

**HOW TO CONTROL MARKET POWER OF  
ACTIVITY CENTRES? A THEORETICAL  
MODEL SHOWING THE ADVANTAGES  
OF IMPLEMENTING COMPETITION  
WITHIN ORGANIZATIONS**

**SAMUEL CRUZ ALVES PEREIRA**

**AND**

**PEDRO COSME COSTA VIEIRA**

# **How to control market power of activity centres? A theoretical model showing the advantages of implementing competition within organizations**

Samuel Cruz Alves Pereira (samuel@fep.up.pt)

Pedro Cosme Costa Vieira (pcosme@fep.up.pt)

Faculdade de Economia do Porto

R. Dr. Roberto Frias, s/n

4200-464 Porto,

Portugal

**Abstract:** One important issue in firms' governance is how to create incentives so that activity centres can become more efficient. In this paper, we first introduce an agency contract where the salary of the manager of an activity centre that produces an intermediate product is dependent of its performance. Secondly, we add competition within the organization. This latter point is new in the literature. We then develop a "static analysis" comparing a firm that has only one activity centre producing an intermediate product with another firm that has two activity centres producing the same intermediate product, in a context where the technology manifests increasing returns to scale. We conclude that the introduction of internal competition makes the firm globally more efficient, even though it cannot fully explore the existence of increasing returns to scale.

**Keywords:** Activity centres, internal market power, firm efficiency.

**JEL codes:** M11, M41

## **1. Introduction**

In a systemic analysis, an organization is a space that internalizes the transactions that are globally more efficient to undertake within it than in the market (Coase, 1937). The transaction costs considered in the literature are information, implementation, negotiation, and information costs. But, even if there were no costs in using the market, there are benefits with the accomplishment of transactions within the organization (Conner, 1991).

On the other hand, each organization is subject to an environment in continuous change, which is reflected in the variation of prices of inputs and outputs. Therefore, it is necessary to implement management strategies that supply permanently information on the relative efficiency of each transaction in order to ascertain which transactions should be internalized and/or externalized. However, there is dependence between transactions, so implying that it is not always possible to determine the relative efficiency of each transaction. In this context, it is necessary to identify, first, the dependence among transactions and, second, mutually independent sub-systems. The analysis of the efficiency of these sub-systems, designed as activity centres, is one of the basic concerns of the management accounting and control systems (Kaplan and Cooper, 1998).

Given that an activity centre use inputs that are the outputs of other activity centres, it is necessary to determine the transfer price of each intermediate product/service in order allocate resources efficiently (Atkinson, 1987). Since both variable and fixed cost costs have to be covered, the problem of the determination of the transfer price, as well as the corresponding distribution of costs, is identical to the macroeconomic problem of determination of the price in a planned economy (Ijiri, 1968, Livingstone, 1969, Farag, 1967, 1968, and Kaplan, 1973), which uses the input-output analysis of Leontief (1941). According with this perspective, the organization is managed centrally, where activity centres are planned in order to maximize the overall profit.

However, the organization can only be managed efficiently if there is perfect information (Hayek, 1945). Although the absence of perfect information can be partially resolved in perfectly competitive markets, where economic agents disclose their private information, within the organization this is not possible because activity centres are monopolists, and so do not have incentives to disclose their private information. Since the curve of production possibilities of activity centres (the efficient curve) is not known, it is not possible to affect efficiently resources based on financial criterions. Hence, the determination of the transfer

price, and so the global allocation of resources, depends, to a great extent, on the capacity of each group in generating "false information" and in using its market power within the organization. This perspective, although partially covered by the agency theory (Alchian and Demsetz, 1972, Rajan, 1992), has been little explored in literature.

In this work we compare the problem of allocation of resources in two organizations that have to produce an intermediate product/service. In one organization the intermediate product/service is produced by a single activity centre, i.e. the activity centre is a monopolist. In the other organization the intermediate product/service is produced by two identical activity centres, i.e. we have a duopoly. We show that the existence of market power, which occurs when the intermediate product/service is produced by a single activity centre, affects negatively the efficiency of the organization. In particular, we show that although the existence of increasing returns to scale might a priori justify the existence of only one activity centre producing the intermediate product/service, the introduction of competition through the duplication of activity centres can make the organization more efficient.

