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Modelling interactions between State and Private sector in a "previously " Centrally Planned Economy*

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Abstract: I model the impact of entry on market performance when a market is dominated by a former monopolist inherited from a previously centrally planned system. An oligopoly model is developed to analyze a market where one Large State Firm and a set of Small Private Firms produce a homogeneous good. Further extentions of the model investigate product differentiation and budget constraint.

* I wish to thank Prof. Steven Martin for helpful guidance through out the writing of the paper. But, of course, I am responsible for all views expressed and any errors.

1 *Introduction*

In the present work I focus on market performance during a transitional phase in which an economy is no longer a Centrally Planned Economy (CPE) but has not yet become a market economy. My aim is to investigate how state and private firms producing similar goods compete within a market where economic mechanisms of the old command system have been abolished and reforms have been implemented to promote market instruments and the "creation" of market actors.

In what follows I model three specific features of these markets.

The first considers the historic monopolistic position of state firms; as a consequence it is assumed that the state firm here investigated is a price-maker.

The second refers to the persistent shortages affecting these economies in the past and which - nowadays - could be seen as an incentive for new private firms to enter the market.

The third is related to the soft budget constraint sometimes faced by state firms during the transitional phase; what matters here is whether this budget constraint is relevant with respect to the presence of private firms in the market.

The remainder of this paper is organised as follows: in section 2 the model is developed to analyse a market where one Large State Firm (LSF) and n Small Private Firms (SPFs) produce a homogeneous good q.

The LSF maximises profit along a residual demand curve. Following Alexeev (1987), the consumer demand for the product q of the LSF depends on a "full price" that includes waiting time. The LSF sets a price which does not clear the market: n SPFs enter the market and pick an output which maximises profits.

Given the LSF's optimisation problem, I focus on the determination of n.

In section 3 n is then related to a parameter θ of product differentiation.

I conclude with section 4 where the analysis is extended to investigate the budget constraint faced by the LSF. Notwithstanding that the state firm is profit-oriented, it remains affected by a form of "soft budget constraint" in the way depicted by Kornai[1]: if the firm makes a loss, some sort of subsidy, bailout credit, or tax exemption is provided by the central government.

The private firm is instead characterised by a "hard budget constraint" which means that its survival depends exclusively on the proceeds from its sales and on the costs of inputs; moreover, the private firm is unable to influence the price.

The impact of soft and hard budget constraints faced by the LSF on the number of SPFs present are then compared to point out how these constraints affect equilibrium market shares.

2 *Residual Demand Analysis*

In this first model the interactions between the LSF's price and the SPF's price through the analysis of the state firm's residual demand are considered.

Consumers are free to buy the good q from the SPF or from the LSF. Consumers are indifferent between one unit of good q from a private firm immediately and $(1+w)$ units from the state firm, where w is the opportunity cost of expected waiting time for a unit of good to be delivered by the LSF. A representative utility function with these characteristics is:

$$(1) \qquad u = m + a\left(x_{T,q}\right) - \frac{1}{2}b\left(x_{T,q}\right)^2$$

where $x_{T,q}$ indicates the total quantity of good q and the numéraire m represents all the other goods.

Let us denote by x_S the quantity purchased from the LSF and x_P the quantity purchased from the SPF; then

$$(2) \qquad x_{T,q} = \frac{x_S}{1+w} + x_P \quad .$$

[1]Kornai J., vol. B, pp.299-322.

The formulation chosen for $x_{T,q}$ - the total amount of good q desired by the consumer - is related to Alexeev's[2] theoretical model of individual behaviour under the dualism of the official and parallel retail markets for agricultural products in Soviet Union.

Alexeev (1987) models a situation in which the good considered can be bought either in the first market or in the parallel one. The first market price is fixed below the market-clearing level and the consumers have to spend on average t hours in a queue for each unit of the good they want to buy. The parallel market price is flexible, market-clearing and gives immediate availability of the good purchased.

For the first market price, Alexeev introduces the concept of "full price", which incorporates the consumer's queuing time t for each unit of good and its monetary value w. In this way, Alexeev analyses the consumer behaviour based on the relationship between

$$p_1 + w^i t \qquad \text{and} \qquad p_2$$

where w^i is the consumer's marginal value of time, p_1 is the first market price and p_2 is the parallel market price.

Obviously those consumers for whom $p_1 + w^i t < p_2$ would prefer to shop in the first market, while those for whom $p_1 + w^i t > p_2$ would opt for the parallel one.

In our model of homogeneous goods, if positive amounts of both goods are consumed, then $p_1 + w^i t$ must be equal to p_2.

