STANISŁAW PIASECKI

AN INTRODUCTION TO A THEORY OF MARKET COMPETITION

Volume II

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INTRODUCTION

The purpose of the present book is to show the possibility of developing a quantitative description of the action of "invisible hand" on the market. This is why the text is full of mathematical expressions, even though they are kept purposefully at the possibly simple level.

At the same time, the book is a subsequent publication of results from the work on establishment of foundations for the theory of economic competition, limited, however, essentially to what is called price competition. Let us note at this point that the "competitors" here considered are the companies selling their produce on the common and limited market, and that price competition analysed takes place among the products of different companies, serving to satisfy the very same kind of demand from the side of the customers.

Price competition ought to be regarded as a dynamic market game, which takes place within the space of retail prices, i.e. in the "open", before the eyes of the consumers, or in the space of wholesale prices – behind the scenes. The strategies of the players consist in selection of prices, at which their products (services) are sold.

Under a close examination of the problem it turned out that most important for defining the market price game is determination of the "payoff function". The present book is devoted, therefore, mainly to this problem.

This volume constitutes a continuation of the considerations from the first volume of "*Introduction to a Theory of Market Competition*", in which territorial expansion strategy of companies has been analysed, this strategy allowing for expansion of sales and lowering of prices. Yet, sooner or later, the instant has to come when a company must enter an "alien" market, and, after a successful entry, face the problem of expanding its market share.

Hence, it is the last two issues that this book takes up and analyses.

The considerations forwarded therein are based on three fundamental assumptions:

- Increase of price of purchase entails a decrease of the number of products sold.
- Increase of the number of products turned out makes it possible to lower the cost of producing these products.
- The market secures the preservation of equilibrium between demand and supply. Customers are directed by reason when making purchasing decisions.

The first assumption results from the fact that each customer has limited financial capacities (of purchasing products and services).

The second assumption is justified by the commonly observed "production scale effect", which results from the continuous technological progress, taking place especially in the domain of production technologies. This fact finds its confirmation in the history of economic development – from handicraft through workshop production to the present-day mass (even if customised) production.

The third, double assumption is associated with the adoption of principles of free market.

In order to represent the "scale effect", the hyperbolic relation was used, resulting from the analysis of the constant and variable production costs.

To describe the dependence of demand upon the product price, stemming from the income structure of potential customers, the linear dependence was used, which is characteristic for the constant income density of customers.

Other adopted assumptions and simplifications are of technical character.

Many of the Readers shall certainly be disappointed, as they will not find in the book the statistical inquiries, based on what is called "real-life data", that would confirm the assumptions adopted and the results obtained. In order, though, for a theory to be subject to verification, it must first be formulated. It should be indicated that the precepts of this theory have been successfully implemented in economic reality, in the practice of quite a significant company in Poland.

Thus, the contents of this book ought to be regarded as an attempt of formulating a definite theory, by no means pretending to having exhausted the entire problem area. It should be added that the results contained in both volumes published so far result from the research done by the respective authors within the Systems Research Institute of the Polish Academy of Sciences. Separate thanks go to the NTT System S.A. company that supported financially the publication of both volumes.

The authors of both volumes hope that this modest contribution shall serve its purpose of providing to the Readers the very first insight into the possibility of representing and analysing in quantitative terms the processes we observe daily on the globalising markets. The authors would also like to announce the preparation of the subsequent volume, presenting the extension to the theory here expounded.

Warsaw, June 2011

Chapter II

STRATEGY OF ENTRY INTO A NEW MARKET

Some Company B has been selling for a long time already its product "B" on a certain market for the price C_B. To simplify the problem, we shall assume that there is no other company on this market that would produce a good satisfying the same kind of need. In other words, Company B is a monopolist on this market.

1. Description of the situation

Some Company A wishes to enter the same market with its competitive product "A". Assume that products "A" and "B" are strictly competitive, i.e. they satisfy the very same need of the customers on a given market.

Assume, further, that demand on this market is described with the simplest formula: $\Lambda_0 = \Lambda_{mx}(1-C_B/C_{mx})$, where Λ_0 is the initial demand, existing on the market at the time instant, when Company A decided to enter the market with its competitive product "A".

Of course, in order for Company A to be able to effectively sell on the market monopolised by Company B, the former has to offer its product for a lower price $C_A < C_B$ ($C_A = C_B - \Delta C$). Naturally, the bigger the price decrease $\Delta C > 0$, the bigger the sales (in natural units) of the Company A, but, at the same time – the bigger the loss of the potential unit profit from sales, $C_A - b$ (see Chapter I, Section 4).

In the first stage of the process, which starts with the "entry" of the product "A" onto the market, two products, "A" and "B" shall compete, sold at different prices, even though identically satisfying the same need of the customers. If the latter is not true then the things get much more complicated, and the population of customers we consider shall break down into two or more groups, as alluded to in Chapter I.

The first stage ends, when either Company B, under the influence of competition, lowers its price to the level of C_A (or even lower), or starts talking to Company A on the potential cooperation on the market or on selling a part of Company B to the competitor. This would be forced upon Company B by the increasing losses, caused by the drop of sales, in conditions of the necessity of maintaining the production apparatus, which has become too extensive, and which cannot be quickly sold.

If in the first stage Company B has not given up fighting, then the second stage shall start, similar to the first one (if Company B adopted the price $C_B = C_A$), or with the roles reversed (when $C_B < C_A$). The price war shall continue, until one of the companies does no longer stand the increasing losses and withdraws its product from the market, or goes bankrupt. The latter case may constitute a classical "inimical takeover". It is therefore obvious that in this struggle the essential aspect is the financial reserve of each of the companies, allowing for a longer struggle, despite the losses.

The problem of competition of two companies can be defined as a two-person, multi-stage game. At the beginning of each stage the players take consecutive decisions concerning the values of price decreases ΔC (or the sales price C of their product).

An essential problem is constituted by the definition of the vector payoff function for each of the players at the end of every stage. The game considered is not a zero-sum game. For instance, the total sales value is an increasing function of price decreases. The sum of profits initially takes decreasing positive values, which gradually turn into increasing negative values. In terms of payoffs we deal, therefore, with positive (profits) or negative ones (losses).

This kind of game can be represented by the following metaphoric image: assume a person B occupies a "nobody's" swimming pool, taking pleasure from bathing there alone. After a longer period of this pleasure another person, A, claims own rights to the pool, and actually starts bathing. The two start fighting in the water. The fight consists in trying to drown the opponent. The losing side is the one that got pushed deeper under water or (and) can stop breathing for a shorter time, the one that gets weaker sooner than the opponent.

Next, let us make more precise what do we understand as the cost of entry of a company onto an existing market, on which competing companies (we actually consider the case of just one such company) have been functioning for a long time already.

Assume that at the instant of entry of our company the price of competitive products (e.g. washing powder) was equal C_B, and total supply was equal $\Lambda_B = \Lambda_0$. Hence, we decided to sell our produce for a lower price $C_A = C_B - \Delta C$, hoping that we can achieve a significant sales volume. Simultaneously, sales of the company B, having monopolised the market until then, would drop.

Thus, in order to make our market entry cost us as little as possible (investment into production assets put apart), we must carefully determine the value of ΔC, or of $C_A = C_B - \Delta C$.

2. Entry into an alien market

Irrespective of the financial reserves of the players the key issue is to select such a market entry strategy for company A as to make the financial reserves of company B dwindle much quicker than those of company A. And the strategy shall be understood as, exactly, the choice of price C_A, and hence also of ΔC.

In order to reach the goal mentioned above, company A ought to achieve the following double effect upon entering the market:

- gain a significant sales volume of its product on the market by appropriate lowering of price C_A compared to price C_B;
- ensure a better economic position in terms of profits of Company B being below those of Company A and that the difference of profits $\Delta Z = Z_A - Z_B$ shall stay positive at least until the end of the first stage.

Owing to the latter condition, financial reserves of Company B, having dominated the market, shall be shrinking quicker than those of Company A.

First of all let us determine the factors decisive for the attainment of high sales of product "A" on this new, up till then monopolised market. Two phenomena occur here, brought about by the appearance of a competitive product, sold at a lower price, namely:

- "new" customers shall appear, who had not been able until then to afford buying product at price C_B; all of these new customers shall buy product "A" for the lower price C_A;
- the group of the "old" customers, who had been buying before product "B" for the price C_B, shall break down into two groups – "the careful conservationists", who shall continue – in the first period – to purchase product "B", and the "sparing" ones, who shall decide to purchase the equally good, but cheaper product "A".

Summing up, demand for the product of Company A, entering the market, at time instant $\tau = 1/\alpha$, that is – at the end of the first stage, shall consist of two components:

- demand, generated by a part of customers to date, purchasing until quite recently product "B", and now purchasing the cheaper product "A", and

- demand generated by the new purchasers, who acquired the capacity of satisfying their needs with products purchased at a price they can afford.

Altogether, then, demand for "A" shall be defined as (see also Chapter I):

$\Lambda_A(\tau) = \Lambda_0(1 - a^{\alpha_1 \tau}) + \Delta\Lambda(1 - a^{\alpha_2 \tau})$, where $a = C_A/C_B$, $\alpha_1 << \alpha_2$.

The courses of the function $\frac{\Delta\Lambda_{AB}}{\Lambda_0} = \frac{\Lambda_A(\tau) - \Lambda_B(\tau)}{\Lambda_0}$ for

C_{mx}/C_B = 2(D/L0-2) and C_{mx}/C_B = 4(D/L0-4) are shown in Fig. 2.1.

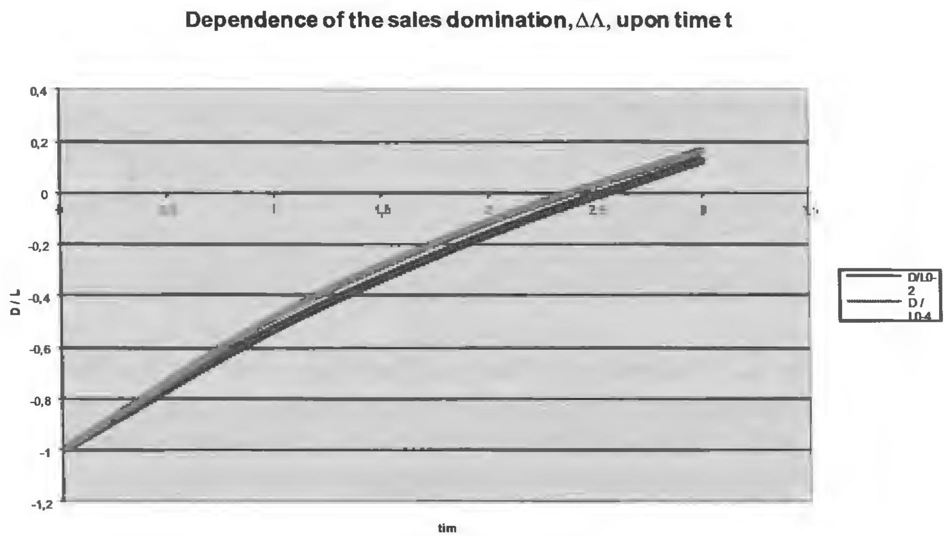

Figure 2.1.

In particular, at the end of the first period, at time instant $\tau = 1/\alpha_1$ we get

$$\Lambda_A(1/\alpha_1) = \Lambda_0(1\text{-}C_A/C_B) + \Delta\Lambda$$

since $\Lambda_0(1\text{-}a) = \Lambda_0(1\text{-}C_A/C_B)$ and $\Delta\Lambda(1\text{-}a^{\frac{\alpha_2}{\alpha_1}}) < \Delta\Lambda$.

Let us remind (see Chapter I) that especially for the durable goods, the strong inequality $\alpha_1 \ll \alpha_2$ holds.

As we now substitute

$\Lambda_0 = \Lambda_{mx}(1\text{-}C_B/C_{mx})$, and $\Delta\Lambda = \Lambda_{mx}(C_B\text{-}C_A)/C_{mx}$,

we get

$$\Lambda_A = \frac{\Lambda_{mx}}{C_{mx}} \cdot (C_B - C_A) \cdot \left[\frac{C_{mx} - C_B}{C_B} + 1\right] = \Lambda_{mx} \cdot \frac{C_B - C_A}{C_B} = \Lambda_{mx} \frac{\Delta C}{C_B}.$$

Similarly, demand for the products of Company B shall be determined by the formula:

$$\Lambda_B(\tau) = \Lambda_0 \cdot a^{\alpha_1 \tau},$$

and for $\tau = 1/\alpha_1$ we get

$$\Lambda_B = \Lambda_0 \cdot \frac{C_A}{C_B} = \Lambda_{mx}\left(1 - \frac{C_B}{C_{mx}}\right) \cdot \frac{C_A}{C_B} = \Lambda_{mx}\left(\frac{C_A}{C_B} - \frac{C_A}{C_{mx}}\right).$$

Fig. 2.2 shows the changes of demand for the products of Companies A and B along time, with the time unit being the segment of the length $1/\alpha$. The diagram LA/L0 refers to the case, when $C_{mx}/C_B = 3$, while the diagram LA/L0-2 refers to the case of $C_{mx}/C_B = 2$.

Then, let us consider the changes in demand for the products of Company A as a function of the initial price C_B of the product of Company B.

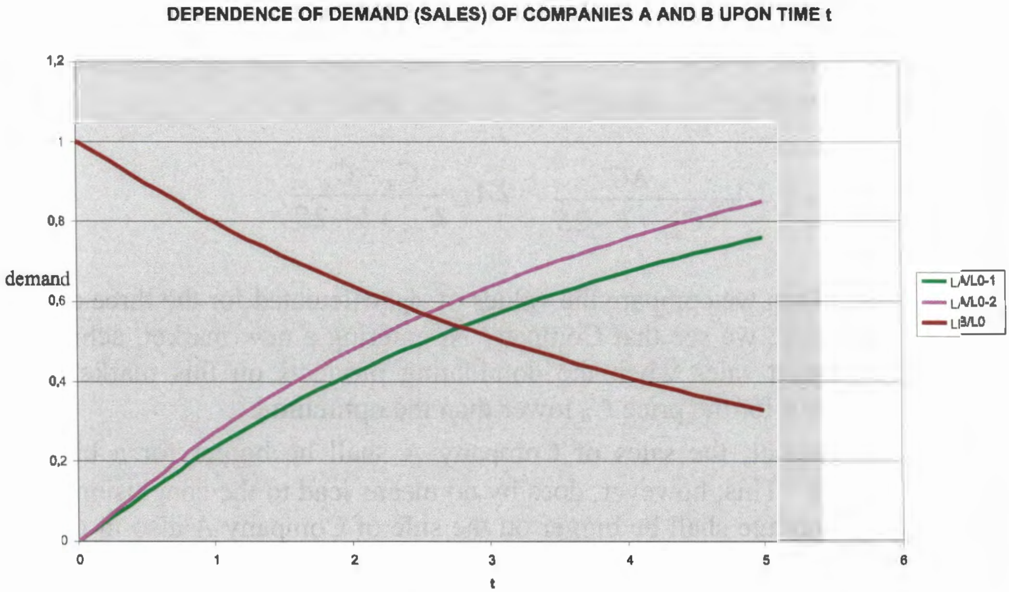

Figure 2.2.

Namely, if the initial price were equal the optimal one (see Volume I), i.e. $C_B = C^* = (C_{mx}+b)/2$, then

$$\Lambda_A = 2\Lambda_{mx}\frac{C_B - C_A}{C_{mx}+b} = 2\Lambda_{mx}\frac{\Delta C}{C_{mx}+b}.$$

On the other hand, if the initial price were higher than C^*, i.e. $C_B = C^* + S$; $C_A = C^* + S - \Delta C$, then

$$\Lambda_A = 2\Lambda_{mx}\frac{\Delta C}{C_{mx}+b+2S} = 2\Lambda_{mx}\frac{C_B - C_A}{C_{mx}+b+2S},$$

where $S > 0$ is the deviation of the sales price C_B from the optimum value.

Now, in case the initial price were lower than the optimum C^*, and equal $C_B = C^* - S$; $C_A = C^* - S - \Delta C$, then

$$\Lambda_A = 2\Lambda_{mx}\frac{\Delta C}{C_{mx} + b - 2S} = 2\Lambda_{mx}\frac{C_B - C_A}{C_{mx} + b - 2S}.$$

When we compare the values of Λ_A, calculated for the three cases considered, we see that Company A, entering a new market, achieves the biggest sales when the dominating products on this market are being sold for the price C_B lower than the optimum C^*.

Further, the sales of Company A shall be bigger for a bigger value ΔC. This, however, does by no means lead to the conclusion that the advantage shall be bigger on the side of Company A also in terms of profits, as this will be demonstrated later on.

Let us, next, determine the value of difference of demands of Companies A and B:

$$\Delta\Lambda_{AB} = \Lambda_A - \Lambda_B = \Lambda_{mx}\cdot\left[\left(1 - \frac{C_A}{C_B}\right) - \left(1 - \frac{C_B}{C_{mx}}\right)\frac{C_A}{C_B}\right] =$$

$$= \Lambda_{mx}\left(1 - 2\frac{C_A}{C_B} + \frac{C_A}{C_{mx}}\right) = \Lambda_{mx}\left[1 - \left(2 - \frac{C_B}{C_{mx}}\right)\frac{C_A}{C_B}\right]$$

Following this, we may track the dependence of the relative difference of demands upon the ratio of prices: C_A/C_B:

$$\frac{\Delta\Lambda_{AB}}{\Lambda_{mx}} = 1 - \left(2 - \frac{C_B}{C_{mx}}\right)\frac{C_A}{C_B}$$

The diagram, showing the course of this dependence, is provided in Fig. 2.3.

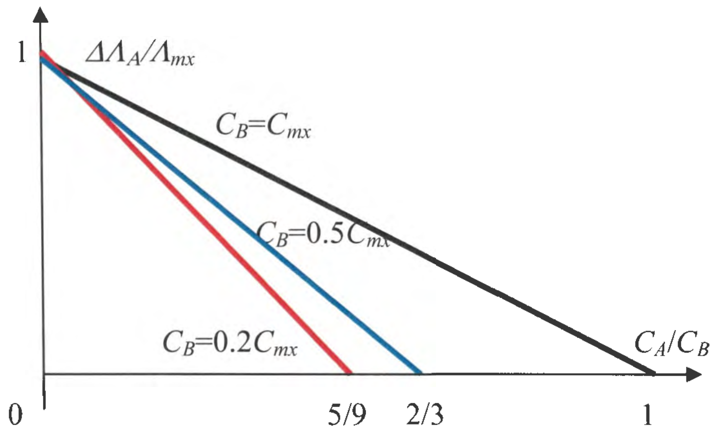

Figure 2.3.

The diagram of Fig. 2.3 allows us, for instance, to read out that if the competitive products are being sold on the market for the price $C_B = 0.5C_{mx}$ then, in order to achieve bigger sales than the competitor (in other terms, in order for the inequality $\Delta\Lambda_{AB} > 0$ to hold), Company A ought to enter the market with the price $C_A < 2C_B/3$.

We can write down this sort of principle in a formal manner by requiring the satisfaction of the inequality

$$\frac{\Delta\Lambda_{AB}}{\Lambda_{mx}} = 1 - \left(2 - \frac{C_B}{C_{mx}}\right)\frac{C_A}{C_B} > 0$$

Since, in addition (in order to effectively enter the market), the inequality $C_A < C_B$ must hold, and so, the condition on the maximum price that we can quote when entering an "alien" market, where products are sold for the price C_B, takes on the following form:

$$\frac{C_A}{C_B} < \min\left\{1, \frac{1}{2 - \frac{C_B}{C_{mx}}}\right\}$$

Satisfaction of this condition allows us to enter a market and push out the previously dominating product of Company B out of its superior position. It is, of course, also possible to lower the price "in instalments", piece after piece, provided we are capable of doing this before the competitor, Company B, acts accordingly, by lowering their price.

Yet, alas, the value of C_A must, at the same time, fulfil the obvious inequality $b < C_A$, or, equivalently, $b/C_B < C_A/C_B$. This inequality results from the assumed conditions of $C_A - b>0$ and $C_B - b>0$.

Now, as we continue with our example, let us check that for $C_B = 0.5C_{mx}$ and the requirement of satisfaction of inequality $C_A < 2C_B/3$, in order for Company A to achieve domination in sales (in physical units) over Company B, it is also required to satisfy inequality $b/C_B < C_A/C_B$.

So, in particular, if the ratio b/C_B is bigger than 2/3, there is no possibility of achieving sales higher than those of Company B (at the end of the first time period).

Consequently, the inequality, conditioning the selection of the value of C_A ought to be complemented to the following form:

$$\frac{b}{C_B} < \frac{C_A}{C_B} < \min\left\{1; \frac{1}{2 - \frac{C_B}{C_{mx}}}\right\} = \frac{1}{2 - \frac{C_B}{C_{mx}}}$$

or:

$$b < C_A < C_B \cdot \frac{C_{mx}}{2C_{mx} - C_B} C_{A,mx}$$

3. Optimum entry strategy

Irrespective of the above, we would also like to have the losses on profit borne by Company B (due to the drop of sales of its products) bigger than the losses on profit of Company A (due to the significant lowering of the sales price C_A). In other words, we would like to achieve the supremacy of profits, that is, we would like the difference of profits to satisfy the inequality

$$\Delta Z_{AB} = Z_A - Z_B > 0,$$

where

$$Z_A = \Lambda_A(C_A - b_A) - W_A, \text{ and } Z_B = \Lambda_B(C_B - b_B) - W_B.$$

If production costs are similar, that is: $W_A = W_B$ and $b_A = b_B$ (see Volume I), then the expression for the difference of profits takes on the form

$$\begin{aligned}\Delta Z_{AB} &= \Lambda_A(C_B - \Delta C) - \Lambda_B \cdot C_B - \Delta\Lambda_{AB} \cdot b = \\ &= \Delta\Lambda_{AB}(C_B - b) - \Delta C \cdot \Lambda_A\end{aligned}$$

As we introduce to the above the previously determined values of ΔC and $\Delta\Lambda_{AB}$, we get:

$$\Delta Z_{AB} = \Lambda_{mx}\left(1 - 2\frac{C_A}{C_B} + \frac{C_A}{C_{mx}}\right)(C_B - b) - \Lambda_{mx}\frac{C_B - C_A}{C_B}(C_B - C_A)$$

or

$$\frac{\Delta Z_{AB}}{\Lambda_{mx}} = \left(1 - 2\frac{C_A}{C_B} + \frac{C_A}{C_{mx}}\right)(C_B - b) - \frac{(C_B - C_A)^2}{C_B}.$$

Consequently, the condition of domination of profit of Company A over that of Company B can be written down as the inequality

$$\frac{\Delta Z_{AB}}{\Lambda_{mx}} = \left(1 - 2\frac{C_A}{C_B} + \frac{C_A}{C_{mx}}\right)(C_B - b) - \frac{(C_B - C_A)^2}{C_B} > 0,$$

or, by transforming this expression, in the form

$$\frac{\Delta Z_{AB}}{C_B \Lambda_{mx}} = \left(1 - 2\frac{C_A}{C_B} + \frac{C_A C_B}{C_{mx} C_B}\right)\left(1 - \frac{b}{C_B}\right) > \left(1 - \frac{C_A}{C_B}\right)^2.$$

Next, if we use notation $x = C_A/C_B$ for the ratio of prices, the same inequality takes the form

$$\left(1 - 2x + \frac{C_B}{C_{mx}}x\right)\left(1 - \frac{b}{C_B}\right) > (1 - x)^2$$

And ultimately, after the following transformations

$$1 - 2x + \frac{C_B}{C_{mx}}x - \frac{b}{C_B} + 2\frac{b}{C_B}x - \frac{b}{C_{mx}}x > 1 - 2x + x^2$$

$$\left(\frac{C_B}{C_{mx}} - 2 + 2\frac{b}{C_B} - \frac{b}{C_{mx}} + 2\right)x - \frac{b}{C_B} > x^2$$

The condition considered assumes the following two equivalent forms:

$$W_2 = x^2 - \left(\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B}\right)x + \frac{b}{C_B} < 0$$

or

$$W_2 = x^2 - \frac{C_B^2 - bC_B + 2bC_{mx}}{C_B C_{mx}}x + \frac{b}{C_B} < 0$$

We can also obtain a different expression, when we divide the value of $\Delta Z/\Lambda_{mx}$ by b. We then get, namely:

$$\frac{\Delta Z}{b\Lambda_{mx}} = W_3 = \frac{C_B}{b}x^2 - \left[\frac{C_B}{C_{mx}}\left(\frac{C_B}{b} - 1\right) + 2\right]x + 1 < 0$$

This expression for the condition on the domination of profits of Company A shall be analysed now.

Thus, polynomial W_3 may take negative values only between its roots, since the coefficient C_B/b is positive.

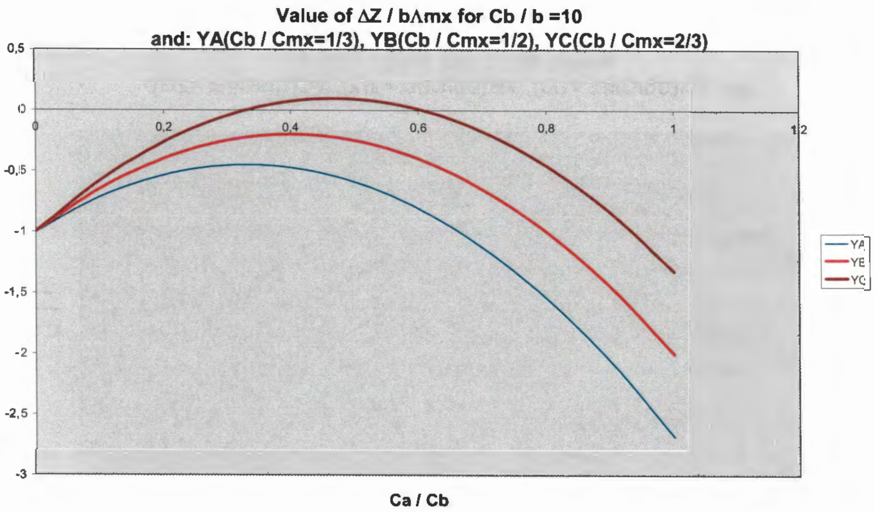

Figure 2.4.

Yet, in order for the roots to exist, the following inequality must hold (see Figs. 2.4 and 2.5):

$$\Delta_3 = \left[\frac{C_B}{C_{mx}}\left(\frac{C_B}{b} - 1\right) + 2\right]^2 - 4\frac{C_B}{b} > 0$$

Then, after the transformation

$$\Delta_3 = \left[\left(\frac{C_B}{C_{mx}}\right)^2\left(\frac{C_B}{b}-1\right)+4\left(\frac{C_B}{C_{mx}}-1\right)\right]\left(\frac{C_B}{b}-1\right)>0$$

We get the following condition, decisive for the sign of the inequality $\Delta_3 > 0$:

$$\omega_3 = \left(\frac{C_B}{C_{mx}}\right)^2\left(\frac{C_B}{b}-1\right)^2+4\frac{C_B}{C_{mx}}-4>0$$

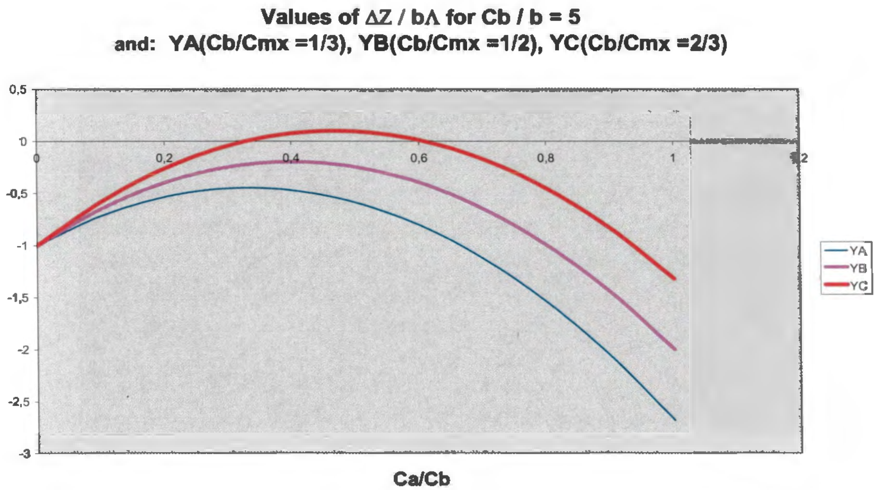

Figure 2.5.

Then, in order for the above inequality to be fulfilled, the discriminant, Δ, of the polynomial must be positive:

$$\Delta = 16+16\left(\frac{C_B}{b}-1\right)^2>0$$

As we can see, this condition is fulfilled. By transforming the condition for $\omega_3 > 0$, we obtain, then, the ultimate condition on the values of parameters, i.e. the inequality

$$\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right) > 4\left(\frac{C_{mx}}{C_B}-1\right)$$

This condition is the requirement set on the interrelations between the values of parameters, C_{mx}, C_B and b, so as to be able to select the value of C_A in such a manner as to secure the domination of profit of the Company A, entering the market, over the profit of the resident Company B.

Naturally, the feasible value of C_A must be selected from the interval between the roots of the equation $W_3 = 0$:

$$x_1 < \frac{C_A}{C_B} < x_2$$

not forgetting that this value also has to fulfil the obvious inequality

$$b < C_A < C_B$$

or

$$\frac{b}{C_B} < \frac{C_A}{C_B} < \frac{C_B}{C_B} = 1$$

Let us now pass over to the analysis of the condition for gaining competitive edge in terms of profits in the form of the inequality

$$W_2 = x^2 - \left(\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B}\right)x + \frac{b}{C_B} < 0$$

or

$$W_2 = x^2 - \frac{C_B^2 - bC_B + 2bC_{mx}}{C_B C_{mx}}x + \frac{b}{C_B} < 0$$

Let us consider inequality

$$W_2(x) = x^2 - \frac{C_B^2 - bC_B + 2bC_{mx}}{C_B C_{mx}} x + \frac{b}{C_B} < 0$$

constituting, again, the condition for gaining domination of profits by the Company A, entering the market, that is – securing that the following inequality is fulfilled:

$$\Delta Z_{AB} = Z_A \quad Z_B > 0 \text{ or } \frac{1}{C_B \Lambda_{mx}} \cdot \Delta Z_{AB} > 0\,.$$

Since in the polynomial W_2 the coefficient (1) accompanying the squared argument x is positive, the inequality can only be satisfied for the values of x belonging to the interval $x_1 < x < x_2$, where x_1, x_2 are the roots of the equation $W_2(x) = 0$, provided these roots exist, of course.

These roots exist, in turn, when the determinant of this equation, Δ_2, takes positive values:

$$\Delta_2 = \frac{\left(C_B^2 - bC_B + 2b\right)^2}{C_B^2 C_{mx}^2} - 4\frac{b}{C_B} > 0$$

As we transform the above inequality, we get, successively

$$\left(C_B^2 + bC_B + 2bC_{mx}\right)^2 > 4bC_B C_{mx}^2$$

$$\left(\frac{1}{C_{mx}} C_B^2 - \frac{b}{C_{mx}} C_B + 2b\right)^2 > 4bC_B$$

And then, by introducing the notations

$$L(C_B) - \frac{1}{C_{mx}} C_B^2 - \frac{b}{C_{mx}} C_B + 2b \quad ; \quad P(C_B) = 4bC_B$$

we can write down this inequality in the form

$$L^2(C_B) > P(C_B).$$

Let us now analyse the function $L(C_B)$.

The coefficient, accompanying the squared C_B is positive, while the determinant of the equation $L(C_B) = 0$ has the form

$$\Delta_L = \frac{b^2}{C_{mx}^2} - 4\frac{1}{C_{mx}}2b = \frac{b}{C_{mx}}\left(\frac{b}{C_{mx}} - 8\right)$$

It can easily be noticed that the determinant has a negative value, since b/C_{mx} is less than 1, and so the function $L(C_B)$ takes uniquely positive values in the range of data that is of interest for us:

$$0 < b < C_B < C_{mx} < \infty.$$

The function $L(C_B)$ attains its lowest value at the point C_B^*, in which the derivative takes the zero value:

$$\frac{dL}{dC_B} = \frac{2C_B^*}{C_{mx}} - \frac{b}{C_{mx}} = \frac{1}{C_{mx}}\left(2C_B^* - b\right) \quad \Rightarrow \quad C_B^* = \frac{1}{2}b$$

Table 2.1, given below, provides some characteristic values of the functions $L(C_B)$, $L^2(C_B)$ and $P(C_B)$.

Table 2.1

$C_B =$	0	½ b	b
$L(C_B) =$	$2b$	¼ $b(8 - b/C_B$	$2b$
$L^2(C_B) =$	$4b^2$	[¼ $b(8 - b/C_B)]^2$	$4b^2$
$P(C_B) =$	0	$2b^2$	$4b^2$

A comparative view of the courses of functions $L^2(C_B)$ and $P(C_B)$ is shown in Fig. 2.6.

As it is evident from Fig. 2.6, the required inequality is fulfilled over the entire interval of values of $C_B > b$, of interest for us.

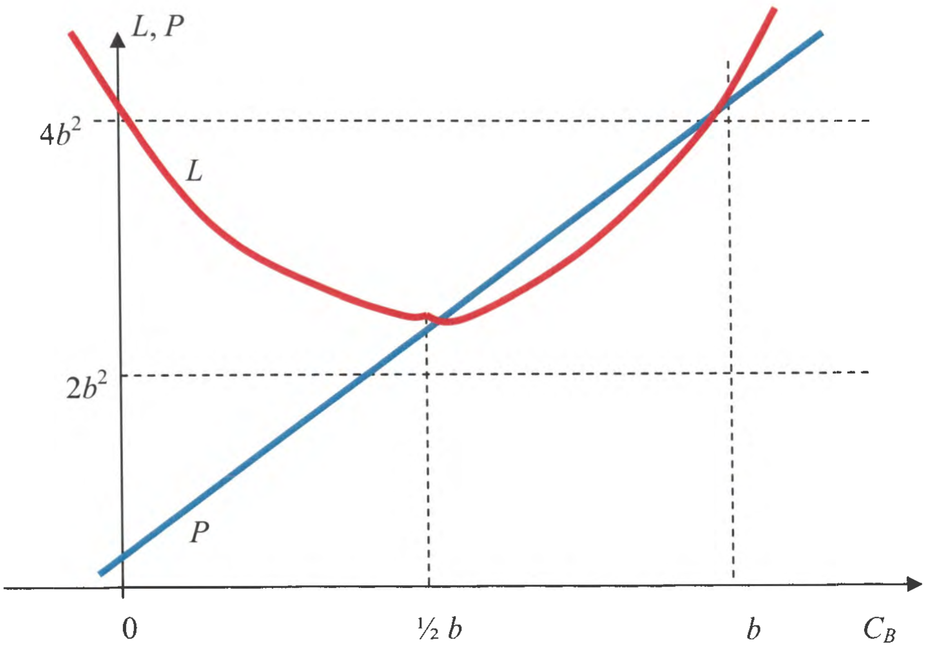

Figure 2.6.

The conclusion therefrom is that the determinant Δ_2 takes always values above zero, and so there exist two roots of the polynomial $W_2(x)$, and, consequently, there exists an interval of values $x = C_A/C_B$, which enable gaining of advantage in terms of profit by the Company A, entering the market. The interval of such prices C_A is given by inequalities $x_1<x<x_2$, with

$$x_{1,2} = \frac{C_B^2 - bC_B + 2bC_{mx}}{2C_B C_{mx}} \mp \sqrt{\Delta_2} =$$

$$= \frac{1}{2}\left(\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B} \right) \mp \sqrt{\Delta_2}$$

Consequently, we have shown that the values of $x = C_B/C_A$ from the inside of the above defined interval fulfil the condition $W_2(x) < 0$, providing the opportunity for gaining competitive edge in terms of profits for Company A.

Naturally, the value of x, selected from this interval, must additionally satisfy the logical inequality, namely

$$\frac{b}{C_B} < x = \frac{C_A}{C_B} < 1$$

Ultimately, then, the interval of values of x, when we account for all the conditions here considered, is

$$\max\left\{x_1; \frac{b}{C_B}\right\} < x < \min\{x_2; 1\}$$

Having the thus defined interval of value of x, allowing Company A to achieve competitive edge in terms of profits, we would like to realise the maximum domination. This requirement, let us note, is equivalent to the search for the value $x = x^*$, for which the polynomial $W_2(x)$ attains the minimum value.

As we differentiate the polynomial, we obtain

$$\frac{dW_2}{dx} = 2x - \frac{C_B^2 - bC_B + 2bC_{mx}}{C_B C_{mx}}$$

and then, by equating the derivative to zero, and solving for x the equation obtained, we get

$$x^* = \frac{1}{2}\frac{C_B^2 - bC_B + 2bC_{mx}}{C_B C_{mx}} = \frac{1}{2}\left\{\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B}\right\}$$

which is equivalent to determining $x^* = C_A^*/C_B$, and hence, actually, $C_A^* = x^* C_B$, the price that ensures for Company A the achievement of the maximum domination of profits,

$$\Delta Z_{AB} = Z_A - Z_B.$$

By using the notion of the optimum value of x we can write down the polynomial in a different form:

$$W_2(x) = x^2 - 2x^* \cdot x + \frac{b}{C_B}$$

and

$$x_{1,2} = x^* \left\{ 1 \mp \sqrt{1 - \frac{4\frac{b}{C_B}}{\left(2x^*\right)^2}} \right\}$$

Let us note that the expression under the sign of the square root,

$$\left(2x^*\right)^2 - 4\frac{b}{C_B} > 0$$

is positive, since, as we have shown, the following inequality is always satisfied:

$$\Delta_2 = \left(\frac{C_B^2 - bC_B + 2bC_B}{C_B C_{mx}} \right)^2 - 4\frac{b}{C_B} > 0$$

So, we can state that the value of the expression under the sign of the square root fulfils the inequalities:

$$0 < 1 - \frac{4\frac{b}{C_B}}{\left(2x^*\right)^2} < 1$$

Hence, the formula for the values of the roots of equation can be expressed as

$$x_{1,2} = x^* \left\{ 1 \mp \sqrt{1 - 4\frac{b}{C_B\left(x^*\right)^2}} \right\} = x^*\left(1 \mp s\right)$$

where s fulfils the condition $1 > s > 0$, since the expression under the sign of the square root has a positive value.

Using this formula, we can define the interval of the desired values of the variable x in the following manner:

$$\max\left\{x^*(1-s);\frac{b}{C_B}\right\} < x < \min\left\{x^*(1+s);1\right\}$$

Let us now analyse the dependence of the value x^* upon the value of C_B. We, namely, have

$$x^*(C_B) = \frac{1}{2}\left\{\frac{C_b - b}{C_{mx}} + 2\frac{b}{C_B}\right\}, \text{ with } 0 < b\ C_B < C_{mx} < \infty.$$

Table 2.2, below, shows the extreme (minimum and maximum) values of x^* for selected values of the variable C_B.

Table 2.2
(values of x^*)

$C_B=$		b	$1.5b$	$2b$	$5b$	$10b$
x^*_{mx}	for $C_{mx}=C_B$	1	5/6	3/4	3/5	11/20
x^*_{min}	for $C_{mx}=\infty$	1	2/3	1/2	1/5	1/10

Additionally, we have

$$\lim_{C_B\to\infty} x^*_{mx} = \frac{1}{2} \qquad \lim_{C_B\to\infty} x^*_{\min} = 0$$

The set of values of x^* as a function of C_B is shown in Fig. 2.7. The upper extreme value of x^* is calculated for the minimum value of $C_{mx} = C_B$, even though the latter cannot be realised, according to the assumption adopted of $C_B < C_{mx}$ (see above).

Similarly, the lower extreme of x^* is calculated for the maximum value of $C_{mx} = \infty$, which, neither, can be attained.

Consequently, the set of values that x^* can take encompasses the interior of the interval between the extreme binding lines, but without these lines.

Let us next check, whether the value of x^* fulfils all the constraints.

The fact that it is contained between the values x_1 and x_2 results from the definition and the formula for these two values.

Now, if we transform the formula for x^* in the following way:

$$x^* = \frac{1}{2}\left\{\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B}\right\} = \frac{C_B - b}{2C_{mx}} + \frac{b}{C_B}$$

it becomes obvious that $x^* > b/C_B$.

On the other hand, in the range of values of interest for us, that is, $x = C_A/C_B < 1$, we have $x^* < 1$, for all the feasible values of C_{mx} and b, conform to the constraint.

Thus, after having demonstrated that the optimum (with respect to the achieved competitive edge in terms of profits) strategy of price setting:

$$C_A^* = x^* \cdot C_B = C_B \cdot \frac{1}{2}\left\{\frac{C_B - b}{C_{mx}} + 2\frac{b}{C_B}\right\} = C_B\frac{C_B - b}{2C_{mx}} + b$$

for the competitive product of Company A, as it enters the market, fulfils all the conditions set on it, both formal and logical, we can indeed propose its use.

This, however, is not the very end of the problem of selecting the best strategy, since from the point of view of achievement of maximum share on the market one should choose the initial price C_A of the product, introduced onto a market, that would be possibly low, not higher than C_{Amax}.

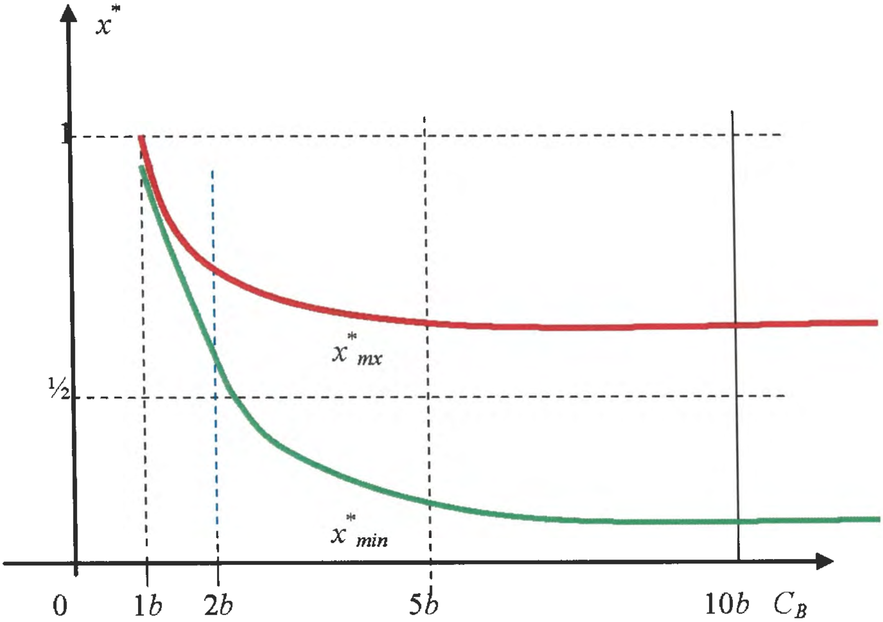

Figure 2.7.

Let us further note that if we multiply the polynomial $W_2(x)$ by C_B^2, then we obtain the squared polynomial $W_4(C_A)$, which is directly the function of the price C_A of products of Company A:

$$\frac{\Delta Z \cdot C_B}{\Lambda_{mx}} = W_4(C_A) = C_A^2 - \left[C_B \frac{C_B - b}{C_{mx}} + 2b \right] C_A + bC_B < 0$$

or, after simple transformations, in the form

$$W_4(C_A) = C_A^2 C_{mx} - (C_B^2 - bC_B + 2bC_{mx})C_A + bC_B C_{mx} < 0$$

If we calculate the derivative of the function W_4 with respect to C_A for definite values of the parameters C_B, C_{mx} and b, then we obtain

$$W'_4(C_A) = 2C_A - \left[C_B \frac{C_B - b}{C_{mx}} + 2b\right]$$

By equating the derivative to zero we can get the value C_A^*

$$C_A^* = b + \frac{1}{2} C_B \frac{C_B - b}{C_{mx}}$$

for which the polynomial assumes the lowest value.

Using the notations adopted above, we can now write down the polynomial considered, along with the condition on its value, in the following form:

$$W_4(C_A) = C_A^2 - 2C_A^* C_A + bC_B < 0$$

The roots of the polynomial are:

$$C_{A1,A2} = C_A^* \pm \sqrt{(C_A^*)^2 - bC_B}$$

The polynomial assumes the negative value between the roots C_{A1} and C_{A2}. The two roots shall exist, of course, when

$$(C_A^*)^2 > bC_B$$

After we substitute for C_A^*, we get

$$\left(\frac{1}{2} C_B \frac{C_B - b}{C_{mx}}\right)^2 > bC_B$$

$$\frac{1}{4} \frac{C_B^2}{C_{mx}^2} (C_B - b)^2 + b \frac{C_B}{C_{mx}} (C_B - b) - b(C_B - b) > 0$$

$$\frac{1}{4} \frac{C_B^2}{C_{mx}^2} (C_B - b) + b \frac{C_B}{C_{mx}} - b > 0$$

and ultimately:

$$\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right)>4\left(\frac{C_{mx}}{C_B}-1\right)$$

We can now easily see that this is exactly the same condition we obtained already before.

Note that if the reverse inequality were true, $(C_A^*)^2 < bC_B$, this would mean that the polynomial has no real-valued roots, and, since the coefficient at C_B^2 is positive, the entire parabola would be situated above the axis 0-C_A, and then the condition, stipulating the advantage of profits for the company entering an alien market, would never be satisfied.

Hence, let us check, for what values of C_{mx}, C_B and b our proposition, expressed through the inequality $W(C_A^*) < 0$ can be fulfilled in various cases.

Let us, namely check whether it is fulfilled when Company B sells its product for the optimum price

$$C_B = C^* = \frac{1}{2}(C_{mx}+b)$$

After we substitute this value into the last equation, we obtain, consecutively,

$$\frac{1}{2}\frac{C_{mx}+b}{C_{mx}}\frac{\frac{1}{2}(C_{mx}+b)}{b}>4\frac{C_{mx}-\frac{1}{2}(C_{mx}+b)}{\frac{1}{2}(C_{mx}+b)}$$

$$\frac{1}{2}\frac{\frac{1}{2}(C_{mx}+b)(C_{mx}-b)}{bC_{mx}}>4\frac{\frac{1}{2}(C_{mx}-b)}{C_{mx}+b}$$

$$\frac{(C_{mx}+b)^2}{bC_{mx}}>16$$

and, ultimately,

$$\left(1+\frac{b}{C_{mx}}\right)^2 > 16\frac{b}{C_{mx}}$$

which is equivalent to

$$\left(\frac{b}{C_{mx}}\right)^2 - 14\left(\frac{b}{C_{mx}}\right) + 1 > 0$$

Now, as we analyse the left-hand-side of this inequality, we obtain the roots of this square polynomial, namely

$$b/C_{mx} = 0.0717 \quad \text{or} \quad = 13.9281.$$

This implies that Company A, entering an alien market, on which products are sold for the optimum price C^*, can gain profit-wise competitive advantage only when the ratio b/C_{mx} has the value contained within the interval (0; 0.07), since the inequality $b < C_{mx}$ must hold. As we have

$$\frac{C^*}{C_{mx}} = \frac{1}{2}\left(1+\frac{b}{C_{mx}}\right)$$

Then for $b/C_{mx} < 0.0717$ we can assume the approximation $C^*/C_{mx} \approx 0.5$, which means that the selling price of product A ought to be at least seven times higher (0.5/0.07) than the direct cost manufacturing this product!

We can see, therefore, that such a condition can only very rarely be met in practice, limiting severely the entry into an alien market with an own competitive product so as to gain a competitive edge in terms of profits, provided the "resident" product is being sold for the optimum price.

It is easily verified that if the Company B sold its product for a price lower than the optimum one, then it would be even more difficult for a Company A to effectively enter the market with an own product.

On the other hand, if the Company B were selling its products for the price higher than the optimum one, this would facilitate the entry into its home market of the external companies, trying to sell their competitive products.

It can be easily noticed that for the involved magnitudes, whose values satisfy the inequalities

$$b < C_A < C_B < C_{mx},$$

which take place in the real-life circumstances, the required inequality $b << C_B$ is fulfilled in the case of high constant costs of production.

Let us illustrate now with an example these here mentioned rare cases.

For this purpose we transform the inequality:

$$\frac{\Delta Z_{AB}}{\Lambda_{mx}} = (C_B - b)\left(1 - 2\frac{C_A}{C_B} + \frac{C_A}{C_B}\right) - \left(1 - \frac{C_A}{C_{mx}}\right)(C_B - C_A) > 0$$

to the form

$$\frac{\Delta Z_{AB}}{b \cdot \Lambda_{mx}} = \left[1 - \frac{C_A}{C_B}\left(2 - \frac{C_B}{C_{mx}}\right)\right]\left(\frac{C_B}{b} - 1\right) - \frac{C_B}{b}\left(1 - \frac{C_A}{C_B}\right)^2 > 0$$

With the notations

$$L\left(\frac{C_A}{C_B}\right) = \left(\frac{C_B}{b} - 1\right)\left[1 - \frac{C_A}{C_B}\left(2 - \frac{C_B}{C_{mx}}\right)\right]$$

$$P\left(\frac{C_A}{C_B}\right) = \frac{C_B}{b}\left(1 - \frac{C_A}{C_B}\right)^2$$

the condition of gaining the advantage in profits may be represented as the inequality

$$L\left(\frac{C_A}{C_B}\right) > P\left(\frac{C_A}{C_B}\right) \iff L(x) > P(x),\ \ x = \frac{C_A}{C_B}$$

This is the necessary condition for the Company A, when it enters an alien market, to assure the advantage in terms of profits, see Fig. 2.8.

The quantities, appearing in this inequality, have, as to their positive values, the following constraints:

$$C_B/b > 1,\ C_B/C_{mx} < 1,\ C_A/C_B < 1.$$

In order to determine, for what values of C_A and under what circumstances the condition, guaranteeing the advantage of profits, can be fulfilled, we can present the diagrams of the functions L and P in one figure. The values, taken by these functions for three values of the argument, are shown in Table 2.3.

Table 2.3.

C_A/C_B	0	½	1
L	C_B/b - 1	$\frac{1}{2}\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right)$	$-\left(\frac{C_B}{b}-1\right)\left(1-\frac{C_B}{C_{mx}}\right)$
P	C_B/b	$C_B/4b$	0

Let us now order the values of functions L and P for the same values of arguments, in the form of ordered pairs according to the decreasing order of values. We then get

$$\left(\frac{C_B}{b},\ \frac{C_B}{b}-1\right),\quad \left(\frac{1}{2}\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right),\ ?\ \frac{1}{4}\frac{C_B}{b}\right),\ \left(-\left(\frac{C_B}{b}-1\right)\left(1-\frac{C_B}{C_{mx}}\right),\ 0\right)$$

We have a problem with the second pair, since its ordering depends upon the relations between the quantities appearing there, b, C_B and C_{mx}.

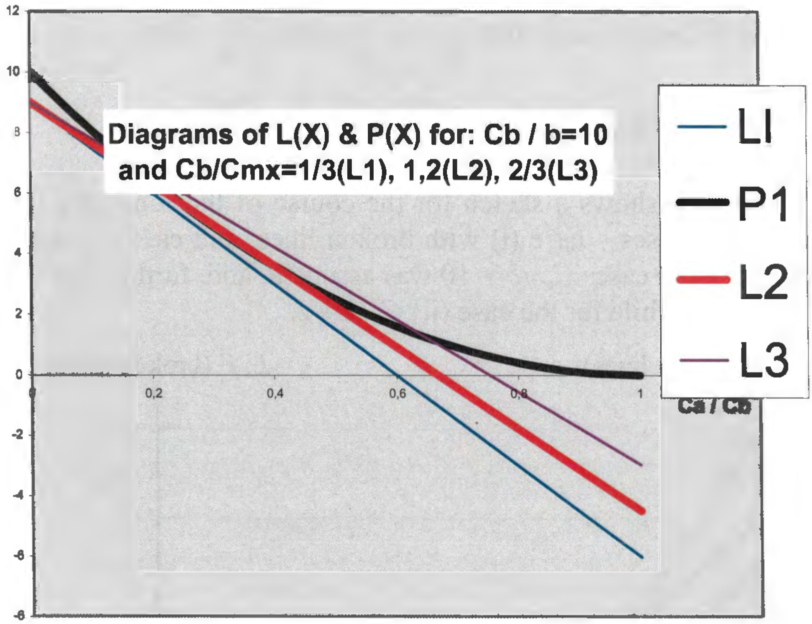

Figure 2.8.

