# The Incentive Effects of the Jones Performance Evaluation System on Price-Setting Managers.

The Jones performance evaluation system treats prices as exogenous, i.e."outside the control of management" (Jones, 1981[1] pp.17-18). The reason given is that many PEs operate in environments where the government sets prices. The principal goal of the performance evaluation system is then to encourage-efficiency; it is not seen as a way of ensuring the setting of correct prices.

Although it is probably true that the bulk of PE output is produced in price-controlled regimes, it is also true that a large number of PEs (frequently the relatively small ones) do have discretion to set prices. Further, even in the price-controlled situations, PE managers can probably exercise some influence on the prices either through their lobbying efforts or because they may hold multiple positions (e.g., the Chairman of SAIL, the Indian steel holding company, was at one time also the secretary to the Steel Ministry). It seems worthwhile, therefore, to examine the incentives the performance evaluation system has on managers who do have some price-setting discretion.

The basic approach of the evaluation system is to examine the trend in the public profit at constant prices generated by the enterprise. Suppose all market prices represent social scarcity so that there is no need to construct separate shadow prices. Suppose also for the moment that input prices remain constant over time, but that output prices may change. The Jones system would then compute public profit in the reference year at base period prices:

$$\pi_1 = P_0 q_1 - C_1 \quad \dots \quad \dots \quad \dots \quad \dots \qquad (1)$$

Where $P_0$ represents the base period price, $q_1$ the reference year output and $C_1$ the reference year costs. This would then be compared with

$$\pi_0 = P_0 q_0 - C_0 \quad \dots \quad \dots \quad \dots \quad \dots \qquad (2)$$

The incentive effect on the manager would then depend on the precise nature of the comparison. Let us focus on the simplest type of comparison that might be made, namely to look at the change in public profit:

$$V_1 = \pi_1 - \pi_0 = P_0 q_1 - C_1 + C_0 \quad \dots \quad \dots \qquad (3)$$

If the manager attempts to maximize this change, or if his bonus depends on this change in some way, we will see that he has perverse incentives concerning the quantities he will produce and the prices he will change.

### Myopic Manager

Consider first a myopic manager who simply attempts to maximize $V_1$ without consideration to future effects. Since I wish to examine the effect of the evaluation system on prices, I will assume the enterprise faces a downward-sloping demand curve for its output (for simplicity, let us assume

[1] Jones, Leroy P., "Towards a Performance Evaluation Methodology for Public Enterprises : With Special Reference to Pakistan", International Symposium on Economic Performance of Public Enterprises. Islamabad, Nov.1981.

only a single product is produced). Then in order to maximize $V_1$, the manager will choose $q_1$ so that

$$\delta V_1/\delta q_1 = P_0 - \delta C_1/\delta q_1 = 0 \quad \dots \quad \dots \qquad (4)$$

i.e., such that the marginal cost of production equals the *base*-year price. Note that (4) yields a maximum only if the marginal cost is rising. If it were constant at, say, C, then $q_1$ would be zero if $c > P_0$ and indefinitely large otherwise. If MC were falling, $q_1$ would again generally be indefinitely large.

The key point to note about (4) is that it will not in general lead to the socially desirable level of output or optimal price. In a first-best world we would want MC to equal *current* price, and in a second-best world the optimal price would require a specific deviation of MC from (again) current price. