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Abstract:

European and national cartel authorities have required dominant national gas pipelines to auction off certain quantities (typically about 10 % of their sales) to competitors. Do such auctions really improve the competitiveness of the wholesale market? Based on a model where oligopolistic pipelines could voluntarily auction gas to competitors (or precommit on certain sales otherwise) we conclude that such release auctions often have no effect because the additional obligations will simply crowd out voluntary sales.

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I. Introduction

After a politically heated debate, E.ON, one of the largest European Electricity producers, was allowed to take over Ruhrgas, the most important pipeline in the European Gas market. The final permission required E.ON to sell a number of shares in other German Gas companies. In addition, E.ON was required to auction off, in six yearly auctions between 2003 and 2009, 200 billion kWh from their long term import contracts to competitors (less than 10 % of its sales, less than 4 % of the German wholesale quantities). The contracts auctioned have durations of three years. Since 2006, after a merger of several energy companies, the Danish company DONG, now supplying 95 % of the gas in Denmark, is required to offer gas in a release auction which constitutes 10 % of the Danish gas market. In this auction quantities are exchanged with quantities in the UK, Belgium, and German market so that competition not only in Denmark but also in other European countries seems to profit. Further gas release auctions take place in Austria, France, and Hungary. In the electricity sector, since 2001 (2003) the French EDF (the Belgium Electrabel) offers 6000 MW (1200 MW) of virtual power plant capacity in yearly auctions.

Can such auctions really improve competition? In the following we will concentrate on the gas market and only in the conclusion we will argue that similar arguments apply to the electricity market

The fundamental question is whether or not capacity auctions will increase the total quantity offered in the market. Otherwise, consumers cannot profit. The reason why the auctioning firms may increase their supply is that auctioning is a form of precommitment. After these quantities are sold they do no longer enter directly the profit calculations. Similar arguments show that a futures market can increase the competition in an oligopoly of producers[1] (Allaz, 1992; Powell, 1993; Bolle, 1993).

In the next section, we will ask when there is an incentive for gas importers to increase their quantities offered after a forced gas release auction. In section III, we will ask which quantities such an importer would offer voluntarily to his non-importing competitors. As in the case of futures markets, selling to competitors may be attractive for the individual importer while the *group* of importers suffers. They play a Prisoners' Dilemma (or Public Goods) game. Though there are similarities in the argument (precomment) the model of the gas market with its Take or Pay contracts is completely different from the above mentioned models. Section IV describes the differences and the common attributes with respect to electricity and concludes.

[1] There is also experimental evidence for such an competition enhancing effect of futures markets (Le Coq and Orzen, 2006).

II. The effect of forced release auctions

Imagine a situation where a country imports all its gas quantities or where the domestic production is fixed. The importing companies I_1. … I_n have concluded Take-or-Pay (ToP) contracts with fixed quantities. These fixed quantities determine the market price via the inverse demand function of the consumers. Can there be any effect from gas release auctions? The total quantity remains the same and thus the market price (which is equal to the auction price of the release quantities).

In the short run, only if the ToP contracts allow the importers to order additional quantities at low enough prices can there be an effect. In a ToP contract a quantity z_i is fixed which has to be payed with $\gamma_i z_i$ whether or not it is demanded by the contract partner (see Figure 1). So the marginal costs of importer I_i is, up to z_i, equal to 0. Usually, additional quantities can be ordered (again limited, which is not indicated in Figure 1) at marginal costs $c_i > \gamma_i$ = average price of z_i. In the long run, new ToP contracts may be concluded, probably, however, also with average prices higher than γ_i. So let us assume that, in any case, additional quantities can be supplied with (average) prices $c_i > \gamma_i$.

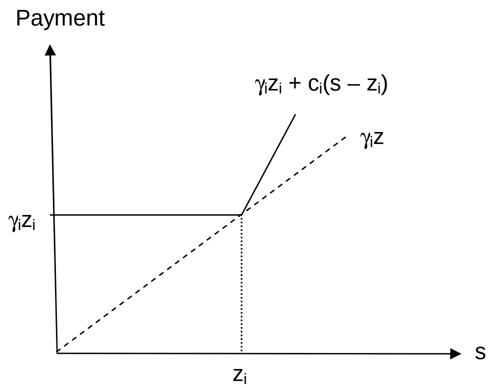

Figure 1: Take or Pay contracts

Assumption: Consumer behaviour is described by a linear inverse demand function $p = a - bs$, s = total quantity offered. There is quantity competition.

Ideally, p is the spot market price. In the gas sector, however, spot markets do not play an important role in Continental Europe. The pipelines deliver gas to customers (retailers, industry) under long-term contracts. In Germany, the regulator Bundesnetzagentur has recently restricted the maximal duration of “dominant” contracts” to 2 years (80 % to full supply) or 4 years (50 % to 80 % of supply). So, it’s the market for such contracts which is described by the inverse demand function. From the perspective of the (insignificant) spot market these contracts are also precommitments. From the viewpoint of this contract market, gas releases to a “competitive fringe” outside the oligopoly of importers are precommitments. The “competitive fringe” will resell the quantities in any case, it does not take into account the effect of these sales on the market price.

Let us first investigate a market where ToP contracts have been concluded but no release auctions take place. Profits and marginal profits of an individual firm I_i after offering quantities $x_i > 0$ (in addition to the ToP quantities z_i) or $x_i < 0$ are

(1) $G_i = (z_i + x_i)(a - bz - bx) - C_i(x_i) - \gamma z_i$

$$\text{with } C_i^{'} = \begin{cases} 0 \text{ for } x_i \le 0 \\ c_i \text{ for } x_i \ge 0 \end{cases} \text{ and } x = \sum x_i, \qquad z = \sum z_i.$$

(2) $$\frac{\partial G_i}{\partial x_i} = a - bz - bx - bz_i - bx_i - C_i^{'},$$

(3) $$\frac{\partial G_i}{\partial x_i} = -2b.$$

Lemma 1: The equilibrium quantities x_i^* fulfil the equations

(4) $$x_i^* = \begin{cases} \frac{r_i}{2b} & \text{for } r_i < 0 \\ 0 & \text{for } 0 \le r_i \le c_i \\ \frac{r_i - c_i}{2b} & \text{for } r_i > c_i \end{cases}$$

with $r_i = a - b\,(z + z_i + x_{-i})$ and $x_{-i} = \sum_{j \ne i} x_j$.

Proof: For $x_i \to -\infty$ or $x_i \to +\infty$ G_i takes arbitrarily large negative values. So, without restriction of generality, we can assume that x_i is restricted to an interval. (3) shows that G_i is a concave function of x_i. The best reply functions (4) are continuous in x_{-i} (see Figure 1). Thus there exists a pure strategy equilibrium $(x_i^*)_{i=1,\ \dots,\ n}$ which, of course, must fulfil (4) (Fudenberg and Tirole, 1993, p. 487).

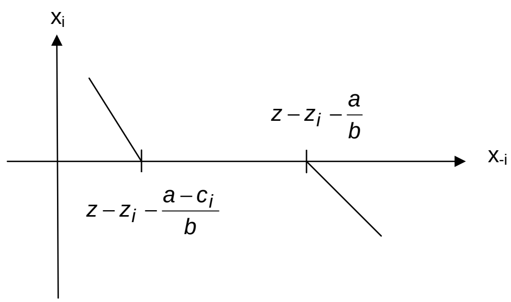

Figure 1: i’s best reply function

Now let us introduce the obligation of importers to auction release quantities y_i to non-importing traders (pipelines).

Assumption: As the purchase payments are sunk, $y = \sum y_i$ will be supplied to market.

After y_i has been sold, the situation has changed: The market price p applies only to $(z_i - y_i + x_i)$ which may cause I_i to offer larger quantities than when p refers to $z_i + x_i$ as in (1).

(5) $G_i = (z_i - y_i + x_i)\,(a - b(z + x)) + y_i \cdot q - x_i \cdot C_i^{'} - z_i \cdot \gamma_i$

with $x = \sum x_i$, q = price in the auction market.

(6) $\dfrac{\partial G_i}{\partial x_i} = a - bz - bx - bz_i + by_i - bx_i - C_i^{'}$.

By comparing (2) and (5) we see that Lemma 1 applies after substituting z_i by $z_i - y_i$. If

(7) $\left.\dfrac{\partial G_i}{\partial x_i}\right|_{x_i = 0, C_i^{'} = c_i} = a - b(z + z_i - y_i + x_{-i}) - c_i > 0$

then $x_i > 0$, i.e. larger quantities than z_i are offered and the market price p decreases.

Assuming that y_i cannot surpass z_i, a necessary condition for the possibility to increase competition by release auctions is $p = a - bz > c_i$, i. e. it must be profitable to market gas beyond the ToP-quantities z_i.

Proposition 1: A necessary and sufficient condition to stimulate competition (decrease prices) by gas release auctions is

(8) $p > c_i$ for at least one i,

accompanied by sufficiently large y_i.

Proof: If (8) applies then, with $y_i = z_i$ for all i, some i have an incentive to offer additional quantities $x_i > 0$. Otherwise, because of $y_i \leq z_i$, no i will offer additional quantities.

Remarks:

(i) The necessity of this condition is trivial, the sufficiency is not.

(ii) If market entry is easy or if producer power is large then p will be close to γ_i and, because of $c_i > \gamma_i$, release auctions will be ineffective.

(iii) If p is above the monopoly price then importers as well as gas producers may have a collective interest in high c_i. The individual interest of importer I_i, however, may still require low c_i.

III. Voluntary release quantities

Do the importers have an incentive to auction off quantities $y_i > 0$ voluntarily? Do they, even without regulatory enforcement, deliver certain quantities to competitors? Empirically, they do: only 7 nationwide active pipelines import gas or produce gas of their own. They deliver gas not only to retailers and industry but and sell it also to other wholesale pipelines. We must keep in mind, however, that the exclusive areas from the previous cartel era are still rather effective. Thus, empirically these deliveries are more to regional monopolists than to competitors. An enforced auction may have two advantages, namely

(i) The competitors have access to larger quantities than the importers offer them voluntarily.

(ii) The competitors get their gas at “market prices” and not in negotiations with a restricted number of importers.

The advantage of (ii) is difficult to evaluate and, for consumers, it seems to be less important than (i). So let us concentrate on (i). In order to be effective the required gas release quantities must be larger than the voluntary quantities. Otherwise the latter might, in the long run, be simply crowded out by the further. As the importers have concluded long-term contracts with the other pipelines, in the short run, i.e. if no previous adjustment is possible, (i) is answered positively. A second important question is whether the voluntary delivery to competitors is planned while the pipeline concluded the ToP contracts. In this case, these quantities are encluded in z_i and thus purchased at costs γ_i.

In the following analysis we assume that the pipelines planned to auction off certain quantities y_i, i.e. these quantities are included in the ToP contracts and that the pipelines could choose these quantities at given average prices γ_i. So, the play the following **"Gas Importers' Game":**

1. **Stage:** The importers choose ToP quantities z_i which are available at costs $\gamma_i z_i$ and auction quantities y_i.
2. **Stage:** The importers choose to offer $z_i - y_i$ or to deviate from $z_i - y_i$ by quantities $x_i < 0$ or > 0.

The second stage has been analysed in Section II. From Lemma 1 and the substitution of z_i by $z_i - y_i$ follows that (4) applies with $r_i = a - b(z + z_i - y_i + x_{-i})$

(4) implies that x_i^* is differentiable for $r_i \neq 0$, c_i with

(9) $$\frac{\partial x_i^*}{\partial z_i} = \begin{cases} 0 \text{ for } 0 < r_i < c_i \\ -1 \text{ otherwise} \end{cases}$$

(10) $$\frac{\partial x_i^*}{\partial y_i} = \begin{cases} 0 \text{ for } 0 < r_i < c_i \\ \frac{1}{2} \text{ otherwise} \end{cases}$$

At the time when the quantities y_i are auctioned the buyers expect p^*. We assume Bertrand competition among these buyers (bidders) and thus $p^* = q$. Thus i's expected profit (when he decides about z_i and y_i) is

(11) $G_i = (z_i + x_i^*)\,(a - b\,(z + x^*)) - x_i^* C_i' - z_i \gamma_i$.

Proposition 2: If

(12) $$\frac{a}{n+1} > \gamma_i > \frac{1}{3} c_i$$

then there is a continuum of equilibria of the Gas Importers' Game with $x_i^* = 0$ and

(13) $$\frac{2}{3}\frac{c_i}{b} < y_i^* < \frac{c_i}{b},$$

(14) $$z^* = \frac{na + by^* - \sum c_i}{(n+1)b},$$

(15) $$p^* = \frac{1}{n+1}\left(a - by^* + \sum c_i\right) > \gamma_i,$$

(16) $$z_i^* = \frac{1}{b}\left(a - bz^* + by_i^* - c_i\right) > y_i^*.$$

Proof: See Appendix.

The condition of Proposition 2, i.e. (12), is sufficient, not necessary. Its second part $\gamma_i < \frac{1}{3} c_i$, which does not seem to be too demanding could be substituted by the even weaker condition (A18).

The first part of (12) tells us something about participation. Only those importers are active who pay prices $\gamma_i < \frac{a}{n+1}$. If, for some of the n importers, this condition is not fulfilled then n is reduced.

Is the precommitment by the release auction beneficial for the consumers? If there was, first, an auction market, followed, second, by the conclusion of ToP-contracts then the precommitment would be always beneficial for the consumers (Allaz, 1992, Bolle, 1993, Powell, 1993). But such a sequence of action is unprobable in the gas market where ToP contracts have a duration up to 40 years. In the above game, the decisions about z_i and y_i took place at the same time. Do the consumers still profit? Cournot competition with costs γ_i yields equilibrium quantities $\tilde{z}_i$ with

(17) $$\tilde{z} = \frac{na - \sum \gamma_i}{(n+1)b} < \frac{na + by^* - \sum c_i}{(n+1)b} = z^*$$

because of (12) and (13). In particular, if c_i and γ_i differ a lot, then $\tilde{z}$ is much smaller than z^*, but also for $\gamma_i = c_i$ we find $\tilde{z} < z^*$.

As we mentioned before, in order to avoid “crowding out” the enforced auction quantities have to be larger than the voluntary quantities. So let us try to estimate the share y*/z*. From (14) follows that his share is maximal for the maximal y^* and minimal for the minimal y^*. So, using (13), we get

$$\frac{2}{3}(n+1)\frac{\frac{1}{n}\sum c_i}{a-\frac{1}{3n}\sum c_i} < \frac{y^*}{z^*} < (n+1)\cdot\frac{\frac{1}{n}\sum c_i}{a} \tag{18}$$

IV. Conclusion

There are no really reliable estimations of the gas demand. Liu (2004) finds long run price elasticities for natural gas between -0.78 and 0.08 for OECD countries. In the following, we use two alternative values, namely η = -0.2 and η = -0.7 for the demand of retailers and large industrial consumers. As van Damme (2004) proposes when applying a linear demand model to the Dutch electricity market we “calibrate” our linear demand to the elasticities, i.e. we assume a = $\left(1-\frac{1}{\eta}\right)p_0$ where p_0 is the current price.

For Germany, we have an average p_0 for retailers of 3 cent/kwh (Pfaffenberger and Gabriel, 2006). The import price of Russian gas was about 230 \$ (200 Euro)/1000 m^3 in 2006 which is equal to about γ_i = 0.5 cent/kwh. We disregard transport costs on the wholesale level within Germany which are less than 10 % of the import price. For c_i, the price of gas quantities beyond theToP quantities, we assume two values, namely c_i = 0.8 and c_i = 1.2 cent/kwh. With these values we get the boundaries for $\frac{y^*}{z^*}$ in Table 1. If we assume, for Germany, n = 7 we find that voluntary releases cover at least 29 % of the market. Even if we assume that, in the long run, there will be only 3

active competitors (E.On, RWE and WinGas (BASF, Gazprom)) the minimal $\frac{y^*}{z^*}$ is 14 %. So the enforced Ruhrgas release auction of less than 4 % of the German market (less than 10 % of the Ruhrgas sales) can hardly be effective.

In our model, we have assumed, for the sake of simplicity, that precommitment takes place only by gas releases for competitors. It seems more plausible, however, that some or most of this precommitment takes other forms. There was a tendency to conclude really long-term contracts also with retailers and industrial customers. After, however, the duration of such contracts is legally restricted the oligopolists have again to look for other forms of precommitment. One substitute of long-term contracts or voluntary releases may be vertical integration. In Germany, we observe an increasing share of retail companies being totally or partially owned by the big importers E.ON and RWE. These are also the two biggest players in the German electricity market and we have to note that the retailers which they (partially or totally) own often distribute gas as well as electricity.

	c_i = 0.8 cent/kwh	c_i = 1.2 cent/kwh
a = 15 cent/kwh	$(n+1)\cdot 0.036 < \frac{y^*}{z^*} < (n+1)\cdot 0.053$	$(n+1)\cdot 0.055 < \frac{y^*}{z^*} < (n+1)\cdot 0.08$
a = 7 cent/kwh	$(n+1)\cdot 0.079 < \frac{y^*}{z^*} < (n+1)\cdot 0.114$	$(n+1)\cdot 0.121 < \frac{y^*}{z^*} < (n+1)\cdot 0.171$

Table 1: Shares of voluntary gas releases for different assumptions about c_i and a.

