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Workable Competition and the Barrier Market

A. van Witteloostuijn and J.A.H. Maks*

1. *Introduction*

The concept of the barrier market aims to integrate the forces behind the introduction of static and dynamic economies of market behaviour. In general, economists focus on dynamic economies to the detriment of static economies, or *vice versa* (see van Witteloostuijn and Maks, 1987). The barrier market concept includes static economies of market behaviour by adopting a contestable market–like multi–period framework. Baumol *et al.*'s (1982) contestable market may be regarded as a formal microfoundation of the Chicago thesis (*e.g.* Demsetz, 1968), contending that two firms may be sufficient to guarantee static optimal *price setting* in a market at a point in time. However, a contestable market excludes the forces behind the introduction of dynamic economies of market behaviour. It is in this respect that *innovations* are important. The barrier market allows for the introduction of dynamic economies by means of incorporating Bain's (1956) barriers to entry. In this way forces behind the introduction of dynamic economies are incorporated without damage to the static optimal character of market behaviour.

In fact, the barrier market introduces a *formal* elaboration of a workable competition concept (Clark, 1940). As Tisdell formulates the implications of workable competition: "The fear of entry might keep prices down, substitutes might keep demand curves relatively flat and entry forestalling behaviour might spur the adoption of new techniques." (Tisdell, 1972, p. 297). The concept of workable competition did not receive a formal elaboration, but instead just listings of relevant criteria (Scherer, 1980, p. 42). More detailed arguments supporting the proposal of the barrier market are offered by Maks (1986), van Witteloostuijn and Maks (1987) and van Witteloostuijn (1988a, 1988b).

The barrier market model is based upon two theoretical notions: threat of entry and barriers to entry. A *dominant threat of entry* forces incumbent firms in a market to employ minimum average cost pricing, even when entry barriers exist. To deter future entry, incumbent firms reduce the ease of entry by means of raising barriers, as described in detail by Bain and his successors. Our definition of *entry barrier* is basically the same as Baumol's concept, which amounts to the presence of sunk costs. In order to introduce the essentials of the analysis in a lucid way, in this paper a very simple case is presented. In section 2 a model of decision making behaviour of an individual incumbent or potential supplier in a barrier market at any point in time is presented. Then, in section 3, there is an analysis of the interaction in behaviour between several individual suppliers whilst engaged in a competitive process over a number of periods of time. Some final remarks are offered in section 4.

2. The Decision Model of the Incumbent and Potential Suppliers

In this section the decision making behaviour of an individual supplier in a barrier market at a certain point in time is modeled, *given his expectations and knowledge.* In fact, the section is devoted to a very simple model of supply side behaviour of a firm in a barrier market. A firm is engaged in temporary and intertemporal decision - making, the former focusing on current period price and quantity setting and the latter on raising barriers to entry in future periods. Firstly, the simple production structure underlying the variable part of the cost is described and, secondly, there is an indication of how the investments lead to sunk costs and so influence the production technology and the variable cost.

Following Baumol *et al.* a flat bottomed U–shaped average variable cost curve is adopted.[1] For the sake of simplicity, the course of the supplier's variable cost curve is determined by a Cobb–Douglas production function with switching returns:

(1) $Y_t = e_t \cdot L_t^{\alpha} \cdot M_t^{\beta}, \quad Y,e,L,M \in R_+, \quad 0<Y_t^1<Y_t^2,$

with,

(1a) $Y_t<Y_t^1$ then $\alpha+\beta>1$,

(1b) $Y_t^1 \leq Y_t \leq Y_t^2$ then $\alpha+\beta=1$, and

(1c) $Y_t > Y_t^2$ then $0 < \alpha + \beta < 1$.

Y_t denotes output produced and offered in the short or ultra short-term period t (these concepts are clarified in section 3). L_t denotes units of labour, M_t units of raw material (for example, energy), α labour elasticity, β material elasticity, and e_t state of the technology. From (1) the average variable cost function (AC_t) can be derived. Prices per unit labour (r_L) and raw material (r_M) are determined in a labour and raw material market respectively. Both are assumed to be determined outside the model and are known to the firms.

The current period quantity (Y_t) and price decision is, *ceteris paribus*, determined by the point of intersection between the cost curve and (expected individual) demand (D_t), as is illustrated with the help of figure I.

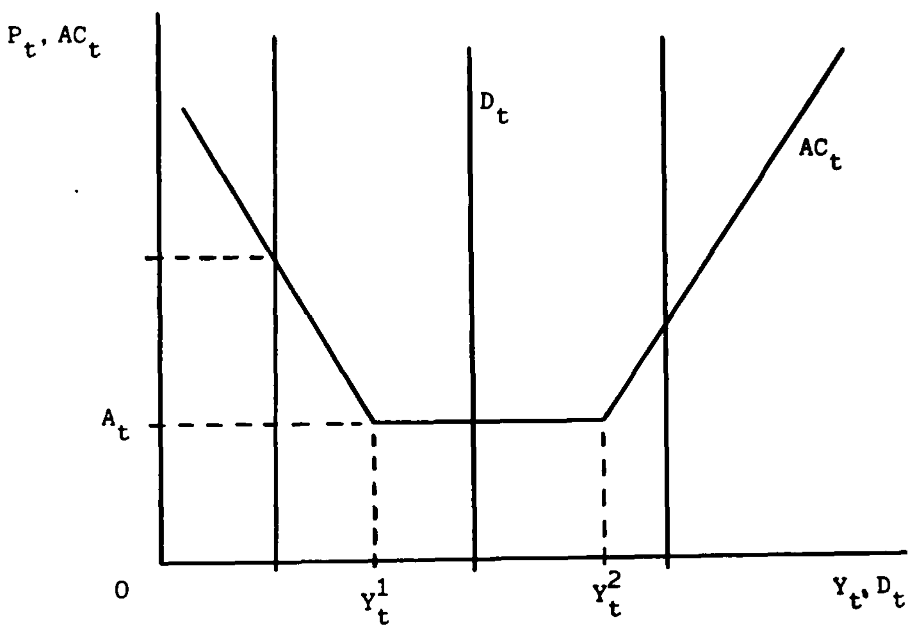

Figure I. Price and quantity setting

In case $D_t < Y_t^2$ (see equation 1a and 1b) a supplier equates D_t and Y_t to offer a price equal to the level of (minimum) average cost, because a higher price indicates profit opportunities for potential entrants by offering a slightly lower price. A lower price leads to losses. Hence,

(2) $Y_t = D_t \Rightarrow$

(3) $P_t = AC_t = A_t \cdot Y_t^{\sigma}$,

where,

(3a) $A_t = (\alpha+\beta) \cdot [(r_L^{\alpha} \cdot r_M^{\beta})/(e_t \cdot \alpha^{\alpha} \cdot \beta^{\beta})]^{1/(\alpha+\beta)}$, and

(3b) $\sigma = (1-\alpha-\beta)/(\alpha+\beta)$ with $\alpha+\beta>1$, and $\sigma=0$ with $\alpha+\beta=1$.

In case $D_t>Y_t^?$ (see equation 1c) a firm is unable to decide on a price–quantity combination which simultaneously guards against losses and deters entry, and for which equation (2) applies. Therefore, part of individual demand is unsatisfied by deciding to offer $Y_t^?$, because then the firm admits entry without suffering losses. Entry is provoked, because an entrant may absorb excess demand. A price exceeding A_t leads to entrants offering lower priced commodities, so the deciding incumbent firm is confronted with unsold commodities and losses. Hence,

(4) $Y_t = Y_t^? \Rightarrow$

(5) $P_t = A_t$.

The excess demand left unfulfilled by the incumbent $(D_t-Y_t^?)$ is, probably, absorbed by an entrant.

Intertemporal decision making is devoted to reducing the probability of entry and, therefore, raising barriers to entry. It is in this context that decision making concerning investment in process innovations is important. In a barrier market reduced average cost results in reduced prices. Thus, an incumbent firm strives to be the first to introduce renumerative process innovations in order to deter entry. The introduction of an innovation is accompanied by sunk costs. Sunk costs result from, for example, search and R&D activities. To achieve a particular reduction in average cost, it is necessary to invest a particular amount of sunk costs, because search and R&D are not costless activities. Sunk costs are included in the decision making process by means of amortization charges on average variable cost prices necessary to precisely recover sunk costs. Hence, after the introduction of an innovation, the equilibrium price level is determined by the reduced level of average variable cost and the amortization charge.

