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IEFE
Centre for Research on Energy and Environmental Economics and Policy

Working Paper Series - ISSN 1973-0381

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Working Paper n. 47

January 2012

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Debiasing through auction? Inertia in the liberalization of retail markets[%]

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Abstract

We analize a market in the process of liberalization. Consumers are biased in favor of the incumbent firm and we assume that they can discover the true value of new suppliers only by switching. In an infinitely-repeated game setting with Bertrand competition, we first show that efficient entry might not take place. We then evaluate the effect of organizing a public auction for assigning consumers to a "default supplier" and show that such a mechanism (which respects the freedom of choice by consumers) would support entry efficiency. However, auctioning might also increase inefficient, although temporary, entry.

KEYWORDS: electricity retail, default supplier, entry, competition policy, universal service obligations.

JEL Classification: D43, L13, L94.

[%] Authors are deeply indebted to Eileen Fumagalli, who was part of the original research project (the usual caveat applies). Financial supports by Regione Lombardia and Fondazione Alma Mater (Pavia) are gratefully acknowledged.

* Statements and opinions expressed in this article are those of Clara Poletti and do not reflect the official position of the Autorità per l'energia elettrica e il gas.

1. Introduction

The definition of good practices to govern the transition to competitive market conditions is a problem of great political relevance that all governments and regulators have to face when liberalizing utility markets (see Armstrong and Sappington, 2006, for a survey of the literature). As a matter of fact, a really competitive environment cannot be built overnight, even in market segments where the transition from regulation to competition is expected to improve welfare, once completed.

In this paper we focus on the role of consumers' inertia (see e.g. Waterson, 2003) as an obstacle to establishing a truly competitive market. Namely, we focus on an issue specific to the market liberalization process, i.e. the definition of the so-called Default Supplier (DS). When competition is introduced in a market, customers can either decide to sign up a contract with a new supplier, or they can remain "passive" and do nothing. In the latter case, absent an explicit customer's decision, there is the need to identify a DS. The regulation of the DS service, therefore, aims at guaranteeing that each consumer at each point in time has a supplier willing to serve her demand at an affordable price. One obvious option is to impose this obligation on a specific operator, usually the incumbent (likely an ex monopolist), leaving de facto the customers with their pre-liberalizaton supplier. Another possibility is to designate the DS through a competitive process.

In defining the type of service the DS must supply, the government (or the regulator) can address all possible concerns about price discrimination and market coverage, by imposing, for example, a uniform price to cross subsidise high-cost customers. However, the regulation of the DS service has sometimes been implemented simply on the ground of concerns for possible price increases brought about by weak competitive pressure in newly liberalized markets. This type of objective clearly results, for example, when reading the 2007 communication from the European Commission (EC) to the Council and the Parliament on the prospects for the internal gas and electricity market, where the EC clearly states that: "Well targeted universal and public obligations, including proportionate price regulation, must remain an integral part of the market opening process […]. Many Member States have retained controls on end-user prices. Although price controls prevent suitable price signals being given to customers about future costs, targeted price regulation may be needed to protect consumers in certain specific circumstances, for instance in the transition period towards effective competition. They must be balanced so as not to prevent market opening, create discrimination among EU energy suppliers, reinforce distortions of competition or restrict resale".

In this paper we argue that decisions about the regulation of the DS service are actually likely to have a material impact on the way competition progresses in newly liberalized markets. We focus on the design of liberalisation policies in utility markets where competition is superior to regulation but barriers to entry due to some mix of consumer ignorance, as well as perceived search and switching costs, can generate consumer inertia and reduce the competitive pressure. Indeed, the empirical experience shows that in many sectors most customers do not switch supplier after the market has been liberalized, even when potential savings were significant and the actual switching costs low (see e.g. Waterson, 2003, on the United Kingdom's domestic electricity market, and Armstrong and Sappington, 2006 on the United Kingdom's natural gas industry)[1]. More generally, from a theoretical point of view, the growing "behavioural economics" literature has stressed a number of reasons as to why consumer decision making could be affected by systematic biases due to some form of "bounded rationality": see e.g. Della Vigna (2009).

Clearly, consumers' inertia gives an advantage to incumbent companies, acting as a barrier to entry. As stressed by Waterson (2003: p. 130): "as a result of the opening up of markets such as the supply of domestic energy and telecommunications to competition, policies to encourage consumers to make an active choice between suppliers are demonstrably required in order that such markets do indeed become competitive". In the same direction, Armstrong and Sappington (2006: p. 350) argue that: "liberalization policies that help to ensure consumers are well informed and are able to switch their service provider easily can stimulate vibrant, enduring competition that may ultimately substitute for regulatory oversight".

In our paper, we consider the case of a monopolistic market in transition towards competition and compare two possible settings. In the first setting the incumbent acts de facto as Default Supplier, while in the second one the Default Supplier is selected through an auction, open to possible entrants. Our analysis is partially motivated by what happened in the Italian electricity sector, where the DS service for non domestic customers was first supplied by the incumbent distributor and, after a few years, auctioned by the government.[2] However, the majority of the issues discussed can be easily applied to other network-related sectors, which have been involved in the same reform process. The idea that assigning through an auction the initial DS for serving the market could by-pass consumers' inertia, giving a better chance to the entrant firm, is also inspired by the theoretical literature on the problem of "debiasing" the consumer's poor judgement: see e.g. Jolls and Sunstein (2006) and Thaler and Sunstein (2009). In this literature (also see Camerer et

[1] Waterson (2003: table 7, p. 140) reports on a survey which showed that 75% of consumers thought that at least one day was needed in order to switch electrivcity supplier or had no idea of how long it would take, while it would have actually taken less than 1 hour (as only 17% of consumers correctly perceived).
[2] DL n. 73/2007.

alii, 2003) mechanisms are proposed that, while libertarian in spirit,[3] can improve market outcomes by altering the environment in which decision-making takes place. The main feature of these mechanisms is indeed that they should not compel consumers to make (or to desist from) particular choices, and leave them free to choose according to their preferences (the so-called "Free Choice Condition").

The intuition behind the paper is simple: if consumers are biased in favor of their incumbent supplier, market liberalization can result in inefficiently low entry and the transition from the regulated monopoly to effective competition can be hampered. The way DS obligations are implemented can ease entry by overcoming consumers' inertia in the newly liberalized sector. In order to formalize this intuition we use a very simple setting: namely, we assume that an incumbent firm and a potential entrant compete in order to supply a market of identical consumers. The modelling set up is kept as simple as possible in order to highlight the impact of the demand side on the market outcome. Accordingly, we assume that firms compete *à la* Bertand, so that, absent consumers' inertia, the market would produce an efficient entry process. However, in the Appendix we show that our results hold even in a more realistic (and complicated) setting *à la* Hotelling, with heterogeneous consumers.

In our model the incumbent and the entrant are perfectly informed and set their prices strategically. Consumers have a linear utility function and buy at most one unit. We model the impact of consumers' inertia by assuming that they expect (possibly mistakenly) to enjoy a positive utility differential if they keep being supplied by the incumbent instead of moving to a new supplier. The actual utility differential offered by the incumbent is generally different from the consumers' perceptions, and we assume consumers have no way of obtaining information concerning its real value, nor the entrant can signal it. Consumers engage in no (optimal) search activity and they can discover the true value of the new supplier only by experiencing the service. The idea is that once suppliers have been switched, they can verify the true "quality" of the new entrant's service. We could as well interpret the consumers' negative attitute towards the new entrant as a matter of reputation (the industry good being an experience good).

Notice that, in this setting, since consumers are all equal and we assume that the (gross) utilities offered by firms are sufficiently large, market coverage is ensured and, accordingly, affordability issues play no role (for a weakening of these assumptions see the Appendix). Thus, if the consumers' bias is nil, Bertrand competition ensures allocative efficiency of the market outcomes.

[3] Its proponents call this approach "libertarian" or "asymmetric" paternalism.

By assuming an infinitely repeated-game setting, and focusing on simple non-collusive stationary strategies, we first show that, in the case of no intervention at all - when the DS is *de facto* identified with the incumbent - efficient entry might not take place, unless the firm intertemporal discount factor is equal to 1. The intuition is that if the incremental value of entry that the entrant can appropriate is not large enough, the incumbent can actually exploit the consumer bias to keep the market, in spite of the more efficient Bertrand potential competitor. Then, we investigate the impact on the liberalization process of organizing a public auction for franchising the DS service *before* opening the market to competition.

Our main result is that the imposition of DS obligations through auctioning can actually have a positive impact on the liberalization process by enhancing entry. Moreover, entry by an inefficient competitor can only be temporary because successive Bertrand competition disposes of it. Therefore, by increasing the probability that a more efficient supplier enters the market, the auction increases the welfare gains from market liberalization. However, it is worth stressing that even in the case of a public auction, efficient entry cannot be guaranteed, unless the cost advantage of the entrant, assumed positive, is sufficiently large.