**2. The theoretical model**

Assume a firm that produces one intermediate product and two final products. The firm is organized in three activity centres. One activity centre produces the intermediate product while the other two produce the final products. Denote the intermediate output by  $I_1$  and the final products by  $F_1$  and  $F_2$ . The firm produces each final product using two inputs: the intermediate product  $I_1$  and input  $I_2$ , which is acquired in the market (e.g., energy). The intermediate product  $I_1$  uses two inputs, the work of the manager responsible for this centre,  $L$ , and input  $I_2$  (see figure 1).

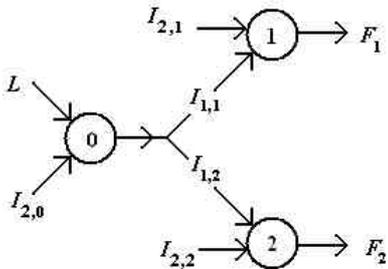


Figure 1: Firm's production layout

Assume also that the technology is *Cobb-Douglas*. The two final products use a technology with constant returns to scale, while the intermediate product uses a technology with increasing returns to scale. Therefore, the technology is represented by:

$$\begin{cases} I_1 = A_0 L^j I_{2,0}^{x-j} & , 0 < j < x, x \geq 1 \\ S_1 = A_1 I_{1,1}^a I_{2,1}^{(1-a)} & , 0 < a < 1 \\ S_2 = A_2 I_{1,2}^b I_{2,2}^{(1-b)} & , 0 < b < 1 \end{cases} \quad (1)$$

where  $I_{2,0}$  denotes the quantity of input  $I_2$  used in the production of the intermediate product,  $I_{i,j}$  denotes the quantity of input  $I_i$  used in the production of the final product  $F_j$ ,  $L$  denotes the work of the manager and  $A_0$ ,  $A_1$  and  $A_2$  are constants. The market demand curves of the two final products are linear decreasing and given by:

$$\begin{cases} D_1 = a_1 - b_1 p_1 \\ D_2 = a_2 - b_2 p_2 \end{cases} \quad (2)$$

where  $p_i$  is the price of the final product  $F_i$  and  $a_1$  and  $a_2$  are constants. The price of input  $I_2$ , traded in a perfectly competitive market, is given by  $w_2$ . It is assumed that the transfer price of input  $I_1$  is the average cost of production,  $w_1$ . The average cost of production depends on both the cost of input  $I_2$  and the salary of the manager. The salary of the manager is equal to a fixed component,  $W_0$ , plus a variable component, which increases with the output of the intermediate input  $I_1$  and depends on the difference between the *standard* cost,  $w_1^s$ , and the cost of production excluding the variable component of the salary,  $w_1^f$ , where  $w_1^f = (I_{2,0} w_2 + W_0)/I_1$ . Hence, the salary of the manager is given by:

$$W = W_0 + k_1 (w_1^s - w_1^f) I_1 = W_0 (1 - k_1) + k_1 (w_1^s I_1 - I_{2,0} w_2), \quad 0 < k_1 < 1 \quad (3)$$

The actual average cost of production of the intermediate product is given by:

$$w_1 = \frac{I_{2,0} w_2 + W_0 + k_1 (w_1^s - w_1^f) I_1}{I_1} = (1 - k_1) \frac{I_{2,0} w_2 + W_0}{I_1} + k_1 w_1^s \quad (4)$$

Since the transfer price of the intermediate product equals the actual average cost of production, the activity centre obtains not profit. Therefore, the profit of the firm,  $\pi$ , equals the sum of the profits of the activity centres that produce the final products,  $\pi_1$  and  $\pi_2$ . Formally, we have:

$$\mathbf{p} = \mathbf{p}_1 + \mathbf{p}_2, \quad \begin{cases} \mathbf{p}_1 = S_1(I_{1,1}, I_{2,1}) p_1(S_1) - (I_{1,1} w_1 + I_{2,1} w_2) \\ \mathbf{p}_2 = S_2(I_{1,2}, I_{2,2}) p_2(S_2) - (I_{1,2} w_1 + I_{2,2} w_2) \end{cases} \quad (5)$$