For reasons of simplicity it is assumed that, although the analysis may subsume an infinite number of short–term periods, the planning horizon of the suppliers in their decision process consists of two short-term periods. The decision making concerning the amount of innovative activity can be attributed to the answers to three questions: what constitutes the choice set of innovative activities from which the supplier must choose, which alternative out of the supplier's choice set is the optimal one, and is the (optimal) amount of innovative activity renumerative? The answers to these questions are examined in another order.

Assume a firm deciding on whether or not to initiate an innovation project at time t. The firm knows or expects the project to

(1) be accompanied by sunk costs SC_t,
(2) lead to the introduction of the innovation after 1 period at t+1,
(3) result in a reduction of average cost ΔAC_{t+1} from AC_t to AC_{t+1}, and
(4) raise an innovation barrier to entry of a one–period lifetime.

Moreover, incumbent firms are frightened that the potential entrants may initiate the same innovation project. The firm has to calculate the amortization charge to be able to recognize whether or not the innovation project is renumerative. An innovation project is renumerative if

(6) $$AC_{t+1} + d_{t+1} \leq P_t,$$

where d_{t+1} denotes the amortization charge and P_t the current price level. If an incumbent firm introduces a surcharge on its average variable cost which reflects the possibility of earning above–normal profits in excess of the amount necessary to recover the sunk costs, then this acts as an incentive to enter, because a potential entrant may profit by including a slightly lower surcharge in its price. Therefore, the feasible amortization charge is calculated by means of balancing the net present value of costs and benefits of the innovation project. It is by this means that a major criterion of workable competition is introduced: "Profits should be at levels just sufficient to reward investment, efficiency and innovation." (Scherer, 1980, p. 42).

The calculation of the feasible amortization charge is illustrated in the case that price inelastic demand grows with expected rate ϵ and, as stated, a simple two–period planning horizon holds. At time t a supplier decides on an innovation project and assumes the sunk costs to appear only in the current period and the benefits to appear only in the subsequent period. Then, in equilibrium

(7) $SC_t = [1/(1+r)] \cdot Y_{t+1} \cdot d_{t+1}$, with

(7a) $Y_{t+1} = (1+\epsilon) \cdot D_t$ if $(1+\epsilon) \cdot D_t \leq Y^2_{t+1}$, and

(7b) $Y_{t+1} = Y^2{}_{t+1}$ if $(1+\epsilon) \cdot D_t > Y^2_{t+1}$.

where r denotes the discount rate (being equal to prevailing and known interest rate). Hence,

(8) $d_{t+1} = f(SC_t) = [SC_t \cdot (1+r)]/(Y_{t+1})$.

A supplier determines the optimal process innovation, given the *expected* possibilities, before deciding on innovative activity[2]. In the case of perfect foresight the actual innovative possibilities would be a public good. However, the uncertainty surrounding the possibilities transforms the public good property into a private one. The perceived choice set is assumed as being represented by a function g. The function g describes a relationship between the amount of sunk costs and the resulting (expected) reduction in average cost. The introduction of a larger reduction of average cost is simply assumed to be associated with a larger amount of sunk costs, such that decreasing returns appear[3], irrespective of the way in which the reduction is achieved. Furthermore, it is postulated that firms are able to introduce a process innovation at the beginning of period t+1 immediately to the entire productive capacity.[4]

Equation (8) implies that d_{t+1} is an increasing function of SC_t given the supplier's decision on Y_{t+1}, his knowledge of r and his expectations on ϵ. Innovation projects are used to reduce the future prices as much as possible and so decrease the likelihood of future - entry. The future price is minimized if the marginal reduction of average cost is equal to the marginal increase of the amortization charge, in case of a marginal increase in the amount of sunk costs. Hence, equating the derivatives of f and g leads to an optimal amount of sunk costs.

The procedure is adapted into formal modeling by postulating *a priori* a relationship between the amount of sunk costs and the reduction of average cost, as represented by the function g:

$$(9) \quad \Delta AC_{t+1} = g(SC_t) = h_t \cdot SC_t^{\mu_t}, \;\; h_t \in R_+ \text{ and } 0<\mu_t<1.$$

Suppliers' expectations and heterogeneity are differentiated by the parameter h_t. In combination with equation (8) the optimal amount of SC_t can be derived with help of

$$(10) \quad \partial f/\partial SC_t = \partial g/\partial SC_t.$$

Hence,

$$(11) \quad (1+r)/(Y_{t+1}) = \mu_t \cdot h_t \cdot SC_t^{\mu_t - 1}.$$

Rearranging leads to the solution

$$(12) \quad SC_t = \{(1+r)/[\mu_t \cdot h_t \cdot Y_{t+1}]\}^{[1/(\mu_t - 1)]}$$

Substituting the optimal amount of sunk costs in (8) and (9) leads to the sustainable amortization charge and the expected optimal reduction of average cost.[5]

3. *The Simulation of an Innovative Struggle*

A presentation has been made in the previous section of a model of the decision making behaviour of an individual supplier in a barrier market at a point in time. In this section the interactive decision - making of suppliers over time is studied to stress the fact that, in a barrier market, static as well as dynamic economies are generated in a competitive struggle. The emphasis on a competitive struggle is in accordance with Schumpeter (1943) as well as the neo–Austrian theory (*e.g.* Kirzner, 1979). The traditional applications of dynamic analysis are based upon the crucial assumption that agents decide *simultaneously*.[6] Non–simultaneous interactions between heterogeneous agents are removed from the scope of the analysis. Van Witteloostuijn (1986a) puts forward an argument in favour of an alternative method of dynamic analysis being based upon non–simultaneous decision making of heterogeneous agents. In the context of the barrier market concept this argument is, in a preliminary way, adapted into a formal model by distinguishing two large groups of decision makers, the incumbent firms and potential entrants, who decide non–simultaneously.

The traditional short–term period (P_t, t=1,...,n) is divided up into three ultra short–term periods ($P_{t,\tau}$, τ=1,2,3). In the first ultra short–term period ($P_{t,1}$) incumbent firms decide simultaneously on supply price, supply quantity and the amount of sunk costs, but no transactions occur. At the end of $P_{t,1}$ potential entrants receive information regarding incumbent firms' decisions on price and quantity which may indicate profit opportunities and, hence, incentives to enter. In the second ultra short–term period ($P_{t,2}$) potential entrants decide simultaneously on the same items as did the incumbents. Moreover, the former also decide whether or not to enter during $P_{t,2}$. Entry occurs if an entrant's supply price is lower than that of an incumbent or when excess demand is left unfulfilled in $P_{t,1}$. It is in the third ultra short–term period ($P_{t,3}$) where the transactions take place. The whole procedure repeats itself in subsequent P_t's. Thus, the two groups of suppliers – incumbent firms and potential entrants – decide non–simultaneously (at $P_{t,1}$ and $P_{t,2}$ respectively). It is by this means that the interactions between incumbent firms and potential entrants come into the picture.

Several crucial aspects of the barrier market are difficult to analyze formally in an integrated fashion. *Disappointed* and *diverging expectations* in the context of a dynamic *process* are extremely difficult to analyze mathematically (see Nelson and Winter, 1977). DEMOS (Birtwistle, 1979) is a promising simulation package to analyze non–simultaneity and heterogeneity in a dynamic context. DEMOS enables the analysis of competition as an ongoing process containing heterogeneous agents engaged in an interactive struggle. DEMOS offers the possibility to model individual agents' behaviour *separately*. By adopting a sequential–analytical approach in support of non–simultaneous decision–making and heterogeneous agents a dynamic analysis is introduced. Moreover, many important phenomena such as actual entry, exit and bankruptcy of agents can be studied in a dynamic context. A closer look at the advantages of simulative dynamic analysis with help from DEMOS is presented in van Witteloostuijn (1986b).

Before interpreting the results of the simulation analysis of suppliers' price and quantity setting and innovative activities in a barrier market, it is stressed that within–period uncertainty is ignored for the sake of simplicity. The expectations on within–period temporary variables (prices and quantities) are confirmed within each short—term period. The prime focus is on the expectations of the future - period intertemporal variables (process innovations). In this respect this analysis is in line with that of Nelson and Winter (*e.g.* 1982). By means of assuming a sequence of temporary market equilibria both in the sense of satisfied *ex ante* demand and within–period certainty, it is possible to *concentrate on the intertemporal coordination achievements of the supply side in a barrier market.* An important aspect of the intertemporal coordination is the manipulation of (the level of) barriers to entry by means of innovative activities, which represent an important type of dynamic economy in market behaviour.

At the beginning of P_t suppliers prepare for future developments in production techniques by investing during P_t at a reduction of (minimum) average variable cost which can be introduced to the entire productive capacity in P_{t+1}. Suppliers are uncertain of the innovative possibilities. The competitive weapon of suppliers consists of the reduction of minimum average cost by means of investing sunk costs. If the individual supplier expects the future innovated price (reduced minimum average cost plus amortization charge) to exceed the current non–innovated price, then the innovative activity is canceled; otherwise, an investment occurs in process innovation.

Expectations on the innovative possibilities are of crucial importance. Individual suppliers' expectations are differentiated by the parameter h_t in the function (9):

$$(13) \quad E(\Delta AC_{t+1}) = E(h_t) \cdot SC_t^{\mu_t}.$$

Half of the suppliers form expectations according to Keynes' convention and say that "our usual practice [is] to take the existing situation and to project it into the future" (Keynes, 1936, p. 148). Hence,

$$(14) \quad E(h_t) = h_{t-1} .$$

The other half of the suppliers employ a simple autoregressive model of expectations formation:

$$(15) \quad E(h_t) = 1/2 \cdot h_{t-1} + 1/2 \cdot h_{t-2} .$$

The importance of the equations (14) and (15) is that they introduce *diverging* expectations. Of course, other models of expectations formation can be introduced as well as long as they allow for diverging expectations. A competitive struggle is a sequel to heterogeneity (see van Witteloostuijn, 1988c). Diverging expectations reflect an upmost important aspect of heterogeneity. In order to illustrate the competitive struggle a simulation is run.

The parameter μ_t is set on 0.5 and Y_t=5. The actual value of h_t is determined by a draw from a normal distribution with mean 3 and standard deviation 0.3. At the beginning of P_t the value of h_t is drawn. At the same time, individual suppliers calculate the expected values of h_t. On the basis of the expected h_t individual suppliers decide on the amount of sunk costs to invest in P_t (equation 12). On its turn ΔAC_{t+1} together with the individual demand, the current level of average cost and discount rate determine the future level of average cost and amortization charge, and thereby the future innovated price (equations 9 and 8). In order to concentrate on the implications of uncertainty and sunk costs to market behaviour in the context of an innovative struggle, the demand side is simplified even further by assuming aggregate demand to be in a price inelastic stationary state (ϵ=0). The market consists of five incumbent firms, each being confronted by a constant level of individual demand, which will permit production at a constant rate of return.

It is important to note that, firstly, potential entrants are also assumed to innovate and that, secondly, retired incumbent firms are allowed to re–enter one period following their exit. It is in this respect that one may think of cross entry and exit from one branch of industry (*e.g.* pick up players) to another that is closely related (*e.g.* compact disc players). Seven entrants are modeled in addition to the five incumbents. Suppliers 3, 4, 6, 7, 10 and 12 employ Keynes' convention and the remainder employ the autoregressive expectation mechanism. The simulation experiment is run with the additional variables of the discount rate and minimum average cost in P_t being 0.03 and 100 respectively. In order to generate the initial situation the suppliers are kept well–informed of h_t in P_1 and P_2. Following an 8–period run the following results occur:

Table I. Process innovations, prices and entry

Short-term period	Optimal price	Actual price surviving incumbents	Actual price retired incumbents	Actual price entrants
1	100	100	-	-
2	93.46	93.46	-	-
3	88.76	88.76	-	-
4	76.93	82.14	83.49	82.14
5	64.61	73.18	74.63	73.18
6	52.40	60.17	-	-
7	42.64	49.58	-	-
8	31.79	38.91	-	-