By consecutively transforming the second pair, we obtain

$$\begin{array}{ll} \frac{1}{2}\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right) & \frac{1}{4}\frac{C_B}{b} \\ \frac{1}{2}\frac{C_B-b}{C_{mx}} & \frac{1}{4} \\ C_B-b & \frac{1}{2}C_{mx} \end{array}$$

So as to establish the ordering of the elements of this pair, we shall determine the critical interrelations of the quantities b, C_B and C_{mx}, by solving the equation: $C_B-b = C_{mx}/2$.

As a result, we can state the following:

(i) if C_B-$b > C_{mx}/2$ then $\frac{1}{2}\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right) > \frac{1}{4}\frac{C_B}{b}$, else,

(ii) if C_B-$b < C_{mx}/2$ then $\frac{1}{2}\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right) < \frac{1}{4}\frac{C_B}{b}$.

Fig. 2.9 shows a sketch for the course of the functions L and P for the two cases – case (i) with broken lines, and case (ii) with solid lines. For both cases $C_{mx}/b = 10$ was assumed, and, further, for the case (i) $C_B/b = 7$, while for the case (ii) $C_B/b = 2$.

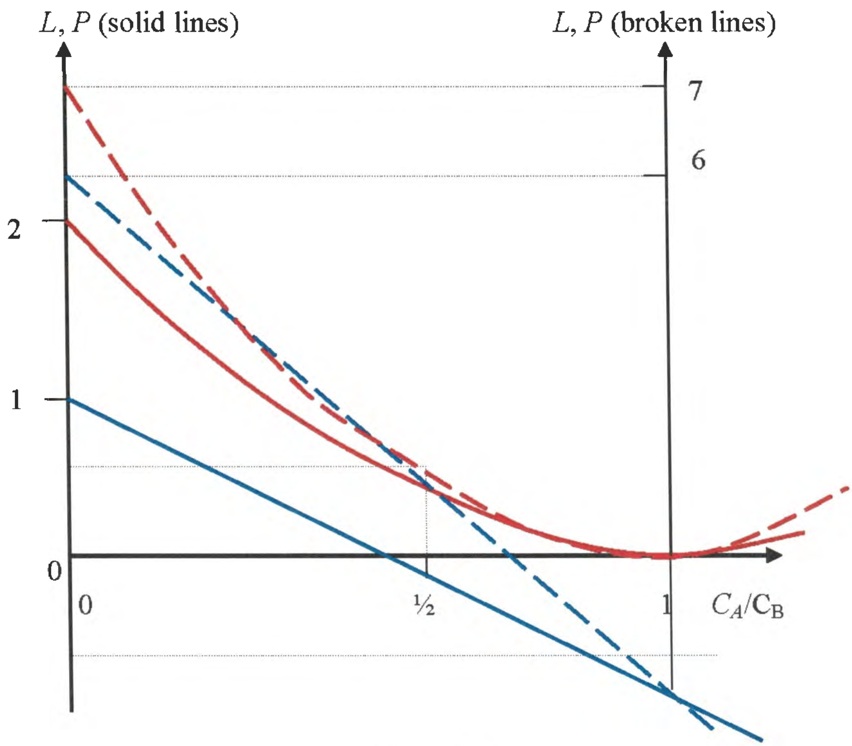

Figure 2.9.

As we continue the analysis of conditions for the advantage of profits,

$$\frac{\Delta Z_{AB}}{b\cdot\Lambda_{mx}}=L\left(\frac{C_A}{C_B}\right)-P\left(\frac{C_A}{C_B}\right)>0$$

we can reformulate the condition as follows:

$$P\left(\frac{C_A}{C_B}\right)-L\left(\frac{C_A}{C_B}\right)<0$$

and then determine the set of values of C_A, satisfying the above inequality, i.e. guaranteeing the advantage of profits for the Company A, entering the market.

By substituting the expressions for the values of functions L and P and rearranging terms we obtain the following polynomial inequality:

$$W=\frac{C_B}{b}\left(1-\frac{C_A}{C_B}\right)^2-\left[1-\frac{C_A}{C_B}\left(2-\frac{C_B}{C_{mc}}\right)\right]\left(\frac{C_B}{C_b}-1\right)<0;\ W=-W_3,$$

see previous derivations.

This inequality can be fulfilled only when the polynomial has two roots. In turn, it will have two roots, when the following inequality is satisfied:

$$\Delta_3=\left[\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right)+2\right]^2-4\frac{C_B}{b}>0$$

As we perform the operations and rearrange terms, we get

$$\Delta_3=\left(\frac{C_B}{b}-1\right)\left[\left(\frac{C_B}{C_{mx}}\right)^2\left(\frac{C_B}{b}-1\right)-4\left(1-\frac{C_B}{C_{mx}}\right)\right]>0$$

Hence, in order for the inequality to be satisfied and Company A have the advantage of profits, suffice to secure the satisfaction of the inequality

$$\left(\frac{C_B}{C_{mx}}\right)^2\left(\frac{C_B}{b}-1\right)>4\left(1-\frac{C_B}{C_{mx}}\right)$$

It can easily be verified that it is equivalent to the previously determined condition.

Let us check, whether this inequality is satisfied for the previously described and illustrated (in Fig. 2.4) two cases.

Namely, we assumed for both cases $C_{mx}/b = 10$, and for the first case $C_B/b = 2$, while for the second case – $C_B/b = 7$.

Now, taking into account the fact that $C_B/C_{mx} = (C_B/b)(b/C_{mx}) = 1/5$ in the first case, and $C_B/C_{mx} = 7/10$ in the second case, we can easily conclude that the advantage of profits can be achieved only in the second case, since then the quantities involved satisfy the condition formulated.

We shall now determine the optimum strategy of selecting the value C_A for Company A. Attention should be paid in this context to the fact that selection of the strategy does not depend upon whether we are capable of securing the advantage of profits or not. In the first situation we would aim at maximising our advantage, while in the second one – at minimising the advantage of the competitor. In both these situations we should select such a value of C_A or C_A/C_B as to minimise the value of the polynomial.

Summing up, for the optimum value C_A^* the derivative of the function

$$W=\frac{C_B}{b}\left(\frac{C_A}{C_B}\right)-\left[\frac{C_B}{C_{mx}}\left(\frac{C_B}{b}-1\right)+2\right]\left(\frac{C_A}{C_B}\right)+1$$

should fulfil the condition

$$\frac{dW}{d\left(\frac{C_A}{C_B}\right)} = 2\frac{C_B}{b}\left(\frac{C_A}{C_B}\right)^* - \frac{C_B}{C_{mx}}\left(\frac{C_B}{b} - 1\right) - 2 = 0$$

As we solve this equation, we get

$$\left(\frac{C_A}{C_B}\right)^* = \frac{1}{2}\frac{C_B - b}{C_{mx}} + \frac{b}{C_B}$$

or

$$C_A^* = \frac{1}{2}C_B\frac{C_B - b}{C_{mx}} + b$$

In order to be able to apply this strategy, we should first verify whether the inequality $C_A^* < C_B$ is satisfied.

As we substitute the value for C_A^*, we get

$$\frac{1}{2}\frac{C_B - b}{C_{mx}} < 1 - \frac{b}{C_B}$$

Now, the answer to the question whether this condition is satisfied for the two cases considered, is, as can easily be shown, positive.

Actually, we should have also verified whether $C_A^* > b$. Yet, by comparing the expression for C_A^* with this condition we see that it is always fulfilled.

Next, let is confront our conclusions, concerning the possibility of gaining the advantage of profits with the requirement of gaining a large share of the new market.

We namely know that in order to gain a large share of the market we should select possibly low values of C_A, situated possibly far from the value of C_B, and not bigger than

$$C_{A,mx} = C_B \cdot \frac{C_{mx}}{2C_{mx} - C_B}$$

On the other hand, in order to gain the maximum advantage of profits – if this advantage is attainable at all – we must select the value $C_A = C_A^*$.

These two postulates are, therefore, partly in opposition (in case, when there exists the possibility of achieving the advantage of profits).

Consequently, in the usually existing circumstances (when the inequality $b << C_B$ does not take place), we must choose one of two feasible strategies:

- either to enter the market with the price $C_A = C_A^*$ of the product, gaining a definite advantage of profits over the profits of the competitor, and winning a relatively narrow share of the market, and so losing more time in the process of pushing away the competitor from the market, or
- to bear the risk of high losses of profits with respect to the profits of the competitor, enter the market with a product sold for the lowest admissible price, gaining the possibility of entirely wiping out the competitor from the market in a short time.

4. General conclusions

We can now draw the general conclusions from the entirety of our previous considerations, these conclusions constituting the indications for taking decisions concerning entering an alien market, dominated by the supplies from another company.

1. It is much easier to enter the market segment of expensive products (featuring higher quality) than the market of mass sales of cheap products. Market entry costs depend upon the

ratio of the quantity C_{mx}, characteristic for a given market, to the price of the currently sold product, C_B. The higher the value of this ratio, the quicker (and with lesser cost) we shall gain advantage in the sales of our product over the sales of the resident company.

