price discrimination is good or bad for competition and welfare is a difficult question with no obvious answer. Using the tools of IO, we build an elementary model of price competition with spatial and behavioral differentiation to highlight the pro and anti-competitive consequences of a ban on price discrimination in a framework that portrays the UK energy retail market but simple enough to provide insights.

Our modeling has some similarities with that of Bester and Petrakis (1996). They use an address model where half the consumers are located at one end of a one-dimension market with one seller, and the other half at the other end of the line with the second seller. However, we consider that the English retail market can be understood only with two firms and three markets. Indeed, there are three types of consumers: first, we must distinguish between active and inactive households in terms of best-offer search. Within the latter category, each consumer is “loyal” to its regional incumbent.<sup>14</sup> In the

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<sup>12</sup>Decision on Standard Condition 25A in the Gas and Electricity Supply Licences, 26 October 2012, [www.ofgem.gov.uk/ofgem-publications/74952/decision-standard-condition-25a-gas-and-electricity-supply-licences.pdf](http://www.ofgem.gov.uk/ofgem-publications/74952/decision-standard-condition-25a-gas-and-electricity-supply-licences.pdf)

<sup>13</sup>[www.ofgem.gov.uk/ofgem-publications/92094/standardcondition25ainthegasandelectricitysupplylicences.pdf](http://www.ofgem.gov.uk/ofgem-publications/92094/standardcondition25ainthegasandelectricitysupplylicences.pdf)

The origin of the mess is probably that when Ofgem decided to allow the sunset clause to lapse, it warned suppliers not to resume differential pricing. Some market participants have interpreted the warning as a mandatory prohibition.

<sup>14</sup>In the summary of the final report on Energy Market investigation (June 2016), CMA explains that it commissioned a survey of 7,000 domestic retail energy customers. The survey provides material evidence of domestic customers’ lack of understanding of, and engagement in, retail energy markets. For example, 36% of respondents either did not think it was possible or did not know if it was possible

IO lingo, we can say that consumers are doubly differentiated: in terms of geographical location and in terms of their ability or willingness to be active in the energy retail market. This only results into three markets because those consumers who are active intensively use the Internet, so that their location does not matter.

Thus, each firm is a monopolist on its local market and it competes against the other on the market of active consumers. With only two markets à la Corts, this double differentiation cannot be featured. Our paper also has a strong connection with the analysis of Dobson and Waterson (2005) who detail the pricing policy of retailers that operate nationally or internationally but mainly compete on local markets. They show that for a chain-store facing a mix of local duopoly and monopoly markets, practising geographical price discrimination is not always best. Our departure point is different since we start from the case where discrimination is profitable and analyse the consequences of a ban.

In the following section, we first present the hypotheses and notations of the model. We then successively determine the price equilibrium in the case where pricing is free and in the case where each firm must fix the same price in its local market and in the competitive segment. We finally show that, even in this over-simplified framework, despite a dramatic decrease in competition due to the monopolization of the active market, one cannot predict whether banning price discrimination is good or bad for consumers without a detailed knowledge of their willingness-to-pay in each market.

### 3.1 Hypotheses and notations

Our model allows to capture the a priori heterogeneous preferences of consumers in the retail market. The differentiation model is the best way to illustrate the different types of consumers: those who remain stuck to their historical retailer because they would suffer a very high switching disutility, and those who can easily forage and seize profitable opportunities.

We start from a situation where two suppliers face two categories of consumers: those who have some knowledge and capacity to be reactive to different offers by competing retailers and those who are not. The latter are stuck with their historical incumbent supplier. Then the problem cannot be analysed in the Corts' way with two sellers and two markets. If we reduce the problem to two sellers, there are at least three markets: two markets of inactive consumers linked to their respective incumbent supplier and a

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to change one or more of the following: tariff; payment method; and supplier; 34% of respondents said they had never considered switching supplier; 56% of respondents said they had never switched supplier, did not know it was possible or did not know if they had done so; and 72% said they had never switched tariff with an existing supplier, did not know it was possible, or did not know if they had done so.