Using (1) and (2), the profit function of the activity centre that produces the final product  $F_1$ ,  $\mathbf{p}_1$ , is given by:

$$\mathbf{p}_1 = A_1 I_{1,1}^a I_{2,1}^{(1-a)} \frac{(a_1 - A_1 I_{1,1}^a I_{2,1}^{(1-a)})}{b_1} - (I_{1,1} w_1 + I_{2,1} w_2) \quad (6)$$

The optimal quantities  $I_{1,1}$  and  $I_{2,2}$  are then the solution to:

$$\begin{cases} \frac{d\mathbf{p}_1}{dI_{1,1}} = 0 \\ \frac{d\mathbf{p}_1}{dI_{2,1}} = 0 \end{cases} \Leftrightarrow \begin{cases} \frac{\mathbf{a}}{b_1 I_{1,1}} [S_1 a_1 - 2 S_1^2] = w_1 \\ \frac{(1-\mathbf{a})}{b_1 I_{2,1}} [S_1 a_1 - 2 S_1^2] = w_2 \end{cases} \quad (7)$$

After simplifying (7), we obtain the demand of inputs  $I_1$  and  $I_2$  by the activity centre that produces the final product  $F_1$ :

$$\begin{cases} I_{1,1} = \frac{w_2 \mathbf{a}}{w_1 (1-\mathbf{a})} I_{2,1} \\ I_{2,1} = \frac{m a_1 (1-\mathbf{a}) - w_2 b_1}{2 m^2 (1-\mathbf{a})}, \quad m = A_1 \left( \frac{w_2 \mathbf{a}}{w_1 (1-\mathbf{a})} \right)^a \end{cases} \quad (8)$$

In a similar way we obtain the demand of inputs  $I_1$  and  $I_2$  by the activity centre that produces the final product  $F_2$ . The demand of input  $I_1$  is then given by:

$$I_1 = I_{1,1} + I_{1,2} \quad (9)$$

Using expressions (1) and (4), the actual average cost at the activity centre that produces input  $I_1$  can be rewritten as depending on the effort of the manager and the demand of input  $I_1$ :

$$w_1(L, I_1) = (1 - k_1) \frac{\left( \frac{I_1}{A_0 E^j} \right)^{\frac{1}{x-j}} w_2 + W_0}{I_1} + k_1 w_1^s \quad (10)$$

Considering (3), and assuming that the disutility of effort is given by  $k_2 L^2$ , the effort exerted by the manager at the activity centre that produces input  $I_1$  results from the resolution of the following optimization problem:

$$Max_L [W(L, I_1) - k_2 L^2] = Max_L \left[ W_0 (1 - k_1) + k_1 \left( w_1^s I_1 - \left( \frac{I_1}{A_0 E^j} \right)^{\frac{1}{\alpha-j}} w_2 \right) - k_2 L^2 \right] \quad (11)$$

It is worth noting that the effort exerted by the manager alters (using (10)) the actual average cost at the activity centre that produces input  $I_1$ , while this changes (using (8)) the demand of inputs  $I_1$  and  $I_2$  by the activity centres that produces the final products. The final solution to the problem results from the resolution of the system of non-linear equations represented by expressions (9) and (11).

### 3. Properties of the model

We start with considering the case where there is only one activity centre producing the intermediate product  $I_1$ . We use simulation methods because the analytic manipulation of the problem is difficult and removes clarity. Future research might explore the analytic properties of the model.

#### Case 1 (There is only one activity centre producing the intermediate product $I_1$ )

In this case, the activity centre that produces the intermediate product acts as a monopolist. Hence, the demand is given by expression (9).