Coming back to our analysis and substituting (2) into (1) we get:

$$(3) \qquad u = m + a\left(\frac{x_S}{1+w} + x_P\right) - \frac{1}{2}b\left(\frac{x_S}{1+w} + x_P\right)^2 .$$

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[2]Alexeev M.,(1987): "Microeconomic modelling of parallel markets: the case of agricultural goods in the URSS", Journal of Comparative Economics, N°11/4; pp.543-557.

The Lagrangian for constrained utility maximisation is:

(4)

$$£ = m + a\left(\frac{x_S}{1+w} + x_P\right) - \frac{1}{2}b\left(\frac{x_S}{1+w} + x_P\right)^2 + \lambda(\gamma - m - p_S x_S - p_P x_P)$$

where $(\gamma - m - p_S x_S - p_P x_P)$ is the consumer's budget constraint, γ is the consumer's income, p_P and p_S are the prices set by the SPF and by the LSF respectively.

If I consider the interior solution[3] in which $x_P > 0$ and $x_S > 0$, then

(4.a) $$\frac{\partial £}{\partial m} = 1 - \lambda = 0 \qquad \lambda = 1$$

(4.b) $$\frac{\partial £}{\partial x_S} = a - \frac{bx_S}{1+w} - bx_P - \lambda(1+w)p_S = 0 \quad \text{and}$$

(4.c) $$\frac{\partial £}{\partial x_P} = a - \frac{bx_S}{1+w} - bx_P - \lambda p_P = 0 \quad .$$

It follows that a necessary relationship between prices is:

(5) $$p_P = (1+w)p_S$$

which depends on the assumption that all firms have positive sales in the long run considered. This is a specific version of Alexeev's result comparing prices on dual markets.

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[3]The corner solution $x_P = 0$ would involve entry deterring behavior by the incumbent, of the kind studied in the literature on limit pricing and predatory behaviour. It seems unlikely that public authorities in transition economies would permit such behaviour. The corner solution $x_S = 0$ would describe situations in which the former state monopolist was so inefficient that competition from small private firms drives it out from the market. While such markets may well exist in practice, their analysis would take me away from the topic of this paper, the interaction of private firms and former state monopolies.

From (4.b) and (4.c) we obtain the (inverse) demand function for q which is:

(6.a) $$p_P = (1+w)p_S = a - b\left(\frac{x_S}{1+w} + x_P\right) \quad .$$

Let

(7) $$x_S^* = \frac{x_S}{1+w}$$

so that (6.a) can be rewritten as

(6.b) $$p_P = (1+w)p_S = a - b\left(x_S^* + x_P\right) \quad .$$

It follows that the equation for the LSF's residual demand is:

(8) $$x_S^* = \frac{[a-(1+w)p_S]}{b} - x_P$$

which is expressed in terms of market demand function and of SPF's demand (x_P) for good q .

Now suppose there is a set of n SPFs who sell the same product q, acting as Cournot oligopolists. Each SPF chooses its level of output (x_P) so as to maximise profit. Supposing the SPF's linear cost function to be

(9) $$c\left(x_{P_i}\right) = c x_{P_i} + F$$

- where F stands for fixed costs - and recalling (6.b), the profit of a single SPF can be expressed as follow

(10) $$\pi_{P_i} = \left[a - c - b\left(x_S^* + \sum_{j=1}^{n} x_{P_j}\right)\right] x_{P_i} - F \quad .$$

Thus each SPF will choose that level of output for which

(11) $$\frac{\partial \pi_{P_i}}{\partial x_{P_i}} = \left[a - c - b\left(x_S^* + \sum_{j=1}^{n} x_{P_j} + x_{P_i}\right)\right] = 0 \quad .$$

Since the SPF's have identical cost functions and behave in the same way, in equilibrium they will produce identical outputs:

(12) $$x_{P_1} = x_{P_2} = \ldots = x_{P_n} = \hat{x}_P \quad .$$

This permits us to write the condensed SPF reaction function as

(13.a) $$x_S^* + (n+1)\hat{x}_P = \frac{a-c}{b}$$

or

(13.b) $$\hat{x}_P = \frac{1}{n+1}\left(\frac{a-c}{b} - x_S^*\right)$$

Recalling (6.b), the presence of n SPFs transforms the LSF's residual demand function as:

(14) $$(1+w)p_S = a - b\left(x_S^* + n\hat{x}_P\right)$$

and combining (13.b) in the previous (14) we get

(15) $$(1+w)p_S = c + \frac{a - c - bx_S^*}{n+1} \quad .$$

We can now work out the LSF's optimisation problem with respect to its residual demand function. The LSF will act as a Stackelberg quantity leader and maximise profit:

(16) $$\pi_S = \left(p_S - c\right)x_S \quad .$$

Substituting (15) we get:

$$(17) \qquad \pi_S=\left\{\left[c+\frac{a-c-bx_S{}^*}{(n+1)}\right]-(1+w)c\right\}x_S{}^* \quad .$$

Taking the derivative of (17) with respect to x_S and solving the resulting first order condition, we get the LSF's profit maximising output:

$$(18) \qquad x_S{}^*=\frac{1}{2}\left\{\frac{a-[1+(n+1)w]c}{b}\right\}$$

which depends on a, b, c, w and n.

It is now interesting to focus on the determination of the number of SPFs which share the market for good q with the LSF.
Suppose that n adjusts so that $\hat{\pi}_P = 0$, which means that SPFs would enter the market until the profit of each private firm is driven to 0. Thus we have

$$(19.a) \qquad \hat{\pi}_P=b\left[\frac{1}{n+1}\left(\frac{a-c}{b}-x_S{}^*\right)\right]^2-F=0$$

which after some manipulation can be written as

$$(19.b) \qquad (n+1)=\frac{\left(\dfrac{a-c}{b}-x_S{}^*\right)}{\sqrt{\dfrac{F}{b}}}$$

and substituting the LSF's profit maximising output (18), equation (19.b) becomes

(19.c)
$$(n+1)=\frac{S\Big/\sqrt{\frac{F}{b}}}{2-\frac{wc}{\sqrt{bF}}}$$

where

(20)
$$S=\frac{a-c}{b} \quad .$$

Looking to (19.c), we can observe that n is an increasing function of w which means that the higher the opportunity cost of expected waiting time is for a unit of good to be delivered by the LSF, the larger the number of SPFs entering the market. Combining (19.b) into the previous (15), we get the long run equilibrium price

(21)
$$p_P=(1+w)p_S=c+\sqrt{bF} \quad .$$

3 *Product Differentiation Analysis*

We now modify the previous model to examine how product differentiation affects market performance - or more precisely - how it affects the number of SPFs coming into the market for good q.

The parameter θ measures the degree of product differentiation: its value can lie between 0 and 1. If $\theta = 0$, products are completely differentiated and each producer is a monopolist for its own brand; if $\theta = 1$, products are completely homogeneous and we are in the case of oligopolistic market.

With this notation, a quadratic representative utility function is

(22) $$u=m+a\left(\frac{x_S}{1+w}+x_P\right)-\frac{b}{2}\left[\left(\frac{x_S}{1+w}\right)^2+2\theta\frac{x_S x_P}{1+w}+x_P{}^2\right] .$$

The Lagrangian for constrained utility maximisation is:

(23)
$$£=m+a\left(\frac{x_S}{1+w}+x_P\right)-\frac{b}{2}\left[\left(\frac{x_S}{1+w}\right)^2+2\theta\frac{x_S x_P}{1+w}+x_P{}^2\right]+\lambda\left[\gamma-m-p_S x_S-p_P x_P\right]$$

From the first order conditions (assuming interior solutions) we get

$$\frac{\partial £}{\partial m}=1-\lambda=0 \qquad \lambda=1$$

$$\frac{\partial £}{\partial x_S}=\frac{a}{1+w}-b\left[\frac{x_S}{(1+w)^2}+\theta\frac{x_P}{(1+w)}\right]-\lambda p_S=0$$

and

$$\frac{\partial £}{\partial x_P}=a-b\left[\theta\frac{x_S}{(1+w)}+x_P\right]-\lambda p_P=0$$

from which we obtain the inverse demand curves:

(24.a) $$p_S=\frac{1}{(1+w)}\left[a-b\left(x_S{}^*+\theta x_P\right)\right]$$

and

(24.b) $$p_P=\left[a-b\left(\theta x_S{}^*+x_P\right)\right] .$$

Proceeding in the same way as in the homogeneous product model, we derive the residual demand curve of the large state firm.
The profit maximisation problem of n SPFs becomes now

(25.a) $$\pi_{P_i} = \left[a - c - b\left(\theta x_S{}^* + \sum_{j=1}^{n} x_{P_j}\right)\right] x_{P_i} - F$$

where the profit maximising quantity is

(25.b) $$x_{P_i} = \left[a - c - b\left(\theta x_S{}^* + \sum_{j=1}^{n} x_{P_j}\right)\right]$$

and on the n SPFs reaction function we get

(26.a) $$\theta x_S{}^* + (n+1) x_P = \frac{a-c}{b}$$

or

(26.b) $$n x_P = \frac{n}{n+1}\left(\frac{a-c}{b} - \theta x_S{}^*\right)$$

which represents the total output of all SPFs as a function of $x_S{}^*$.
The LSF's residual demand curve in a market affected by product differentiation becomes

(27) $$(1+w) p_S = \left[c + \frac{1+(1-\theta)n}{n+1}(a-c) - b\frac{1+\left(1-\theta^2\right)n}{n+1} x_S{}^*\right].$$

The LSF's profit is

(28) $$\pi_S = \left\{-wc + \frac{[1+(1-\theta)n](a-c) - \left[1+\left(1-\theta^2\right)n\right] b x_S{}^*}{n+1}\right\} x_S{}^*$$

which is maximised for

$$(29) \qquad x_S^{\ *} = \frac{[1+(1-\theta)n](a-c)-(n+1)wc}{2b\left[1+\left(1-\theta^2\right)n\right]} \quad .$$

We focus now on the relation between product differentiation and the number of SPFs.
Recalling (26.a) and (24.b), p_P could also be expressed as follow

$$(30) \qquad p_P = c + bx_P$$

which permit us to write the SPF's profit

$$(31.a) \qquad \pi_P = (p_P - c)x_P - F = b(x_P)^2 - F \quad .$$

Substituting (29) in (26.b) we get

$$(32) \qquad x_P = \frac{1}{n+1}\frac{[2-\theta+(1-\theta)(2+\theta)n]S}{2\left[1+\left(1-\theta^2\right)n\right]} + \frac{\theta}{2\left[1+\left(1-\theta^2\right)n\right]}\frac{wc}{b} \quad .$$

Suppose n adjusts so that $\pi_P = 0$; the profit maximisation problem of n SPFs in a market with product differentiation is

$$(31.b) \qquad \frac{1}{2\left[1+\left(1-\theta^2\right)n\right]}\left\{\frac{[2-\theta+(1-\theta)(2+\theta)n]S}{n+1} + \theta\frac{wc}{b}\right\} = \sqrt{\frac{F}{b}} \quad .$$

Solving the previous (31.b) for $(n+1)$ we get

(33)

$$(n+1) = -\frac{\left[2\theta^2\sqrt{\frac{F}{b}}-(1-\theta)(2+\theta)S-\theta\frac{wc}{b}\right]}{4\sqrt{\frac{F}{b}}\left(1-\theta^2\right)} \pm$$

$$\pm\frac{\sqrt{\left[2\theta^2\sqrt{\frac{F}{b}}-(1-\theta)(2+\theta)S-\theta\frac{wc}{b}\right]^2-8\theta^2\sqrt{\frac{F}{b}}\left(1-\theta^2\right)S}}{4\sqrt{\frac{F}{b}}\left(1-\theta^2\right)}$$

Only the plus sign in the numerator need be considered. A numerical simulation gives a clear picture of the relation between the number of SPFs and product differentiation (θ), fixed costs (F), and opportunity cost of expected waiting time (w) respectively.

The three different cases are here investigated keeping constant values for a, b, c, and m and assigning reasonable values to the parameters θ, F, and w. (See the Appendix for more details about the simulation).

The number of SPFs is positively affected by the opportunity cost of expected waiting time: as w increases, $(n+1)$ increases.

Considering fixed costs, it can be observed that $(n+1)$ is a decreasing function of F.

In the case of product differentiation, the number of SPFs entering the market is higher the greater the product differentiation but only until $\theta = 3/4$ (see Tab.1).

Coming back to the previous (31.b) and focusing on its partial derivatives, I found that the value of w is relevant to the sign of the whole function when θ assumes values near to 1.

The problem now is to determine what could be a reasonable value for w. In my view w should be somehow related to the firm's cost since it is a sort of cost as well but for the consumer. For this reason I performed the simulation assuming - as basic case - $w = 11/4$, given $c = 2$ and $F = 4$.

In Tab. 2 numerical solutions of (33) are provided with respect to different values of θ and as w changes. As w increases the interval where $(n+1)$ is positively affected by the product differentiation becomes progressively smaller. This result is shown as well as by the graphical representations which follow the numerical simulation in the Appendix.

While performing the simulation, however, a new insight has been gained to the whole issue: the resulting consumer's Net Welfare has been investigated with respect to product differentiation, fixed costs and the opportunity cost of expected waiting time.

The results obtained highlight on the one hand that the consumer's Net Welfare decreases as product differentiation decreases and as fixed costs increase; on the other hand it increases as the opportunity cost of expected waiting time decreases (see Tab.1, 3, 4). It comes that the consumer is better off when product differentiation is present in the market and when "queuing time" disappears.

4 *Budget Constraint Analysis*

In this section we introduce the budget constraint analysis to the model.

Such budget constraints have been investigated by J. Kornai (1980) who recognised it as one of the key differences between capitalist and socialist firms along with resource constraints and demand constraint[4].

Whereas a capitalist firm nearly always faces a hard budget constraint, the corresponding constraint for a socialist firm tends to be soft. In Kornai's analysis four conditions contribute to the softness of the constraint for a state enterprise:

1) price-making, in the sense that sooner or later enterprises are able to pass cost increases on to customers;

2) a soft tax system, in which the enterprise is able to negotiate special rates or exemptions, or to influence the formulation of tax rules;

[4] With respect to these last two items, Kornai underlined in his work that under capitalist conditions it is demand constraints that normally limit production while under socialism it is the resource constraints (of labour, capital, intermediate inputs) which perform that role.

3) free state grants available to enterprises for a variety of purposes;
4) a soft credit system, with loans only loosely related to future sale revenue and with only mild repayment conditions and/or weak penalties for non repayment.
Obviously under these conditions - which can hold to a different extent in different countries or at different times - the survival of a state firm depends hardly at all on its ability to cover all its cost out of its sales proceeds since grants, subsidies, bailouts, tax favours etc. can be negotiated to fill the gap.
It follows that the softness of the budget constraint which characterises socialist firms is an important feature in the evaluation of the transition toward a market economy and, moreover, in the analysis of interaction with the growing private sector.

In this section we generalise the previous model - where one LSF and n SPFs were sharing the market for good q - to make bankruptcy possible and to model the impact of a soft budget constraint.
First of all we suppose the market inverse demand function has a stochastic intercept a, taking a high (a_H) or low (a_L) value with probability μ and $(1-\mu)$ respectively. Whether demand is high or low in a given period of time is unknown in advance by LSF and SPFs, while μ is known to LSF and to SPFs.
This means that

(34) $$E(a) = \mu\pi_H + (1-\mu)\pi_L \quad .$$

LSF and SPFs must pick output before they know the realised value of the market demand - that means before they know if a is high or low. The LSF and SPFs pick their own output to maximise their own expected profit.
Two cases will be considered: one where LSF is affected by a "hard budget constraint" and the other where LSF faces a "soft budget constraint".
In both the cases SPFs come into the market for good q until their expected profits are zero.
The expected profit of a generic SPF will now be

(35) $$\pi_{P_i} = \mu\pi_H + (1-\mu)\pi_L$$

where, recalling (10), we have

$$\pi_H = \left\{ \left[a_H - c - b\left(x_S{}^* + x_{P_i} + ... + x_{P_n} \right) \right] x_{P_i} - F \right\} \tag{36}$$

and

$$\pi_L = \left\{ \left[a_L - c - b\left(x_S{}^* + x_{P_i} + ... + x_{P_n} \right) \right] x_{P_i} - F \right\} \quad . \tag{37}$$

The first order condition is

$$\frac{\partial \pi_{P_i}}{\partial x_{P_i}} = \left[E(a) - c - b\left(x_S{}^* + 2x_{P_i} + ... + x_{P_n} \right) \right] = 0 \quad . \tag{38}$$

The (38) gives us the SPF profit maximising output, which can be written in condensed form as

$$x_P = \left[\frac{(E(a) - c)}{b} - x_S{}^* \right] \frac{1}{(n+1)} \quad . \tag{39}$$

The residual demand curve of LSF - in presence of n SPFs - becomes

$$(1+w)p_S = \frac{\left[E(a) - bx_S{}^* \right] - c}{(n+1)} \quad . \tag{40}$$

Acting as a Stackelberg leader, the LSF maximises expected profit along the residual demand curve. LSF's expected profit is:

$$\pi_S = \frac{b}{(n+1)} \left[\frac{E(a) - c}{b} - (n+1)w\frac{c}{b} - x_S{}^* \right] x_S{}^* \tag{41}$$

which is maximised for

(42) $$x_S^{\ *} = \frac{1}{2}\left[\frac{E(a)-c}{b} - (n+1)w\frac{c}{b}\right] \ .$$

Considering the number of SPFs, when LSF faces a hard budget constraint, the previous (19.c) becomes

(43) $$(n+1)_{HardB.C.} \quad = \frac{\dfrac{E(a)-c}{b} \Big/ \sqrt{\dfrac{F}{b}}}{2-\dfrac{wc}{\sqrt{bF}}} \ .$$

Moving now to the case where LSF faces a soft budget constraint and recalling (36) and (37), the problem of the firm is:

(44) $$\max \qquad \mu\pi_H + (1-\mu)(0) \ .$$

In the case of a hard budget constraint to a low demand function (a_L) it will correspond to a negative profit ($\pi_L < 0$); while in the case of a soft budget constraint - given the bailout credit provided by the central government - to (a_L) it will result in a profit equal to zero ($\pi_L = 0$). Whenever the LSF makes losses, the government covers them.