2. It is easier to enter an alien market, when the sales price of our competitive product, C_A, is much lower than the price C_B of the product sold to date on this market. The lower the value of the ratio C_A/C_B, the faster we achieve the advantage in the sales over the competitor. This is, definitely, not astonishing at all, but should be well considered. This means that the market ought to be continuously monitored for identification of these products, for which the difference of their sales price and production costs is especially large. If this is the case, we can enter the market with our competitive product by selling it for a much lower price, e.g., equal the direct production cost, b.
3. If the product of interest for us does not feature high value of C_{mx}/C_B nor low value of C_B/b, then an effective entry into an alien market, dominated by a resident company, is possible only if we dispose of much ampler financial reserves than our competitor, these reserves making it possible for us to win the "war of attrition". This observation is not surprising, either, but its use consists in noting when the competitor got engaged financially in some large-scale undertaking. In such a period the competing company may not be able to mobilise adequate financial reserves.
4. If none of the above circumstances takes place, we are left with the option of proposing joint activity with the competitor, in the form, say, of a consortium. Yet, in order to be in a position to forward such a proposal, we must have an advantage in some element of production technology or sales organisation in respect to the resident company. The manner of proceeding in

such a case is described in more detail in Piasecki (1999). If, however, we do not dispose of an advantage in any fragment of production technology nor in organisation of sales, we cannot do anything else but give up all attempts of entering an alien, though interesting, market.

Now, at the end of these considerations we shall provide an example, involving concrete numbers, for which standard computer software was used. The results are illustrated in Fig. 2.10. Yet, in order to introduce this example, some preliminaries are necessary.

With notation $x = C_A/C_B$ the formulae for the sales volume of both companies (after a time unit) take the following shape:

$$\Lambda_A = \Lambda_0 \cdot \left\{ 1 - x^{\tau} + \frac{1-x}{C_{mx}/C_B - 1}\left(1 - x^{k\tau}\right)\right\}$$

$$\Lambda_B = \Lambda_0 \cdot x^{\tau}$$

hence, the difference of sales (after the time unit) shall be equal

$$\Delta\Lambda = \Lambda_A - \Lambda_B = \Lambda_0\left\{1 - x^{\tau} + A(1-x)(1-x^{k\tau}) - x^{\tau}\right\}$$

where

$$A = \frac{1}{\dfrac{C_{mx}}{C_B} - 1}$$

while the relative difference shall be expressed through the formula

$$\frac{\Delta\Lambda}{\Lambda_0} = 1 - 2x^{\tau} + A(1-x)(1-x^{k\tau})$$

The diagrams of the calculated differences in the sales values as functions of time are shown in Fig. 2.10.

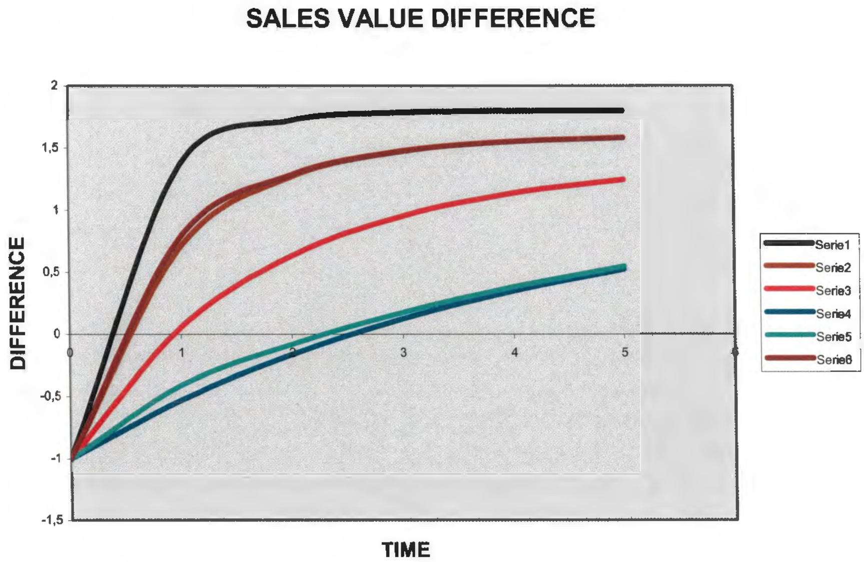

Figure 2.10.

All of the curves of Fig. 2.10 are drawn for the value $C_{mx}/C_B = 2$ ($A = 1$). The figure shows four curves, of which two are doubled. The consecutive curves were obtained for the values of x equal 0.2; 0.4; 0.6 and 0.8. For all the curves $k = 2$ was assumed, and for the doubled curves – also $k = 4$ was taken, additionally.

CONCLUDING REMARKS

This book, like the previous one, constituting Volume I of the introduction to a theory of market competition, contains considerations that involve a number of approximations and simplifications. We, that is – the authors of both these volumes – would like to draw the attention of the Reader to them.

In general, we do not explicitly consider the vague, uncertain or "fuzzy" character of some of the quantities we refer to. This concerns, in particular, such quantities as the limit value of d in the determination of the demand function, $\lambda(C)$.

Likewise, the uncertain, or specific character of some relations has not been treated in an explicit manner. Thus, for instance, we state in the book that the situation when the market shares of two competitors are equal, 50% each, constitutes indeed a kind of equilibrium, but this is an unstable equilibrium point, for any disturbance to this situation shall drive it far away from the equilibrium (assuming, of course, that this disturbance, due to behaviour of one of the competitors, does not find any "appropriate" reaction from the side of the other competitor).

In reality, though, this equilibrium point is not that unstable, i.e. it is not that sensitive to the very small disturbances. Actually, an interval of insensitivity always exists, due to various reasons, such as delays, information shortage, lack of reaction of customers to very small price changes etc. It is even possible that the "hysteresis" effect may appear. In terms of the notions introduced in this book, the magnitude of the zone of insensitivity depends upon the slope of the production characteristics (the value of the derivative $dk/d\mu$).

Independently of the above remarks the considerations here presented neglect the effect of the change in the number of potential customers due to the change in product price. Namely, along with the change in product price, there is also change in the value of the difference C-b, exerting the decisive influence on the magnitude of the optimum radius R^* of the area, over which the company effectively caters to its potential customers. This radius R^* defines, in turn, the number of such potential customers, i.e. the ones, to whom the products are effectively supplied. This number, in turn, together with the income structure of the customers, defines the value of Λ_{mx} (see also Volume I). Yet, in the book, for both companies selling their products for different prices, the very same value of Λ_{mx} was adopted.

Neglecting this particular aspect is justified by the following circumstances:

- a company that just enters the market (as well as the one, which tries to expand its market share) can hardly afford the advertising saying that its product is not worse than the one of the competitor, even though it is cheaper – and this not for all the potential customers, exception being constituted by the farthest ones;
- on the other hand, the company defending its market share and for this purpose decreasing the sales price of its products, ought not get rid of its more distant customers, since this would make a very disadvantageous effect on the remaining customers and would actually accelerate elimination of such a company from the market.

Of course, the fact that we neglected the influence, exerted by the changes in the reach, R, was also largely due to the wish of simplifying the complicated interrelations, constituting the description of the market process, the mechanism of functioning of the "invisible hand of the market".

Considerations, contained in the book, do not account, either, for the influence of advertising, although certain remarks on this subject are forwarded in Chapter I.

Likewise, we did not forward the estimates for the cost of entry onto an alien market, which could be formulated with the use of the formulae for the sales magnitudes (Λ_A and Λ_B).

When considering the (initial) shares of two competing companies, we analysed the case, when they start from equal market shares. For modelling and analysing other possible situations, we could use the coefficient u.

In the case when more than two companies have (non-negligible) shares in a market, the struggle for the market share ought to be started with the weakest company, avoiding the appearance of a hostile coalition of the remaining companies on the market. Otherwise, it would become necessary to establish an own coalition that would be able to withstand the competition of the other coalition. In such a case the struggle for the market shares would reduce to the case of two competitors, that is – to the situation described in the book.

In view of these and, indeed, many other aspects that remain to be accounted for, it is obvious that the description of the mechanism behind the functioning of the "invisible hand" is far from complete.

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This book is the second part of an exposition of a coherent and far-reaching theory of market competition. The theory is based on simple precepts, does not require deep knowledge of either economics or mathematics, and is therefore aimed primarily at undergraduate students and all those trying to put in order their vision of how the essential market mechanisms might work. The present Volume II constitutes a complement to the considerations, contained in Volume I.

The logic of the presentation is straightforward; it associates the easily grasped microeconomic elements of quantitative character in order to arrive at both more general conclusions and at concrete formulae defining the way the market mechanisms work under definite assumed conditions.

Some may consider this exposition too simplistic. In fact, it is deliberately kept very simple, for heuristic purposes, as well as in order to make the conclusions more clear. Adding a lot of details that make theory more realistic – these details, indeed, changing from country to country, and from sector to sector – is mainly left to the Reader, who is supposed to be able to design the more accurate image on the basis of the foundations, provided in the book.

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