Assuming that  $w_1^s = 2$ ,  $w_2 = 1$ ,  $A_0 = 2$ ,  $A_1 = A_2 = 1$ ,  $\mathbf{a} = \mathbf{b} = \mathbf{j} = 0,5$ ,  $\mathbf{x} = 1.1$ ,  $W_0 = 1$ ,  $k_2 = 1$ ,  $a_1 = a_2 = 5$  e  $b_1 = b_2 = 1$ , we next represent the profit of the firm, the average cost of the intermediate output and the effort exerted by the manager as the parameter  $k_1$  changes.

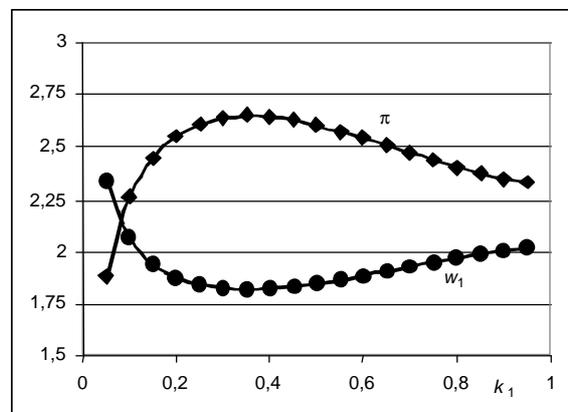


Figure 2: Firm's profit and average cost of the intermediate output

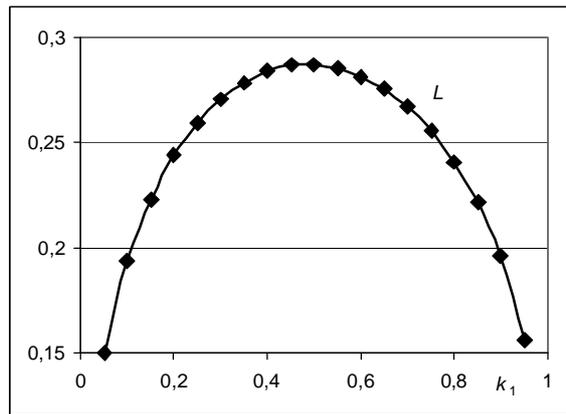


Figure 3: Effort exerted by the manager

Since that the activity centre that produces the intermediate product is monopolist, the effort the manager exerts is relatively small, unless the owner of the firm pays to the manager a relative high percentage of the difference between the standard cost and the actual cost. The simulation results show that the profit of the firm is maximized when the owner pays to the manager, as a variable component of the salary, approximately 35% of the difference between the standard cost and the actual cost. Hence, the manager increases his effort and the average cost reduces. In a sense, we obtain a better congruence between owner interests and manager interests.

### Case 2 (There are two activity centres producing the intermediate product $I_1$ )

One way of reducing the market power that results from the fact that there is only one activity centre producing the intermediate output is by introducing another competitor within the organization. In this case, each activity centre might have a different average cost of production. Moreover, the activity centres that buy the intermediate products choose first the centre that practices a lower average cost. In figure 4 we represent the organization of the activity centres.

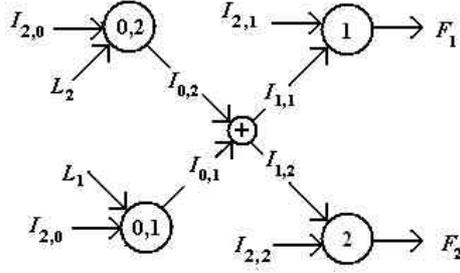


Figure 4: Firm's production layout

In this case, each activity centre producing the intermediate product produces only a part of the demand of input  $I_1$ . Assuming that the average cost and the quantity produced at activity centre  $(0, j)$ ,  $j = 1, 2$  are, respectively,  $w_{0,j}$  and  $I_{0,j}$ , the overall average cost of the intermediate product, which will be used by the activity centres that produce the final products, is given by:

$$w_1 = \frac{w_{0,1} I_{0,1} + w_{0,2} I_{0,2}}{I_1} \quad (12)$$

Where  $I_1 = I_{0,1} + I_{0,2}$ . As observed above, it is assumed that the activity centre that has a lower average cost produces a higher quantity. Moreover, the distribution between the two activity centres is, by assumption, given by:

$$\begin{cases} I_{0,1} = \frac{w_{0,2}}{w_{0,1} + w_{0,2}} \\ I_{0,2} = \frac{w_{0,1}}{w_{0,1} + w_{0,2}} \end{cases} \quad (13)$$