The inverse demand function is now

(45) $$(1+w)p_S = a_H - b\left[x_S * + nx_P\right]$$

and considering (34) and (39) we get

$$(46) \qquad (1+w)p_S = a_H - b\left[x_S{}^* + \frac{n}{n+1}\left(\frac{\mu a_H + (1-\mu)a_L - c}{b} - x_S{}^*\right)\right]$$

The LSFs expected profit is

(47)

$$E(\pi_S) = \mu(p_S - c)x_S =$$
$$= \frac{\mu b}{(n+1)}\left\{\frac{(n+1)(1-\mu)(a_H - a_L)wc}{b} + \frac{\mu a_H + (1-\mu)a_L - c}{b} - x_S{}^*\right\}x_S{}^*$$

which is maximised for

(48)

$$x_S{}^* = \frac{1}{2}\left\{\left[\frac{\mu a_H + (1-\mu)a_L - c}{b}\right] - (n+1)w\frac{c}{b} + \left[(1-\mu)(n+1)\left(\frac{a_H - a_L}{b}\right)\right]\right\}$$

Focusing on the determination of the number of SPFs sharing the market for good q with the LSF affected by a soft budget constraint we consider the previous (43) where the LSF maximising output is substituted by (48) and we get:

$$(49) \qquad (n+1)_{Soft\,B.C.} = \frac{\dfrac{E(a)-c}{b} \Big/ \sqrt{\dfrac{F}{b}}}{2 - \dfrac{wc}{\sqrt{bF}} + (1+\mu)\left(\dfrac{a_H - a_L}{b}\right)}.$$

Comparing (49) with the previous (43) we should highlight that in the presence of a LSF facing a soft budget constraint the number of SPFs is lower than in presence of a LSF facing a hard budget constraint.

5 *Conclusion*

In this paper I have studied the impact of small private firms on a market initially dominated by one large state firm in a previously Centrally Planned Economy.

I considered a model which allows us to investigate a LSF behaving as a Stackelberg leader and n SPFs playing Cournot.

For the analysis on residual demand (section 2) the main result is that increasing the LSF's "full price" - which includes the opportunity cost of expected waiting time - the number of SPFs entering the market increases. In these circumstances, the number of private firms producing a homogeneous good is increased by the persistence in the market of queuing time in acquisition of commodities. Shortages should encourage the entry of SPFs in the market.

In addition, considering product differentiation (section 3), under specific conditions given by the numerical simulation performed, the greater the differentiation of the good, the larger the number of SPFs entering the market.

The budget constraint analysis (section 4) shows that if the LSF faces a soft budget constraint the number of SPFs is lower than with a LSF facing a hard budget constraint. In the environment considered, where reforms to create conditions for a decentralised market system are being implemented, it is more desirable[5] that a LSF faces a hard budget constraint, since this leads to a larger number of small private firms and, consequently, to higher competition[6].

A last remark is in order. In this paper we dealt with a LSF maximising profit; this assumption is not at all obvious since the objective function of a state firm is controversial.

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[5]The concept of desirability expressed in this statement refers to the objectives of the transitional phase in Central and Eastern economies among which the implementation of market competition assumes a relevant role. The social impact of the dynamics considered above have not been investigated here. Moreover, I should here stress that this conclusion comes from a partial equilibrium setting and it may not be true in a general equilibrium setting.

[6]The last statement could be correlated with some feedback which are beyond the scope of the present paper. In fact, soft and hard budget constraint have different influence on delays in production and shortages in supply. Such feedback may foster fundamental rethinking of the analysis above and may constitute new fields for further investigations.

The usual approach[7] states that state firm is social welfare maximising. Our choice relates to the transitional phase of the economy, when the creation of market actors and the acquisition of market rules are being followed up and where a lot of large state firms are touched by the privatisation process which induces the state firm itself to maximise profit. In the light of these considerations, our assumption seems to be justified.

[7] see: Cremer H., Marchand M., Thisse J.F., (1989): "The public firm as an instrument for regulating an oligopolistic market", Oxford Economic Papers, 41, pp. 283-301; and De Fraja G., Delbono F., (1989): "Alternative strategies of a public enterprise in oligopoly", Oxford Economic Papers, 41,pp. 302-311

Appendix - Numerical Simulation

The numerical simulation presented here investigates the number of SPFs coming in the market and the consumer's Net Welfare. In each case the behaviour of three key variables is described: the parameter of product differentiation (θ), the fixed costs (F), and the opportunity cost of expected waiting time (w).

The results from the following numerical simulation are performed assuming constant values for a, b, c and m.