We conclude that, in Germany, gas release auctions are ineffective. Even in France where, since 2000, Gaz de France lost 30 % of its industrial customers, small scale auctions cannot be expected to have an impact. In Denmark however, where DONG has a 95 % market share, the release auction of 10 % of DONG’s supply may have at least some effect.

How fits electricity in our model? Electricity is (mainly) domestically produced and not imported. Additional quantities, however, can be delivered in the short run – as in the gas case – only with higher marginal costs. The spot market is far more important for electricity than for gas. There also exists a liquid futures market. In electricity, we could distinguish precommitment on two (interrelated) markets: the spot market and the contract market for retailers/industrial customers. Electricity release auctions would lead to "fringe supply" on both markets.

In the German electricity market, E.On, RWE, Vattenfall, and EnBW (EdF) produce 80 % of the electricity consumed in Germany. If we apply (18) with n = 4 or n = 5 production costs $\gamma_i \approx 3$ cent/kwh, $c_i \approx 4$ cent/kwh a spot market price $p_0 = 5$ cent/kwh and $\varepsilon = -0.2$ (see van Damme, 2006), we arrive at the conclusion that these firms should try to precommit 50 % of their production which may be done, with respect to the spot market, by forward trading and contracts with retailers. It is difficult to imagine that a forced release auction would be concerned with more than 10 % of the production of these firms which therefore could and would be crowded out. The variation of the above assumptions in a sensible region of prices and elasticities does not change this conclusion. In France, things are different. EdF is a quasi-monopolist. Thus electricity release auctions probably have an effect.

Our general conclusion is that release auctions are only effective in the beginning of the transformation from a monopoly to a competitive system. With some competition, however, i.e. active competitors, such auctions must cover a high share of the market in order to be effective. But that would be expropriation and not liberalisation.

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Appendix

Proof of Proposition 2

For $r_i \neq 0$, c_i we differentiate G_i with respect to y_i and z_i.

(A1) $$\frac{\partial G_i}{\partial z_i} = a - b\left(z + x^* + \left(z_i + x_i^*\right) - x_i\right.$$
$$+\left[a - b\left(z + x^* + z_i + x_i^*\right) - c_i\right]\frac{\partial x_i^*}{\partial z_i}$$

(A2) $$\frac{\partial G_i}{\partial y_i} = a - b\left(z + x^* + z_i + x_i\right)$$
$$+\left[a - b\left(z + x^* + z_i + x_i^*\right) - c_i'\right]\frac{\partial x_i^*}{\partial y_i}.$$

If the equilibrium values (y_i^*, z_i^*) would imply $r_i \neq 0, c_i$ then $\frac{\partial G_i}{\partial z_i}=0$ and $\frac{\partial G_i}{\partial y_i}=0$ have to be fulfilled. Because (9) and (10) imply $\frac{\partial x_i^*}{\partial z_i}=-2\frac{\partial x_i^*}{\partial y_i}$, these optimality conditions require

(A3) $$a-b\left(z+x^*+z_i+x_i^*\right)=\frac{\gamma_i}{3}$$

and thus

(A4) $$\frac{\partial G_i}{\partial z_i}=\frac{\gamma_i}{3}-\gamma_i+\left[\frac{\gamma_i}{3}-c_i^{'}\right]\cdot\frac{\partial x_i^*}{\partial z_i}=0\,,$$

(A5) $$\frac{\partial G_i}{\partial y_i}=\frac{\gamma_i}{3}\qquad+\left[\frac{\gamma_i}{3}-c_i^{'}\right]\frac{\partial x_i^*}{\partial y_i}=0\,.$$