Between about 20 and 30% of the domestic electricity customers of the six largest retailers have been with their current supplier for more than ten years.

The competition authority concludes that the large retailers enjoy a position of unilateral market power over their inactive customer base and have the ability to exploit such a position through pricing their standard variable tariffs materially above a level that can be justified by cost differences from their non-standard tariffs.

set of versatile consumers ready to switch to the best offer <sup>15</sup>

The three markets are:

- market  $a$  is the historical ground of firm  $a$ . Demand is given by the linear function  $q_a = a - \frac{p_a}{2}$ .
- market  $b$  is the historical ground of firm  $b$ . Demand is given by the linear function  $q_b = b - \frac{p_b}{2}$  where  $a \geq b$ .
- market  $c$  is a versatile market where firms  $a$  and  $b$  can compete. All consumers have the same willingness to pay  $c$ . They are uniformly distributed along a segment of length 1. Firm  $a$  (resp.  $b$ ) is installed at the left (resp. right) end of the segment. The firms fix FOB prices and consumers have to pay the extra cost of ‘travelling’ towards their preferred supplier at a disutility of  $t$  per unit of distance, with  $t \leq c$ . A consumer who does not buy has a zero net utility.

In the case of active consumers who search new offers on the Internet, the search cost in terms of the time spent and transaction costs induced by switching to a better offer is close to zero; we will fix  $t = 0$  in section 3.4. By contrast, because of large switching costs, it is too costly for  $a$  (resp.  $b$ ) to enter the local market served by  $b$  (resp.  $a$ ). Competition, if any, is limited to market  $c$ . Given the loyalty of consumers in local markets, we can set that  $b > c$ .

Finally, retailers do not differ very much in terms of costs. They can buy energy competitively on the wholesale market, or by contract, or use their own production plants; additionally, commercial expenditures are not very high. Consequently to simplify notations, we normalize their costs by fixing them equal to 0.

### 3.2 The unconstrained equilibrium

Since 1999, in the UK energy retail industry all retailers are allowed to sell anywhere within national boundaries. Then location should be irrelevant. Actually, location is a relevant issue by a hysteresis effect: large retailers have inherited client portfolios from former regional utilities. This gives them a kind of monopoly power on the most inactive local customers, that is on a large majority of the portfolio (see the CMA report of June 2016). Only the active ones form the nationwide competitive market. This is why local markets  $a$  and  $b$  are modelled as monopoly markets and market  $c$  as a differentiated duopoly (that will be simplified in section 3.4 to take account of the homogeneity of electricity).

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<sup>15</sup>Waddams et al. (2014) present the observation of over a hundred thousand ‘real’ switching decisions by participants in a collective switching exercise in 2012. They find that in this exercise, i) the probability of switching rises with increases in the gains available; ii) despite substantial gains available and very little further effort required to switch, only a third of participants switched supplier; iii) Participants who saw two offers were less likely to switch than those who saw only one.

### 3.2.1 Local markets

On market  $i$  ( $i = a, b$ ), firm  $i$  is a monopolist. It solves  $\max_{p_i} p_i q_i(p_i) = p_i \left(i - \frac{p_i}{2}\right)$ . We can easily compute

- the monopoly price

$$p_i^m = i \quad (1)$$

- the monopoly quantity

$$q_i^m = \frac{i}{2} \quad (2)$$

- the monopolist's profit

$$p_i^m q_i^m = \frac{i^2}{2} \quad (3)$$

- the global surplus

$$u_i^m - \text{cost} = 2q_i^m \left(i - \frac{q_i^m}{2}\right) - 0 = \frac{3}{4}i^2 \quad (4)$$

- the consumers' surplus

$$u_i^m - p_i^m q_i^m = \frac{3}{4}i^2 - \frac{i^2}{2} = \frac{i^2}{4} \quad (5)$$

### 3.2.2 The competitive market

The consumer located at distance  $x$  from the left end of the segment (where firm  $a$  is installed) enjoys the net utility  $c - p_a - tx$  if she buys one unit at  $a$ 's and  $c - p_b - t(1 - x)$  if she buys at  $b$ 's. We assume that  $c$  is large enough so that all consumers can buy one unit, even though only one firm is active.<sup>16</sup>

- To identify the constraint created by this requirement, suppose that only firm  $a$  is active in market  $c$ . The marginal consumer is then located at  $\tilde{x}$  such that  $c - p_a - t\tilde{x} = 0$ , and since consumers are distributed uniformly with density 1,  $\tilde{x}$  also is the quantity purchased at firm  $a$ . Hence, as long as  $\tilde{x} = \frac{c - p_a}{t} \leq 1$  the best choice of  $a$  is the solution to

$$\max_{p_a} p_a \frac{c - p_a}{t} \quad (6)$$

The resulting monopoly price is  $\frac{c}{2}$ , so that the marginal consumer is located at  $\frac{c - \frac{c}{2}}{t} = \frac{c}{2t}$ . Since the consumer most remote from 0 (where firm  $a$  is installed) is located at 1, to be sure that he will be served we assume that

$$\frac{c}{2t} \geq 1 \quad (7)$$

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<sup>16</sup>In the UK, like in all developed countries, the rate of coverage is close to 100% for electricity provision.

Under this assumption, if let alone, the best choice of firm  $i$  is to fix

$$p_i^{cm} = c - t \quad (8)$$

which gives it the whole market of size 1.

- When both firms are active, the marginal consumer is located at distance  $\tilde{x}$  such that  $c - p_a - t\tilde{x} = c - p_b - t(1 - \tilde{x})$ . Because of the uniform distribution hypothesis,  $\tilde{x}$  is also the quantity purchased at firm  $a$ . Let us denote it by  $\tilde{q}_a(p_a, p_b) = \frac{1}{2} + \frac{p_b - p_a}{2t}$  and, similarly,  $\tilde{q}_b(p_a, p_b) = \frac{1}{2} + \frac{p_a - p_b}{2t}$ .<sup>17</sup>

Solving for

$$\max_{p_i} p_i \tilde{q}_i(p_i, p_j) = p_i \left( \frac{1}{2} + \frac{p_j - p_i}{2t} \right) \quad i = a, b \quad j = a, b \quad i \neq j \quad (9)$$

we obtain the best response function of firm  $i$ ,  $R_i(p_j) = \frac{t + p_j}{2}$ . From the Nash equilibrium  $p_a^N = R_a(p_b^N)$ ,  $p_b^N = R_b(p_a^N)$  we can deduce

- – the equilibrium duopoly prices

$$p_a^N = p_b^N = t \quad (10)$$

- the duopoly quantities

$$q_a^N = q_b^N = \frac{1}{2} \quad (11)$$

- the duopolists' profit

$$p_i^N q_i^N = \frac{t}{2}, \quad i = a, b \quad (12)$$

- the global surplus

$$u^{cN} = 2 \int_0^{\frac{1}{2}} (c - tx) dx = 2 \left( \frac{c}{2} - \frac{t}{8} \right) = c - \frac{t}{4} \quad (13)$$

- the consumer's surplus

$$2 \int_0^{\frac{1}{2}} (c - tx) dx - 2p^{iN} q^{iN} = c - \frac{5}{4}t \quad (14)$$

Clearly, all profits in this market come from the differentiation index (cost of transportation)  $t$ . If  $t = 0$ , we have Bertrand competition (price = zero marginal cost). Keeping the hypothesis (7), all consumers in market  $c$  are served and, the higher  $t$  is, the lower the consumers' surplus and global surplus, and the higher the profits and the deadweight loss will be.

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<sup>17</sup>Actually,  $q_i(p_i, p_j) = \min \left[ \frac{1}{2} + \frac{p_j - p_i}{2t}, 1 \right]$ . We see that  $q_i(p_i, p_j) = 1$  if  $p_j \geq p_i + t$ .

### 3.3 No price discrimination

The regulator considers that price discrimination  $p_i^m = i > p_i^N = t$  is unfair for consumers in market  $i$ . It imposes firm  $i$  to set the same price in its historical market where demand is  $q_i = i - \frac{p_i}{2}$  and in the competitive market where demand is  $\tilde{q}_i(p_i, p_j) = \frac{t+p_j-p_i}{2t}$ .

If the two firms are active in market  $c$ , firm  $i$  solves

$$\max_{p_i} \left( i - \frac{p_i}{2} \right) p_i + \frac{t + p_j - p_i}{2t} p_i \quad i = a, b \quad j = a, b \quad i \neq j$$

From the FOC  $(i - p_i) + \frac{t+p_j-2p_i}{2t} = 0$ , we derive the best response function  $\hat{R}_i(p_j) = \frac{2ti+t+p_j}{2(1+t)}$ . The Nash equilibrium is defined by  $\hat{p}_a^N = \hat{R}_a(\hat{p}_b^N)$ ,  $\hat{p}_b^N = \hat{R}_b(\hat{p}_a^N)$ . Solving for the two best-response functions, we obtain the equilibrium non discriminatory prices in the case of both  $a$  and  $b$  remaining active in market  $c$ .

$$\hat{p}_i^N = t \times \frac{(3 + 2t) + 4(1 + t)i + 2j}{4(1 + t)^2 - 1} \quad i = a, b \quad j = a, b \quad i \neq j \quad (15)$$

Unsurprisingly, the result is an increase in the prices on the competitive market as long as the differentiation parameter  $t$  is not very large:

$$\hat{p}_i^N - p_i^N = t \times \frac{4(i - t)(1 + t) + 2(j - t)}{4(1 + t)^2 - 1} > 0 \quad i = a, b \quad (16)$$

for  $i > t$  and  $j > t$ . Since  $t$  is rather small for active consumers, it can definitely be expected that SLC 25A will push prices up in the active consumer market. Note that the increase is not the same for the two firms if their home markets are different:

$$\hat{p}_a^N - \hat{p}_b^N = \frac{t}{4(1 + t)^2 - 1} (2 + 4t)(a - b) \geq 0 \quad (17)$$

If  $a > b$ , firm  $a$  increases its price more than firm  $b$  and loses a share of market  $c$ .

Concerning the inactive consumers, we have that

$$p_i^m - \hat{p}_i^N = \frac{(3 + 2t)(i - t) + 2t(i - j)}{4(1 + t)^2 - 1} \quad (18)$$

We see that  $p_a^m - \hat{p}_a^N > 0$  since  $a > b$ : the captive consumers of firm  $a$  benefit from SLC 25A. As regards the captive consumers of firm  $b$ , the result is less sure. If the difference  $a - b$  is not very large, again  $p_b^m - \hat{p}_b^N > 0$  and the captive consumers of  $b$  are better off when discrimination is forbidden. But the opposite can occur if  $b$  is small compared to  $a$ . We see from (17) that the larger the difference  $(a - b)$  is, the weaker competition on market  $c$  will be. Firm  $b$  can then easily increase its non discriminatory price, and if consumers on market  $b$  have a low willingness to pay, meaning that they initially paid a low  $p_b^m$ , SLC 25A can result in a price increase in market  $b$ :

$$p_b^m \leq \hat{p}_b^N \iff b \leq t \times \frac{3 + 2(t + a)}{3 + 4t} \quad (19)$$

The model with three markets and two firms thus confirms that banning price differentials has

- a positive impact for inactive consumers who initially paid a high price (here market  $a$ );
- a uncertain impact for inactive consumers who initially paid a low price (here market  $b$ );
- a negative impact for active consumers (here market  $c$ ).

One can easily conclude that the global result of this type of price regulation is hard to predict without in-depth knowledge of the preference parameters of consumers in each market. This uncertainty is reinforced by the possibility of one firm leaving the competitive market to its competitor and retreating to its more profitable home market where there is no pricing constraint. As seen in section 2.2.3, this is the main argument used by the opponents to SLC 25A. To emphasize this uncertainty, we now consider the extreme case of Bertrand competition in market  $c$ .

### 3.4 Fierce competition in the market of active consumers

#### 3.4.1 Mixed and pure strategies

We can obtain a simple global view of the effects of the non-discrimination clause in the case where  $t = 0$ . With a zero transaction cost, market  $c$  is a battlefield for Bertrand competition.

*a)* Without the regulatory constraint on prices, from (10), we obtain  $p_i^N = 0$ . The result is that the overall profit of firm  $i$  is derived exclusively from its local market:  $p_i^m q_i^m = \frac{i^2}{2}$

*b)* Under the obligation to fix the same price on markets  $i$  and  $c$ , firm  $i$  has two pure strategies:

- *b1)* To quit market  $c$ , which guarantees  $p_i^m q_i^m = \frac{i^2}{2}$  from its home market  $i$ ;
- *b2)* To stay in market  $c$ , with a profit that depends on the decision of its competitor. If the competitor stays in, the price is given by (15) with  $t = 0$ , that is  $\widehat{p}_i^N = 0$ , which means a nil global profit. If the competitor leaves market  $c$ , from (8) firm  $i$  can at best set  $p_i^{cm} = c$ . The resulting profit is  $(p_i^{cm} \times 1) + p_i^{cm} \left( i - \frac{p_i^{cm}}{2} \right) = c \left( 1 + i - \frac{c}{2} \right)$ . Then, if  $\alpha_j$  is the probability of  $j$  leaving market  $c$ , the expected profit of  $i$  when staying in market  $c$  is  $E_i = \alpha_j c \left( 1 + i - \frac{c}{2} \right)$ .

We see that firm  $i$  is indifferent between serving only market  $i$  at the local monopoly price  $p_i^m = i$  or serving the two markets at the non-discriminatory price  $p_i^{cm} = c$  if  $\frac{i^2}{2} = \alpha_j c \left( 1 + i - \frac{c}{2} \right)$ , that is if firm  $j$  exits market  $c$  with probability

$$\alpha_j = \frac{i^2}{c(2 + 2i - c)} \quad (20)$$

Therefore, we can have an equilibrium in mixed strategies where each firm  $i, j = a, b$ ,  $i \neq j$  randomizes its decision to leave market  $c$  with probability given by (20). To have this type of equilibrium, it is necessary that

$$\alpha_j < 1 \implies \frac{i^2}{2} < c \left(1 + i - \frac{c}{2}\right) \quad i, j = a, b, i \neq j \quad (21)$$

### 3.4.2 The effects of the no-discrimination clause

Based on the above result, we know how to obtain an equilibrium in pure strategies where one firm (namely firm  $a$ ) leaves the market of active consumers. It suffices to assume that

$$\frac{a^2}{2} - ac > c \left(1 - \frac{c}{2}\right) > \frac{b^2}{2} - bc \quad (22)$$

Under this condition, firm  $a$  (resp.  $b$ ) is better off (resp. worse off) when serving only its local market.

This is a drastic case where price regulation changes the competitive market  $c$  into a monopoly market. We will show that even when this adverse effect to competition occurs, forbidding price discrimination can make consumers better off.

When these two inequalities are satisfied, the no-discrimination constraint has the effects of

- i*) pushing firm  $a$  out of market  $c$  where firm  $b$  becomes a *de facto* monopolist facing a (endogenous) price cap constraint;
- ii*) leaving the situation on market  $a$  unchanged;
- iii*) decreasing the price on market  $b$  from  $p_b^m = b$  to  $p_b^{cm} = c$ ;
- iv*) increasing the price on market  $c$  from  $p^{bN} = 0$  to  $p_b^{cm} = c$ .

Effect *iv*) is not a surprise: active consumers are penalized. The decrease of the price on market  $b$  in *iii*) was also expected as we started with  $b > c$ : inactive consumers of market  $b$  are the winners. Effect *ii*) is the side effect of *i*). Effect *i*) is the worst result for the regulator as monopolization is a visible structural characteristic that can be interpreted as the result of a poor regulation.

However, even in this apparently very negative configuration, one can find that the overall effect is not bad for consumers.

We can use two main gauges to assess the global effect of the non-discrimination rule: a normative one by comparing the levels of global surplus and consumer's surplus, and a practical one, by comparing the average prices.

### Surplus index

- Before the constraint on price is imposed, total welfare is

$$W^D = u_a^m + u_b^m + u^{cN} = \frac{3}{4}a^2 + \frac{3}{4}b^2 + c \quad (23)$$

Under the no-discrimination rule, total welfare becomes

$$W^{ND} = u_a^m + u_b^{cm} + u_c^{cm} = \frac{3}{4}a^2 + \left(b^2 - \frac{c^2}{4}\right) + c \quad (24)$$

We clearly have  $W^{ND} > W^D$  since the regulation leaves the quantities sold unchanged in markets  $a$  and  $c$  whereas trade increases in market  $b$ . Then from the global point of view, in our oversimplified model, *the obligation to sell at the same price in and out of the area is a good initiative.*

This first effect is an artefact due to the lack of elasticity of demand in market  $c$ . If demand in  $c$  decreases after the price increase, the loss of surplus in  $c$  can be larger than the gain in  $b$  and the net effect on total welfare could be reversed.

- However, Ofgem alleged that SLC 25A was implemented in the interest of consumers. What can we say about their surplus?

Without the price constraint,

$$CS^D = (u_a^m - p_a^m q_a^m) + (u_b^m - p_b^m q_b^m) + (u_c^{cN} - 2p_i^N q_i^N) = \frac{a^2}{4} + \frac{b^2}{4} + c \quad (25)$$

Under the non-discrimination rule, the consumers' surplus becomes

$$CS^{ND} = (u_a^m - p_a^m q_a^m) + (u_b^{cm} - p_b^{cm} q_b^{cm}) + (u_c^{cm} - p_c^{cm} q_c^{cm}) = \frac{a^2}{4} + \left(b - \frac{c}{2}\right)^2 + 0 \quad (26)$$

We see that the consumers' surplus is unchanged by regulation in market  $a$ , it decreases in market  $c$  and it increases in market  $b$ . Therefore, there is no guarantee that the regulation has positive effects for consumers. We can compute  $CS^D - CS^{ND} = \frac{b^2}{4} + c - \left(b - \frac{c}{2}\right)^2$ , which we can rewrite as

$$CS^D - CS^{ND} = \left[ c \left(1 - \frac{c}{2}\right) - \left(\frac{b^2}{2} - bc\right) \right] - \left(\frac{b^2 - c^2}{4}\right) \quad (27)$$

By the second inequality in (22), the term in brackets is positive but after subtracting  $\left(\frac{b^2 - c^2}{4}\right) > 0$ , the sign of  $CS^D - CS^{ND}$  cannot be certified. For example if  $b = 1, c = \frac{1}{2}$ , we obtain

$$CS^D - CS^{ND} = \frac{3}{16} \quad (28)$$

whereas if  $b = 1, c = \frac{1}{3}$ , we obtain

$$CS^D - CS^{ND} = -\frac{1}{9} \quad (29)$$

In a nutshell, when  $c = \frac{1}{2}$  consumers are globally better off without the price regulation and the opposite is true when  $c = \frac{1}{3}$ . This is because the consumers' surplus in market  $c$  is fully confiscated by firm  $b$  when the latter is left alone because of the regulation. Therefore, we have that *for a "high" (resp. "low") value of  $c$ , the non-discrimination clause is harmful (beneficial) to consumers.*<sup>18</sup>

<sup>18</sup>It is easy to check that when  $b = 1$  the value of  $c$  that changes the sign of  $CS^D - CS^{ND}$  is  $c \simeq .4$ .

**Average price** The surplus index cannot be calculated without sound knowledge of consumers' willingness to pay. Regulators may rather use an observable index, such as the average price  $\bar{p} = \frac{\sum pq}{\sum q}$ . When prices are set freely, we have  $p_i^m = i$ ,  $q_i^m = \frac{i}{2}$  on the local markets and  $p_i^N = 0$ ,  $q_i^N = \frac{1}{2}$  on the shared market ( $i = a, b$ ). The average price is then

$$\bar{p}^D = \frac{\frac{a^2}{2} + \frac{b^2}{2}}{\frac{a}{2} + \frac{b}{2} + 1} \quad (30)$$

Under the no-discrimination clause, we have  $p_a^m = a$ ,  $q_a^m = \frac{a}{2}$  on market  $a$ ,  $p_b^{cm} = c$ ,  $q_b^{cm} = b - \frac{c}{2}$  on market  $b$ , and  $p_b^{cm} = c$ ,  $q_b^{cm} = 1$  on market  $c$ . Then the average price is

$$\bar{p}^{ND} = \frac{\frac{a^2}{2} + (b - \frac{c}{2})c + c}{\frac{a}{2} + (b - \frac{c}{2}) + 1} \quad (31)$$

Note first that more consumers are served under the no-discrimination requirement. Indeed, markets  $a$  and  $c$  have the same quantity sold whereas consumption increases in market  $b$  where the price has decreased. The denominator is then higher in  $\bar{p}^{ND}$  than in  $\bar{p}^D$ .

Now consider the expenditures, that is the numerator in the two average prices. In market  $a$ , the regulation leaves consumers' expenditures unchanged at  $\frac{a^2}{2}$ . In market  $b$ , expenditures decrease (from  $\frac{b^2}{2}$  to  $(b - \frac{c}{2})c$ ), while they increase in market  $c$  (from 0 to  $c$ ). Nevertheless, taking together markets  $b$  and  $c$ , expenditures increase since this higher revenue is the reason why firm  $b$  remained active in market  $c$  despite the price constraint (see the second inequality in (22)). The result is that the numerator is higher in  $\bar{p}^{ND}$  than in  $\bar{p}^D$ .

As a consequence,  $\bar{p}^D$  can be larger or smaller than  $\bar{p}^{ND}$  depending on the values of the parameters  $a$ ,  $b$  and  $c$ .

For example, assume that  $a = 2$  and  $b = 1$ .

\* If  $c = \frac{1}{2}$ ,

$$\bar{p}^D - \bar{p}^{ND} = -\frac{1}{22} \quad (32)$$

\* If  $c = \frac{1}{3}$ ,

$$\bar{p}^D - \bar{p}^{ND} = \frac{4}{51} \quad (33)$$

which confirms the result we have obtained in terms of consumers' surplus: when  $c = \frac{1}{2}$ , consumers are better off without the price constraint and it vice-versa when  $c = \frac{1}{3}$ .

The way we have measured the average price is nevertheless disputable since it integrates consumers in market  $a$ , whereas their situation does not change when the regulation is implemented. Note that consumers of market  $a$  are cancelled out in the index in terms of surplus variation. If we restrict the computation of the average price to markets  $b$  and  $c$ , we obtain

$$\underline{p}^D = \frac{\frac{b^2}{2}}{\frac{b}{2} + 1} = \frac{1}{3} \quad (34)$$

when  $b = 1$ , and

$$\underline{p}^{ND} = c \tag{35}$$

Then, we can keep the former statement that for a “high” (resp. “low”) value of  $c$ , the no-discrimination clause is harmful (beneficial) to consumers.

The result is that one firm retreating to its home market because of price regulation, a very negative signal in terms of competition policy, can be profitable to consumers. But assessing whether consumers will benefit necessitates in depth knowledge of consumers’ preferences. Additionally, we must emphasize that knowledge can be insufficient as different indexes can give opposite answers. For example, with  $b = 1$ , for  $\frac{1}{3} < c < .4$ , we have that  $\underline{p}^D - \underline{p}^{ND} < 0$  meaning that the constraint on prices is bad for consumers and  $CS^D - CS^{ND} < 0$  which means the opposite.