The number of SPFs is analysed evaluating the previous (33) and considering the only positive root:

$$(n+1) = -\frac{\left[2\theta^2\sqrt{\frac{F}{b}} - (1-\theta)(2+\theta)S - \theta\frac{wc}{b}\right]}{4\sqrt{\frac{F}{b}}\left(1-\theta^2\right)} + \frac{\sqrt{\left[2\theta^2\sqrt{\frac{F}{b}} - (1-\theta)(2+\theta)S - \theta\frac{wc}{b}\right]^2 - 8\theta^2\sqrt{\frac{F}{b}}\left(1-\theta^2\right)S}}{4\sqrt{\frac{F}{b}}\left(1-\theta^2\right)}$$

The consumer's Net Welfare is measured through the equation of the consumer's utility function minus the costs of production (these last correspond to the costs faced by $(n+1)$ SPFs and the LSF to produce their output):

$$\textit{Net Welfare} = m + a\left(\frac{x_S}{1+w} + nx_P\right) - \frac{b}{2}\left[\left(\frac{x_S}{1+w}\right)^2 + 2\theta\frac{x_S nx_P}{1+w} + \left(nx_P\right)^2\right] - c\left(x_S + nx_P\right) - nF$$

Setting F=4 and w=11/4, *Table 1* shows how the number of SPFs and the consumer's Net Welfare are affected by the parameter of product differentiation θ.
In *Table 2*, I focus on the relation between $(n+1)$ SPFs and θ, as w changes.

Table 3 and *Table 4* describe how the number of SPFs and the consumer's Net Welfare are sensitive to different value of F and w respectively.

Tables

Tab. 1 - θ = (1/10, 1/8, 1/4, 1/2, 3/4, 7/8, 9/10, 11/12); F = 4; w = 11/4 =2,75

Constant Parameters:
$a = 56$
$b = 1$
$c = 2$
$m = 0$

	θ=1/10	θ=1/8	θ=1/4	θ=1/2	θ=3/4	θ=7/8	θ=9/10	θ=11/12
(n+1)	25,91	25,67	24,64	23,28	23,04	24,38	25,14	25,90
Net Welfare	2061.97	2023.96	1855.71	1603.86	1427.91	1365.89	1357.35	1353.52

Tab. 2 - θ = (1/10, 1/8, 1/4, 1/2, 3/4, 7/8, 9/10, 11/12); F = 4; w = (0, 1, 11/4, 10, 100, 1000)

Constant Parameters:
$a = 56$
$b = 1$
$c = 2$
$m = 0$

	w=0	w=1	w=11/4	w=10	w=100	w=1000
θ=1/10	25,77	25,81	25,91	26,27	30,82	76,27
θ=1/8	25,49	25,56	25,67	26,12	31,84	88,98
θ=1/4	24,27	24,40	24,64	26,10	37,59	157,57
θ=1/2	22,37	22,70	23,28	25,67	55,58	355,12
θ=3/4	20,75	21,58	23,04	29,1	105,81	877,09
θ=7/8	19,67	21,36	24,37	37,28	204,31	1239,96
θ=9/10	19,32	21,40	25,14	41,41	253,41	2384,79
θ=11/12	19,01	21,46	25,91	45,54	302,47	2884,87

Tab. 3 - θ = 1/2; F = (4, 64, 144, 400, 1600); w = 11/4

Constant Parameters:
$a = 56$
$b = 1$
$c = 2$
$m = 0$

	F=4	F=64	F=144	F=400	F=1600
(n+1)	23,28	5,72	3,77	2,21	1,05
Net Welfare	1603.86	267.06	-1515.34	-7219.02	-33955

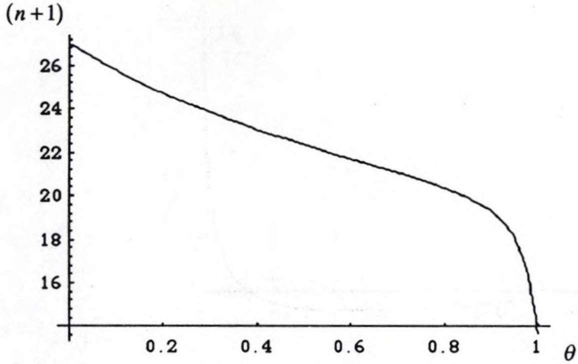
Tab. 4 - θ = 1/2; F = 4; w = (0, 1, 11/4, 10, 100, 1000)

Constant Parameters:
$a = 56$
$b = 1$
$c = 2$
$m = 0$

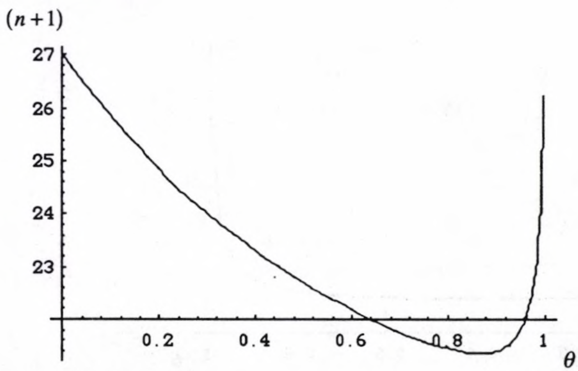
	w=0	*w*=1	*w*=11/4	*w*=10	*w*=100	*w*=1000
(n+1)	22,37	22,53	23,28	25,67	55,58	355,51
Net Welfare	1536.27	1764.35	1603.86	1371.02	1231.02	1214.51