As both equations contain only parameters, they could be fulfilled only by chance (a non-generic case). But not even this is possible because of $c_i > \gamma_i > 0$. For $\frac{\partial x_i^*}{\partial z_i}=\frac{\partial x_i^*}{\partial y_i}=0$, (A4) is strictly positive and (A5) is strictly negative so that we have to conclude $\frac{\partial x_i^*}{\partial z_i}=-1$, $\frac{\partial x_i^*}{\partial y_i}=\frac{1}{2}$. Now, because of $c_i > \gamma_i$, (16) is positive and (17) is negative. So we have to conclude that $r_i = 0$ or $r_i = c_i$ have to be fulfilled for every i, i.e. $x_i^* = 0$.

Now we will ask whether $r_i = c_i$ or $r_i = 0$ can be fulfilled in equilibrium. If not, then no pure strategy equilibrium exists. So, in the following, we will ask whether deviations $z_i \pm \varepsilon$ or $y_i \pm \varepsilon$ pay. For this purpose we determine the upper and lower derivations of G_i with respect to z_i and y_i for $r_i = c_i$ ($r_i =0$) and $x_j^* = 0$, j = 1, …, n. So we set $x_{-i}^* = 0$ *in* the computation of the derivative but $x_i^* = 0$ only *after* the computation.

From (A1), (A2) and $r_i = a - b(z + z_i - y_i + x_{-i})$ follows under these conditions ($x_j = 0$) that, for $r_i \neq 0, c_i$,

(A6) $$\frac{\partial G_i}{\partial z_i}=r_i-by_i-\gamma_i+\left(r_i-by_i-C_i^{'}\right)\frac{\partial x_i^*}{\partial z_i}$$

(A7) $$\frac{\partial G_i}{\partial y_i}=r_i-by_i\qquad\left(r_i-by_i-C_i^{'}\right)\frac{\partial x_i^*}{\partial y_i}$$

The upper derivation $\frac{\partial G_i}{\partial z_i^+}$ is computed in the following way: If z_i is increased then r_i decreases which, because of (9), implies $\frac{\partial x_i^*}{\partial z_i}=0$. So, this deviation is not profitable if

(A8) $$\frac{\partial G_i}{\partial z_i^+}=c_i-by_i-\gamma_i<0\,.$$

We argue similarly for the other derivations. If z_i is decreased then r_i is increased which implies $x_i^*>0\left(C_i^{'}=c_i\right)$ and $\frac{\partial x_i^*}{\partial z_i}=-1$. So, for $r_i = c_i$, the lower derivative with respect to z_i is

(A9) $$\frac{\partial G_i}{\partial z_i}=c_i-\gamma_i>0\,.$$

Therefore, decreasing z_i would cause lower profits.

If we increase y_i then r_i increases which again implies $x_i^* > 0$ ($C_i^{'} = c_i$) but this time $\frac{\partial x_i^*}{\partial y_i}=\frac{1}{2}$. So, the condition that such a deviation is not profitable is

(A10) $\frac{\partial G_i}{\partial y_i^+} = c_i - \frac{3}{2} b y_i < 0$.

If we decrease y_i then r_i decreases which implies $\frac{\partial x_i^*}{\partial y_i} = 0$. This deviation is not profitable if

(A11) $\frac{\partial G_i}{\partial y_i^-} = c_i - b y_i > 0$.

(A9) is always fulfilled and (A8), (A10), (A11) are fulfilled under the condition of Proposition 2. So, such combinations of (z_i^*, y_i^*) values constitute equilibria of the Gas Importers' Game.

For $r_i = 0$ we do not find equilibria. If we decrease z_i then r_i increases which implies $\frac{\partial x_i^*}{\partial z_i} = 0$ and

(A12) $\frac{\partial G_i}{\partial z_i^-} = -b y_i - \gamma_i < 0$.

So, for $r_i = 0$, it would always be profitable to reduce z_i.

(A10) and (A11) are implied by (13). Under (12), (A8) is weaker than (A10). So all equilibrium conditions can be fulfilled if (12) holds. We get z^* by summing up the equations $r_i = c_i$, and then p^* and z_i^* as in (14), (15), (16). Because of (13), $p^* > \frac{a}{n+1}$, so (12) implies that $p^* > \gamma_I$, i.e. all importers make a profit. (12) and (13) imply that $z_i^* > y_i^*$.