## 4 Conclusion

Clearly, Ofgem was not entirely certain that prohibiting spatial discrimination would benefit consumers, since it had added a sunset clause to its regulation. By contrast, the British economists who opposed its decision were convinced that, because it was anti-competitive, it would harm consumers. Actually, as we have shown, even in an oversimplified framework, it is difficult to assess *ex ante* whether price discrimination is good or bad both globally and individually for each category of players: incumbents, rivals and consumers. As Armstrong (2006) states, “*Price discrimination can lead to more intense competition which benefits consumers. When firms have difficulty committing to prices, they often are forced to charge low prices. In such situations, a policy which forbids discrimination endows a firm with commitment power and prevents the firm competing with itself, to the detriment of consumers and welfare.*” This is precisely what occurred in the British case. Nevertheless, Armstrong cautiously writes that price discrimination **can lead** to more intense competition. It may be that competition is not intense enough under price discrimination. As Stole (2007) writes in his in-depth analysis of price discrimination, “*In many circumstances the theories cannot provide definitive answers without additional empirical evidence*”. We conclude that Ofgem was not wrong since the sunset clause put a stop to a sort of market experiment, showing that price discrimination was eventually better for consumers than was uniform pricing. Whether econometric methods would allow one to reach the same conclusion *ex ante* is by no means evident because of the structural changes that can occur when firms are considering the possibility of quitting some market segments. If this can occur, the changes produced by new regulatory rules can be so drastic that the data available in the initial state of the industry are not reliable enough to evaluate the final state. Our model shows that, even if one firm retreats to its home region letting a monopoly position on two markets to the other, discrimination banning can be profitable to consumers. In such cases, market experiments are welcome.

The episode also raises an institutional question that deserves deeper investigation: is it efficient to have an industry-specific regulator authorized to curb pricing rules in the retail market. Competition works well when it puts sellers under pressure to

offer the best goods at the lowest prices. If they don't, consumers will prefer to buy elsewhere. When companies are able to limit competition, in particular in cases of abuse of dominant position and agreements to avoid competing with each other, it is time for competition authorities to impose fines and remedies. An energy-specific regulator should just exert an ex ante control on the activities of natural monopolies, such as the operators of electricity transmission and distribution networks. Consequently it should be the role of competition authorities to monitor wholesale production and supply to final consumers that are supposed to be competitive segments. Why to maintain an ex ante regulator that edicts pricing rules on the retail market? Does it mean that even when retail is open to free entry, competition is not workable? If so, it is the very rationale for the liberalization of the energy industry that is disputable.

In its report of June 2016 on the Energy Market Investigation, CMA recommends that Ofgem should remove a number of standard licence conditions such as the ban on complex tariff structures, a rule limiting the number of tariffs, restrictions on the offer of discounts, and restrictions on the offer of bundled products. This suggests that the competition authority views any ex ante pricing limitation as counterproductive. However, we should not forget that CMA is judge and jury in this case since there is some form of competition in the regulation game between entities operating ex ante and those operating ex post.

However, industry regulators often play political and social roles that are beyond the prerogatives of competition authorities, tightly tied by international rules. This is true in all network industries. For instance, in the perspective of competition opening in the railways industry, –a politically sensitive issue– one may advocate in favor of strengthening the regulator's authority to implement social experiments whenever neither theoretical models nor econometrics can suggest clear-cut ex ante remedies to adverse effects on competition. This is quite common in real life where markets are neither perfectly competitive nor completely monopolized. As Stole (2007, p. 2292) writes, "*it may be frustrating that truly robust theoretical predictions are a rarity due to the additional effects of imperfect competition on our classic price-discrimination theories*". Whenever theory cannot provide definitive answers without additional empirical evidence, since empirical evidence can only be collected ex post, social experiment organized by the sector regulator can be an efficient solution.

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