Graphics

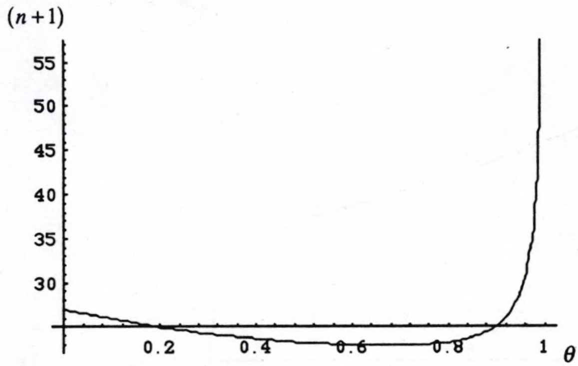
$w=0$, $1 > \theta > 0$



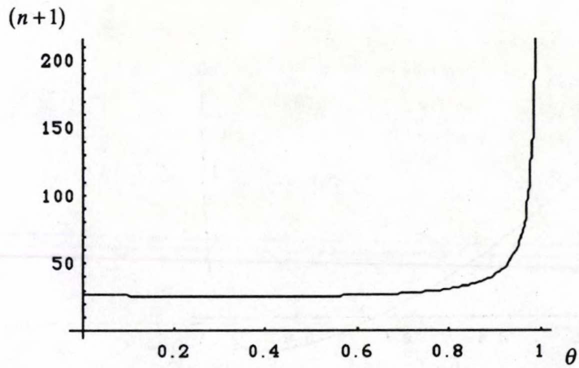
$w=1$, $1 > \theta > 0$



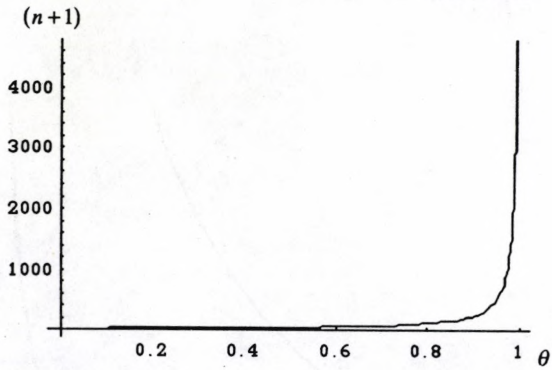
$w = 11/4, \quad 1 > \theta > 0$



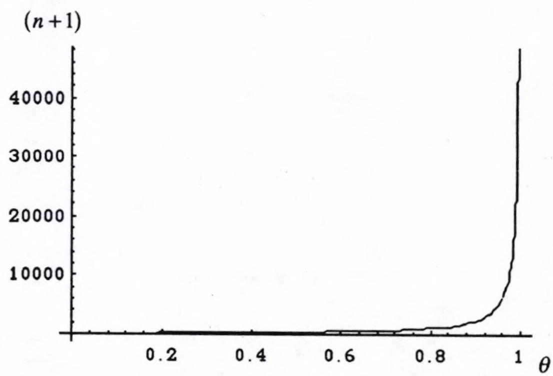
$w = 10, \quad 1 > \theta > 0$



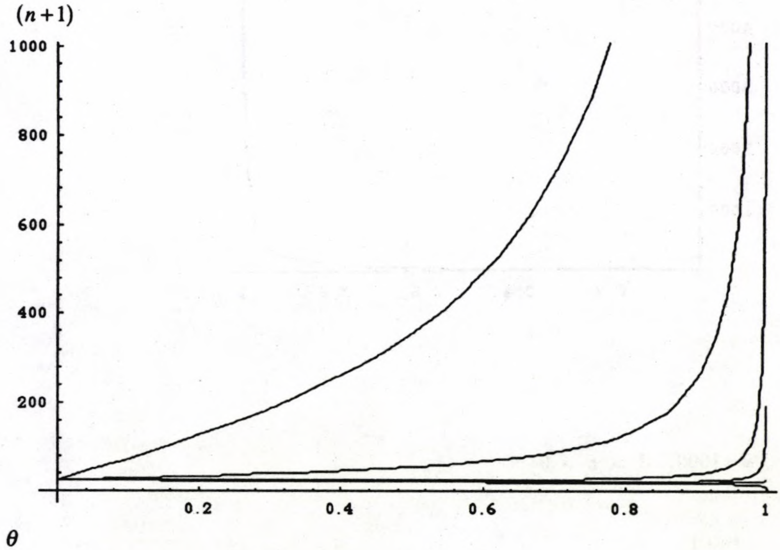
w=100, $1 > \theta > 0$



w=1000, $1 > \theta > 0$



$w = (0,\ 1,\ 11/4,\ 10,\ 100,\ 1000),\quad 1 > \theta > 0$



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