The paper is organised as follows: Section 2 introduces the formal setting. Section 3 focuses on the case in which efficient entry can be deterred. Section 4 briefly discusses the case of (temporary) ineffcient entry. Section 5 concludes. In the Appendix we show that the main message of the paper generalizes to a case of heterogeneous consumers (*à la* Hotelling) in which DS obligations both enhance entry and increase market coverage.

2. Setting

Consider a market in the process of being liberalized. Consumers (who are identical) have the following (net) utility if they buy from firm *i*:

$$U_i = v_i - p_i, \qquad (1)$$

where v_i is the utility they get from (one unit of) consumption and p_i is the price they pay.

All consumers are initially supplied by an incumbent firm *I* which provides them a service whose observable (gross) utility is given by v_I. We are interested in studying the impact of different DS regulatory mechanisms on the entry process. In particular, we consider a potential entrant *E*. Since *E* has not entered the market yet, consumers don't know which level of utility they will get from choosing her as service provider. They therefore choose the supplier on the ground of their perceptions. Let $\underline{v_E}$ be the (gross) utility level consumers expect to get if supplied by E. Since we are interested in studying the impact of consumers' inertia on the entry process, we assume that they have a negative bias towards the entrant. Hence, the (gross) utility they expect to get from the incumbent (v_I) is higher than $\underline{v_E}$, so that $\Delta v = v_I - \underline{v_E}$ is positive. $v_E = \underline{v_E} + x$ is the gross utility consumers would actually get had they chosen *E*, where *x* is a "utility component" they become aware of if and only if they actually test the new supplier. This utility component can be either positive or negative. In the former case ($x > 0$), consumers, after switching, realize that the utility they can get from the new supplier is higher than their initial perseptions. We can therefore call this a "good news" entrant scenario. Simmetrically, if $x < 0$ we are in a "bad news" entrant scenario. If positive, *x* can therefore be interpreted as a measure of consumers' inertia when moving to a new supplier: the higher the value of *x*, the higher the ex-ante negative bias towards a new company entering the market. Notice that if $\Delta v = v_I - \underline{v_E} = x$ the gross utility consumers can actually get from being served by the incumbent *I* is equal to what they would get from the entrant *E* and the two products supplied are homogeneous.

Finally, in our setting consumers have no way of obtaining information concerning the true value of the new entrant (*x*) before switching supplier, nor can it be signalled by the entrant. Accordingly, consumers engage in no (optimal) search activity. As an alternative interpretation, one might think of the service provided in this market as an "experience commodity", and of Δv in terms of (a differential of) reputation of the two firms.

On the supply side, firms have complete information on the model parameters (but cannot signal their value to consumers). We further assume that *E* has a cost advantage with respect *I*, that is $\Delta c = (c_I - c_E) > 0$, where c_i is the average cost of firm *i* of providing a unit of service. Notice that, even if the new entrant *E* is more efficient on costs, the incumbent *I* can be allocatively more efficient iff the utility gap ($\Delta v - x$) is positive and higher than the cost benefits coming from *E* entering and supplying the market (Δc). Therefore, $\Delta c + x - \Delta v$ is the (per-period) Incremental Social Value (ISV) of entry. As for the competitive process, we assume that if entry occurs, the two companies *I* and *E* compete à la Bertrand.

The main questions we want to consider are the following: is it possible that, after liberalization, due to consumers' inertia the entry process is curbed? And if so, would the franchising of the DS service through an auction improve this outcome? Notice that, given the assumption on Bertand competition, if $x = 0$ entry takes place iff it is efficient. Moreover, once entry has taken place (and accordingly a situation of complete information has been established) market competition ensures the efficiency of the final allocation. Intuitively, an efficiency problem arises if $\Delta c < \Delta v < \Delta c + x$, which requires $x > 0$. This corresponds to the case in which, in front of a more efficient entrant, there is a binding consumer bias pro incumbent. Also notice that x is an upper bound on the (per-period) welfare loss due to insufficient entry. This case, in which the ISV is positive as illustrated in Figure 1, is explored in section 3.

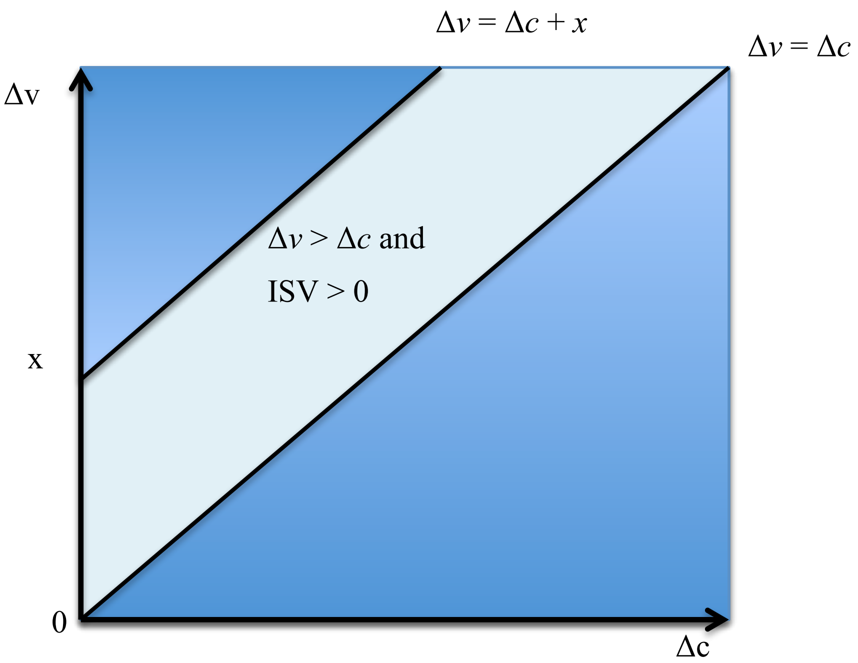

Figure 1: *Binding consumer bias pro incumbent*

Notice that other possible scenarios are either trivial or not interesting. This is the case, for example, when the entrant's cost advantage is larger than the utility bias pro incumbent (Δc - $\Delta v > 0$) and we have a "good new" entrant ($x > 0$). The ISV of entry is then largely positive and entry cannot be deterred: as a matter of fact, in order to keep the market the incumbent should (permanently) price less than c_I. Therefore E enters at the transition stage to stay, and she will raise her price during the market stage in order to take advantage of the widening of her "reputation", as measured by x. Conversely, if the ISV is negative, the entrant cannot keep the market, and she cannot even enter if her cost advantage is not sufficiently large, i.e. if $\Delta c > \Delta v$. However, temporary entry by a "bad-news" entrant is actually possible and is discussed in section 4.

3. Infinitely repeated-game setting: too much consumers' inertia?

We assume that in the liberalization process a "transition stage" is followed by an infinitely repeated "market game", in which firms discount future payoffs with an intertemporal discount factor $1 > \delta > 0$. Assuming market coverage (that is, assuming that v_I and v_E are sufficiently large), after the transition stage there are only two types of sub-games, depending on whether entry has or has not occured in the transition stage. The market game is stationary in its nature, and we will accordingly focus on simple, "stationary", non collusive strategies.

Let's assume entry has occurred in the transition stage. The equilibrium outcome in the market stage will depend on the ISV of entry, given by the difference between the entrant's cost advantage Δc and the utility differential $\Delta v - x$:

1) if $\Delta v - x - \Delta c > 0$, so that the incremental social value (ISV) of entry is negative, the incumbent will win the market competition (by pricing $p_I = \Delta v - x + c_E$)[4] and obtain a (unit) profit given by $\Delta v - x - \Delta c$;

2) if $\Delta v - x - \Delta c < 0$, so that the incremental social value (ISV) of entry is positive, the entrant will stay in the market (by pricing $p_E = - \Delta v + x + c_I$) and obtain a (unit) profit exactly equal to the ISV, $\Delta c + x - \Delta v$.

If entry does not occur at the transition stage, the incumbent keeps the market and consumers never become aware of the true value of the entrant's service. This is naturally the case if the ISV of entry is negative. However, if the consumers' inertia is strong enough (x is sufficiently large) and the entrant is not sufficiently patient (δ is not close enough to 1), even if the ISV of entry is positive ($\Delta v - x - \Delta c < 0$), efficient entry may not take place, in spite of competition *à la* Bertrand. The insight is that the entrant can set a price inclusive of x only one period after entry has occurred. Therefore, what we may call the "*present* incremental *private* value" (PIPV) of the entrant, $\Delta c + \delta x - \Delta v$, is lower than the ISV and it might be negative even when the entry is efficient. This requires $\Delta c < \Delta v$; i.e., that the cost advantage of the entrant is relatively low (given Δv).

In this scenario, in the transition stage, in order to enter the market E would need to be ready to price down to:

$$p_E = c_E - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v); \quad (2)$$

that is, she would accept to cut her price under its unit cost, up to the present value of her future profit. To deter entry, the incumbent firm will have to name the price:

[4] In what follows, as standard with Bertrand "asymmetric" competition, the "winning" firm which serves the market should formally thought to use the indicated price "minus ε", where ε is "an arbitrary low real number" (the smallest monetary unit).

$$p_I = \Delta v + c_E - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v). \qquad (3)$$

These prices are the outcome of a Sub-Game Perfect Nash Equilibrium in which the entrant never actually enters if the incumbent can obtain a positive profit. This requires $p_I - c_I > 0$, i.e.:

$$x > \Delta v - \Delta c > \delta x. \qquad (4)$$

In this equilibrium the entrant never actually enters, in spite of being more efficient than the incumbent. The intuition is that, while entry is efficient, the entrant cannot get a discounted positive profit from entering the market.

If, on the contrary, the PIPV of the entrant is positive ($\Delta v - \delta x - \Delta c < 0$), the entrant enters in the transition stage and stays in the market afterwards. Namely, the incumbent names $p_I = c_I$, while the entrant names $p_E = -\Delta v + c_I$ and enters the market in the transition stage. In this equilibrium *E* can enter the market (pricing below c_E) with a positive discounted stream of profit.[5] Notice that the entrant raises her price in the market stage by taking advantage of the fact that consumers get to discover the real value of her product after one period of consumption.

We summarise our results so far in the following Proposition.

Proposition 1. *When the DS service is not auctioned, efficient entry (ISV > 0) does not take place if and only if PIPV < 0.*

This is illustrated in Figure 2.

[5] The overall profits by the entrant, $(\Delta c - \Delta v) + \delta(\Delta c + x - \Delta v)/(1 - \delta)$, are positive.

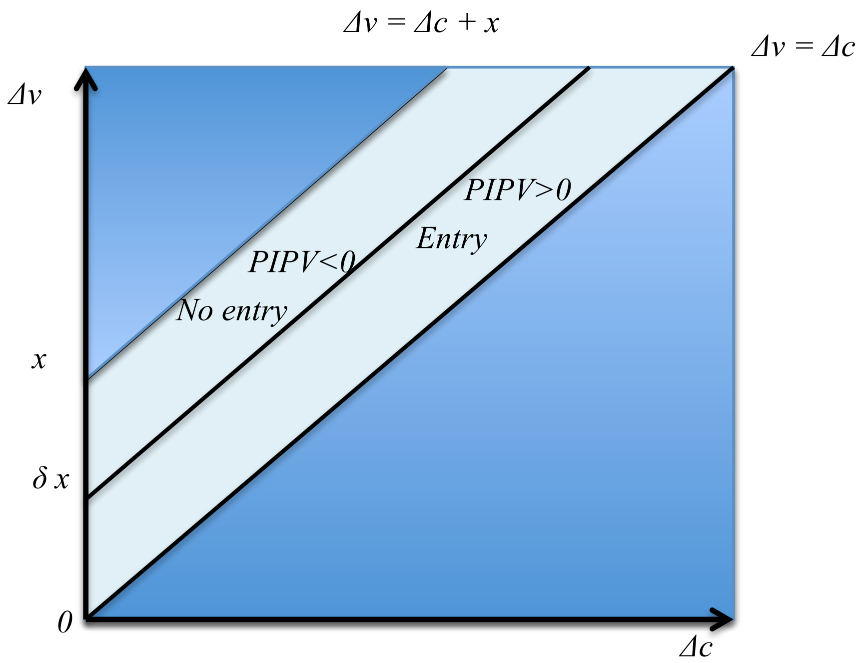

Figure 2: *efficient entry deterrence without auction*

Now suppose that a "public auction" is organised to frame the transition, and in particular to assign the USO to serve the market as a DS. In this case, the market is served by the firm that names the lowest price in the first stage, regardless of consumers' perceptions.[6] To deter entry, the incumbent has to now win an auction in which consumer bias plays no role. If entry does not occur at this stage, we are back to the previous setting. If on the contrary the entrant wins the auction, the market stage starts immediately. As a result, for the incumbent is more difficult to deter efficient entry even if the PIPV of the entrant is negative. Again, to enter the market *E* would be ready to name the price given in (2). The incumbent firm would be able to match that price only if its overall profit is positive; i.e., if:

$$-\Delta c - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v) + \frac{\delta}{1-\delta}\left[\Delta v - \Delta c - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v)\right] > 0, \quad (5)$$

which is equivalent to:

$$\Delta v > \frac{x}{2-\delta} + \frac{\Delta c}{(2-\delta)\delta}. \quad (6)$$

If (6) holds, efficient entry can be deterred even when the DS service is auctioned. The reason is again the favourable bias that the incumbent can exploit if he manages to deter entry at the auction stage. However, this happens under more restrictive conditions than if the position of DS is not

[6] In principle, this should be done only for the consumers who have not chosen a supplier.

auctioned. For example, in the case in which $x = \Delta v$ (i.e., the product is actually homogeneous) entry is always efficient (given our assumption that $\Delta c > 0$) but for $(\delta - \delta^2)x < \Delta c < x(1 - \delta)$ it takes place only thanks to the auction.

Notice that, according to (6), since $1/[(2 - \delta)\delta] > 1$, if the DS service is auctioned there is a maximum threshold value of Δc^* (which also depends on x):

$$\Delta c^* = \frac{\delta}{1-\delta} x, \tag{7}$$

which sustains an equilibrium without entry.

If (6) is violated (while (4) holds) then, thanks to the auction, the entrant enters by pricing:

$$p_E = c_I - \frac{\delta}{(1-\delta)^2}(\Delta v - \Delta c - \delta x). \tag{8}$$

We summarise the case of an auctioned DS service as follows.

Proposition 2. *When the DS service is auctioned, even if PIPV < 0 efficient entry (ISV > 0) does take place as long as* $\Delta v < \frac{x}{2-\delta} + \frac{\Delta c}{(2-\delta)\delta}$.

This is illustrated in Figure 3.

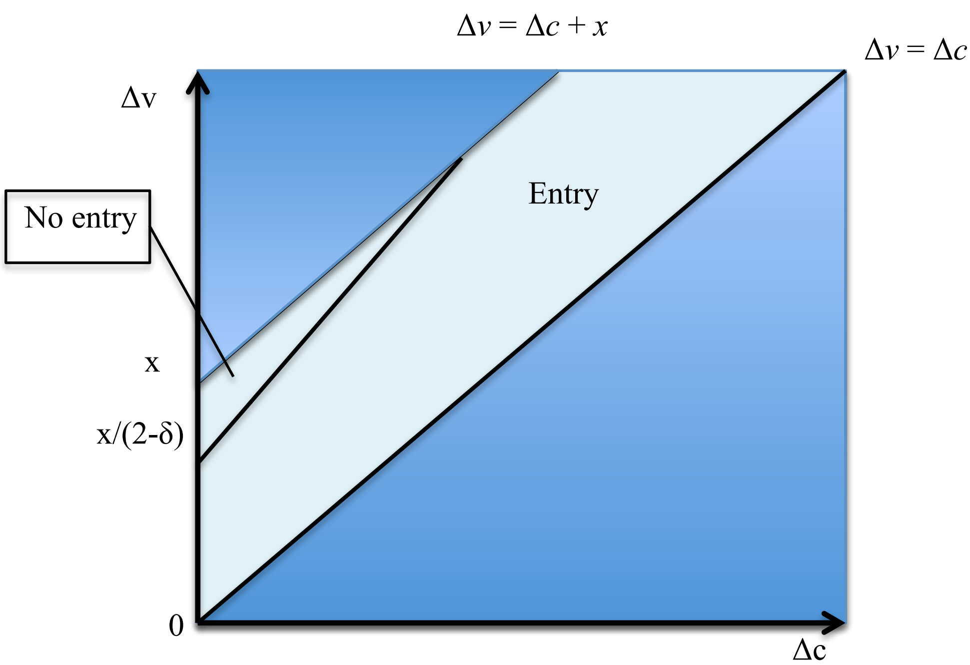

Figure 3: *Efficient entry deterrence with auction*

The equilibrium prices in the case of entry are summarised in the following Table.

	No DS auction	*DS auction*
Transition stage	$c_I - \Delta v$	$c_I - \frac{\delta}{(1-\delta)^2}(\Delta v - \Delta c - \delta x)$
Market stage	$c_I + x - \Delta v$	$c_I + x - \Delta v$

Table 1. Equilibrium prices under efficient entry

Notice that, if both IPS and PIPV are positive, organizing the auction to assign the DS service is worthless, in that *E* would enter the market anyway. Moreover, the auction has the negative effect of raising the equilibrium price ($p_E = c_I$) at the transition stage.

4. Other scenarios: the case of a "bad-news entrant"

Up to now we have focused on "good-news" entrant scenarios, in which x is positive. Here we explore a case dual to the one considered in the previous section, in which $\Delta c > \Delta v > \Delta c + x$. This scenario, where the ISV of entry is negative, requires $x < 0$, i.e., a "bad-news" entrant. If this is the case, the entrant cannot keep the market, but she might enter at the transition stage if the incumbent "allows" her to do so. Indeed, in the equilibrium the incumbent is not willing to deter entry because it would cost him a negative profit at the transition stage. In particular, the entrant enters the market by naming the price $p_E = c_I - \Delta v$ which matches the incumbent's offer equal to his marginal cost. In such an equilibrium temporary inefficient entry takes place. Afterwards, the incumbent supplies the market at a price equal to $p_I = c_E + \Delta v - x$. Notice that the equilibrium price rises in the market stage as the entrant leaves the market. Under the above stated conditions, auctioning the DS service would simply allow the entrant to enter (temporary) by winning the auction with the higher price $p_E = c_I$.

Similarly, if ISV < 0 and $\Delta v > \Delta c$, the auctioning of the DS obligations allows temporary inefficient entry (even if $x > 0$). Indeed, since we have assumed that $\Delta c > 0$, in our setting the auction *always* allows *inefficient* entry to *temporary* take place. This is, in a sense, the welfare cost of using the proposed mechanism to debias the consumers' choice.

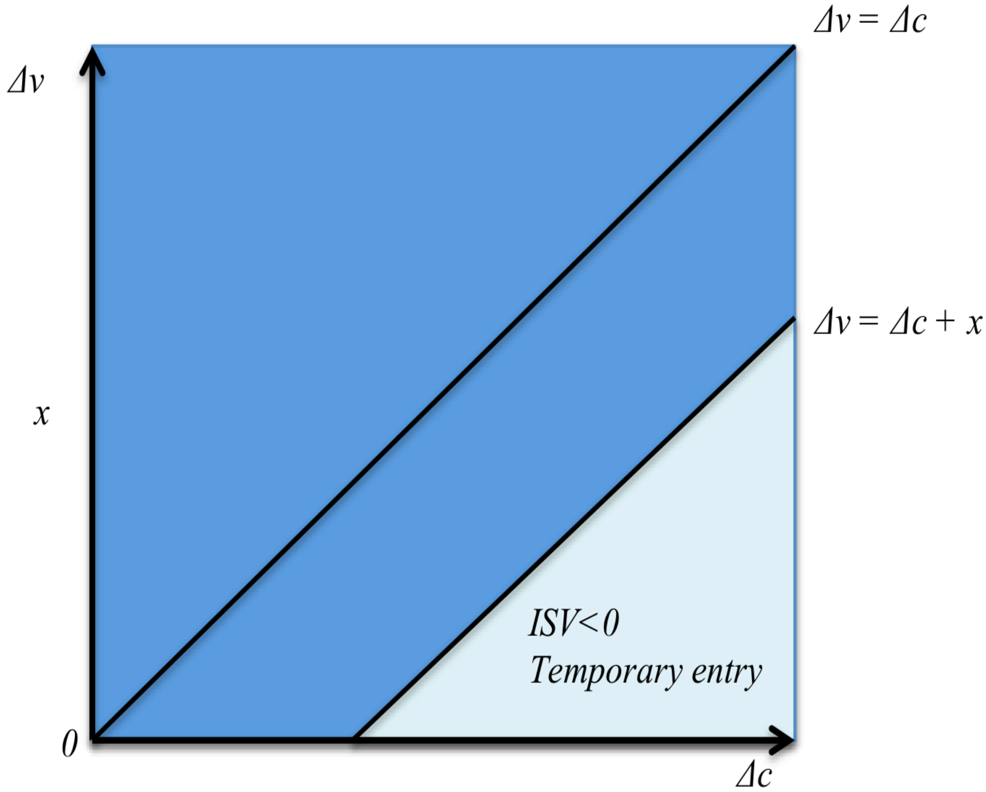

Figure 4: *Inefficient temporary entry under auctioning*

5. Conclusions

In this paper we have argued that decisions about how to implement the DS service are actually likely to have a material impact on the way competition progresses in newly liberalized markets. We focus on the design of liberalisation policies in utility markets where competition is welfare inproving but consumers' inertia reduces the competitive pressure. Namely, we analyse the case of a market in transition from a regulated monopoly towards competition and compare two possible settings. In the first setting the incumbent acts as DS, while in the alternative one the DS is selected though an auction open to the new entrants.

Our main result is that the imposition of DS obligations through auctioning can have a positive impact on the liberalization process by enhancing entry. Moreover, if competition (once established) is effective, entry of an inefficient competitor can only be temporary. Thus, by increasing the probability that a more efficient supplier enters the market, the auction increases the welfare gains from opening the market. However, even in the case of a public auction, efficient entry cannot be guaranteed, unless the cost advantage of the entrant is sufficiently large. Moreover, a possible drawback of the auctioning is that it increases inefficient entry. Finally, while in our basic setting the imposition of DS obligations have no impact on market coverage and consumers' surplus, we show in the Appendix that in the more realistic case of heterogeneous consumers they both improve.