After P_2 suppliers no longer receive advance information regarding the actual development of the innovative possibilities. Therefore, they are unable to keep pace with the time path of the lowest prices. In period 4 and 5 higher priced incumbent firms are expelled from the market by lower priced entrants. To sketch a detailed picture of the underlying competitive processes, a closer look is taken at the life-history of suppliers 2 and 3. The development of values of relevant parameters and variables as would be generated by a well–informed "perfect foresight" supplier has been employed as a point of reference. A "perfect foresight" supplier would decide on its innovative activity on the basis of the actual development of parameter h_t, which determines innovative possibilities:

Table II. Innovative possibilities

Short-term period	Actual innovative parameter at t-1	Optimal sunk costs at t-1	Optimal average cost reduction at t	Optimal minimum average cost at t	Optimal amortization charge at t	Optimal price at t
4	3.39	21.73	15.80	72.46	4.48	76.93
5	3.07	10.77	10.07	62.39	2.22	64.61
6	3.28	16.89	13.47	48.92	3.48	52.40
7	2.88	7.31	7.79	41.13	1.51	42.64
8	3.22	14.86	12.40	28.73	3.06	31.79

Supplier 2 and 3 base their decision upon autoregressive expectations and Keynes' convention respectively, leading, in the turbulent periods 4 and 5, to the following results:

Table III. Life–history supplier 2 and 3

	Short-term period 4		Short-term period 5	
	Supplier 2	Supplier 3	Supplier 2	Supplier 3
Expected innovative parameter at t-1	2.61	2.31	2.85	3.39
Actual sunk costs at t-1	4.27	2.41	6.88	21.73
Expected average cost reduction at t	5.40	3.59	7.48	15.80
Expected minimum average cost at t	82.86	84.67	73.78	67.19
Actual amortization charge at t	0.88	0.50	1.42	4.48
Expected price at t	83.74	85.17	75.20	71.67

In P_3 supplier 2 as well as supplier 3 *under*estimated the actual innovative possibilities, as reflected in $E(h_3)$. However, supplier 2's expectation diverges from reality to a greater extent than that of supplier 3. Based upon their estimates, both suppliers decided on their innovative activity in P_3, leading to the following results in P_4:

Table IV. Competitive struggle in short–term period 4

Value short-term period 4 variables	Supplier 2	Supplier 3
Average cost reduction	7.00	5.62
Minimum average cost	81.62	83.00
Amortization charge	0.88	0.50
Price offered	82.14	83.49

In P_4 both supplier 2 and supplier 3 are surprised by a larger reduction in average cost than expected. However, supplier 2 attains a larger reduction because of its larger investing efforts. Supplier 3 is unable to compensate its innovative inferiority by means of a lower amortization charge. Therefore, in $P_{4,1}$ supplier 2 succeeds in offering a price lower than the price level of supplier 3. Hence, in P_4 suppliers employing autoregressive expectations show a superior performance relative to those suppliers who are behaving in accordance with Keynes' convention. Therefore, the former stay in the market (among these is supplier 2), and the latter (among these is supplier 3) are pushed aside by lower priced entrants. At the end of $P_{4,1}$ potential entrants receive information about incumbent firms' price and quantity setting and, probably, recognize profit opportunities. In $P_{4,2}$ incumbents 3 and 4 are outbid by entrants 8 and 9. In $P_{4,3}$ transactions take place and *ex ante* demand is satisfied. With respect to entry movements, the "first come first served" rule holds, because the demand side shows no preference for either equal priced entrant.

In the short–term period V the opposite results occur. Supplier 2 *under*estimated and supplier 3 *over*estimated the actual innovative possibilities. Therefore, in P_4 supplier 2 invested insufficiently in innovative activity and supplier 3 overstated its investment. Based upon the under respectively overshooting of the amount of sunk costs the following results occur in P_5:

Table V. Competitive struggle in short–term period 5

Value short-term period 5 variables	Supplier 2	Supplier 3
Average cost reduction	8.04	14.30
Minimum average cost	73.21	68.70
Amortization charge	1.42	4.48
Price offered	74.63	73.18