Considering the same values used in Case 1, except that  $W_0 = 0,5$  ( $w_1' = 2$ ,  $w_2 = 1$ ,  $A_0 = 2$ ,  $A_1 = A_2 = 1$ ,  $\mathbf{a} = \mathbf{b} = \mathbf{j} = 0,5$ ,  $\mathbf{x} = 1,1$ ,  $W_0 = 0,5$ ,  $k_2 = 1$ ,  $a_1 = a_2 = 5$  e  $b_1 = b_2 = 1$ ), we next represent the profit of the firm, the average cost of the intermediate product and the effort exerted by the manager as the parameter  $k_1$  changes.

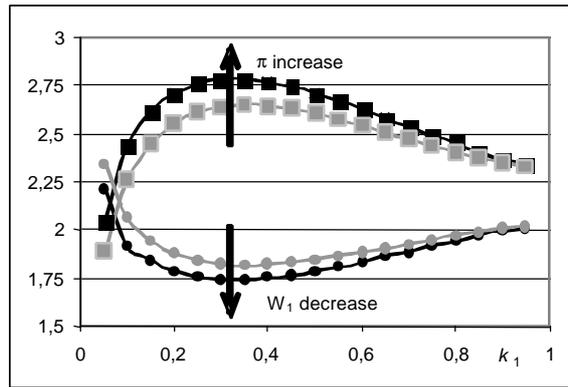


Figure 5: Increase of the profit and decrease of the average cost of the intermediate output when there are two activity centres producing the intermediate output

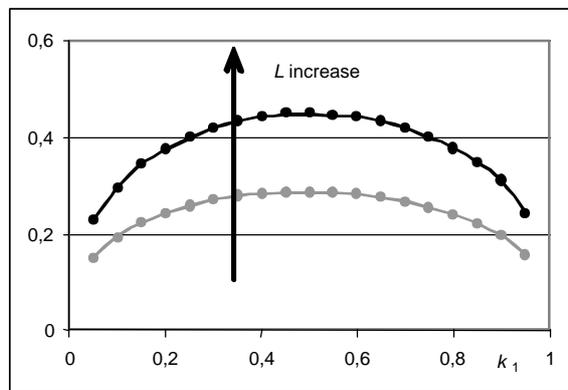


Figure 6: Increase of the effort exerted by the (two) managers responsible for the activity centres that produce the intermediate output

As figure 5 shows, the profit of the firm is maximized when the owner pays to the two managers, as a variable component of the salary, approximately 35% of the difference between the standard cost and the actual cost. More importantly, the profit of the firm increases when we introduce competition, although there are increasing returns to scale in the production of the intermediate output ( $x = 1.1 > 1$ ).

#### 4. Conclusion

It is well known that the absence of competition in the markets induces a loss of economic welfare. Similarly, within organizations, the market power that results from the fact that an intermediate product is produced by a single activity centre induces an inefficient allocation

of resources. This occurs because the activity centre does not have incentives to disclose information concerning the (efficient) curve of production possibilities. Consequently, the power to impose the transfer price is the main factor affecting the allocation of resources.

Although it might be a priori more efficient to use a single activity centre to produce an intermediate input when there are increasing returns to scale, in this work we show that this is not always the case. Thus, comparing a firm that has a monopolist activity centre producing an intermediate product with another firm where the same intermediate product is produced by two activity centres, we show that, even if there are increasing returns to scale, the firm might become more efficient duplicating activity centres.

The great question we should pose is to know how the production processes should be modified so that it is possible the existence of a great number of activity centres operating in competition.

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