The paper is partly motivated by the Italian experience on regulation of the Default Supplier in the electricity sector. In 2007 the Italian Government approved the transposition of the EU 2003/54/EC directive concerning the electricity internal market (DL n. 73/2007) with respect to the universal service obligations (article 3). In line with the EC Directive, the Italian government decided to auction the DS service for non domestic customers. The provision has been implemented in 2008 and, since than, three auctions have already taken place, covering overall a three years period. The results have shown two main features: the auction has actually spurred entry; the entrants' pricing at the transition (auction stage) has been aggressive in the first auction but prices have rapidly increased afterwards. Though our setting does not deal with the case of repeated DS auctioning (nor with the multeplicity of entrants), it is worth stressing that these phenomena are consistent with our findings.

Future developments should consider the case of heterogeneous consumers possibly engaging in search activities, and with entrant firms which can advertise their product (signalling their "quality"). A further extension should also consider cases in which firms face incomplete information on their reciprocal unit costs.

Appendix: The case of heterogeneous consumers

In order to show that the main lesson coming from our results applies to a more general setting, in this Appendix we have considered the case (somehow *à la* Hotelling) in which heterogeneous consumers are uniformly distrituted along the half line $[0, \infty)$, and pay an additional "location" cost given by td, where $t > 0$ and d is their Eucledian distance from the point 0. In other words, we now assume that:

$$U_i = v_i - p_i - tx, \tag{A.1}$$

where x is the location of the consumer we are considering. Notice that (A.1) implies that the monopolistic demand of firm i would be given by:

$$D_i(p_i) = \frac{v_i - p_i}{t}, \tag{A.2}$$

so that the "first-best" regulatory quantity at marginal cost would be given by:

$$q_i^R = \frac{v_i - c_i}{t}. \tag{A.3}$$

Focusing on the $\Delta c < \Delta v < \Delta c + x$ scenario, first observe that the equilibrium pricing strategies after entrance are the same with those considered in section 3.[7] However, after having entered the market previously, in this setting the entrant would get a profit given by $(\Delta c + x - \Delta v)q_I^R$. Accordingly, in order to enter she would be ready to price down to:

$$\underline{p}_E = c_E - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v)\frac{q_I^R}{\underline{q}_E}, \tag{A.4}$$

where $\underline{q}_E = (\underline{v}_E - \underline{p}_E)/t$.[8] Thus, to keep her out the incumbent should price:

$$p_I = \Delta v + c_E - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v)\alpha, \tag{A.5}$$

where $\alpha = q_I^R/\underline{q}_E$ and (A.4)-(A.5) describe an equilibrium without entrance if:

$$x > \Delta v - \Delta c > \frac{\alpha\delta x}{1-\delta+\alpha\delta}. \tag{A.6}$$

(A.6) can be intepreted similarly to (4) (notice that its RHS is increasing with respect to α).

Now suppose that the DS service is auctioned. Assuming that (A.6) holds, to deter entry the incumbent has to match the price given by (A.4). This is an equilibrium if its overall profit is positive, that is if:

$$[-\Delta c - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v)\alpha]\underline{q}_I + \frac{\delta}{1-\delta}\left[\Delta v - \Delta c - \frac{\delta}{1-\delta}(\Delta c + x - \Delta v)\alpha\right]q_I > 0, \tag{A.7}$$

where $\underline{q}_I = (v_I - \underline{p}_E)/t$ and $q_I = (v_I - p_I)/t$. Notice that $\beta = q_I/\underline{q}_I < 1$: thus, in the case of a variable demand it becomes more difficult to deter entry if an auction is organised to frame the transition. In fact, (A.7) is equivalent to

$$\Delta v > \frac{\alpha x(1-\delta(1-\beta))}{\alpha(1-\delta)+\beta(1-\delta(1-\alpha))} + \Delta c\frac{(1-\delta(1-\alpha))(1-\delta(1-\beta))}{\delta[\alpha(1-\delta)+\beta(1-\delta(1-\alpha))]}, \tag{A.8}$$

which generalizes (6) to the case in which $\alpha \neq 1 \neq \beta$.

We summarize the result of this Appendix by noticing that, also in the case of market fundamentals characterized by (A.2), an efficient entry might not take place, and that the

[7] Both competitors are “located at 0. For the sake of simplicity, to avoid the case in which entrance implies a “drastic” improvement, we assume that $\Delta c + x \leq \Delta v + v_I - c_I$.

[8] $\underline{p}_E$ is the *minimum* price which satisfies (A.4).

auctioning of the DS service enhances entry. Notice that in this setting more efficient entry means a higher coverage of the market (a greater consumers' surplus), which in turn possibly provides a further rationale for public intervention.

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