Supplier 2 is surprised by a *larger* reduction in average cost than expected. The *opposite* holds for supplier 3. Nevertheless, in $P_{5,2}$ supplier 3 is able to undercut supplier 2's price, because the latter's lower amortization charge does not outweigh the former's larger reduction in average cost. Hence, in P_5 contrary to P_4, "Keynes' convention" suppliers' performance is superior relative to that of the "autoregressive expectation" suppliers. At the end of $P_{5,1}$ potential entrants receive information on incumbent firms' prices and quantities and, probably. notice profit opportunities. Therefore, in $P_{5,2}$ supplier 3 *re–enters* the market by outbidding an incumbent who employs autoregressive expectations. "Autoregressive expectation" incumbents are expelled from the market by the lower priced entrants. In $P_{5,2}$ incumbents 1, 2, 5, 8 and 9 are pushed aside by entrants 3, 4 (both re–entering), 6, 7 and 12. In $P_{5,3}$ transactions occur and *ex ante* demand is satisfied. In the short–term periods thereafter the "Keynes' convention" suppliers are able to survive the competitive struggle to the expense of "autoregressive expectation" suppliers. Thus, the suppliers including additional information in their forecasting procedure, show a performance inferior to those employing limited information!

The simulation experiment reflects a further step in the direction towards analyzing heterogeneous agents engaged in a competitive struggle. The introduction of process innovations is endogenized. The barrier market combines, given suppliers' expectations, careful pricing at a point in time with the introduction of innovations over time. Therefore, static and dynamic economies of market behaviour are integrated.

4. Final Remarks

This paper has been devoted to two important subjects: firstly, the barrier market concept has been formally elaborated in a very simple context and, secondly, an alternative method of dynamic analysis has been employed. The barrier market is meant to be a theory of suppliers' market behaviour in which the forces behind static and dynamic economies are integrated. Suppliers' decision making and their behaviour is directed by a dominant threat of entry. Contrary to the contestable market the barrier market includes barriers to entry, and contrary to the theory of barriers to entry the barrier market excludes the earning of above-normal profits. In this way, a formal elaboration of the concept of workable competition is offered.

A method of dynamic analysis has been employed so enabling the study of market behaviour as an ongoing competitive process. Non-simultaneity of incumbents' and entrants' decision making and heterogeneity in the form of diverging expectations are the essentials of the competitive process. The dynamic analysis introduces the implications of an innovative struggle in the form of entry and exit movements, a changing state of the technology and decreasing prices.

Notes:

* University of Limburg, Faculty of Economics and Business Administration, P.O. Box 616, 6200 MD Maastricht, the Netherlands.

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[1] A flat bottomed U–shape of cost curves is not in conflict with the results of empirical research (e.g. Scherer, 1980, p. 89. Shepherd, 1979, p. 245 and Koutsoyiannis, 1983, p. 137).

[2] Of course, the modeling of perceptions can be easily bypassed by assuming perfect foresight in this respect, for example by means of a Kennedy–like (1966) innovation possibility curve. However, if everybody knows everything, then the analysis of a process becomes superfluous, as, in a way, shown by Dasgupta and Stiglitz (1980a, 1980b) and Kamien and Schwartz (1982). In the case of perfect foresight the extent of innovative activity is postulated rather than explained (see, for instance, Binswanger, 1978).

[3] To assume decreasing returns in this respect is in accordance with the results of empirical and theoretical research (see Kamien and Schwartz, 1982. pp. 64–70 and 192).

[4] As is usually done in models of endogenous innovations (e.g. Binswanger, 1978 and Iwai, 1984).

[5] Van Witteloostuijn and Maks (1987) and van Witteloostuijn (1988a) offer an elaborated analysis of a barrier market model. In particular, the link between the state of the technology e and investment behaviour SC is elaborated. Moreover, in van Witteloostuijn (1988a) and (1988b) the existence of Nash equilibria within each period (with respect to price and quantity setting) and over periods (with respect to investment in process innovations) is proven.

[6] This method of discrete dynamic analysis is in particular employed within general equilibrium theory, being based upon the assumption of temporary equilibria (e.g. Hicks, 1939, Arrow and Hahn, 1971 and Grandmont, 1983).

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ABSTRACT: To decide on interventions in a market economy politicians have to consider the temporary and intertemporal coordination achievements of market behaviour, as reflected in static and dynamic economies respectively. In this respect the barrier market concept might serve for guidance. The barrier market amounts to a formal elaboration of the workable competition concept. In this paper a model is presented of decision making of an individual supplier in a barrier market. Moreover, results are offered of analyses of competitive processes in which heterogeneous suppliers interact over time.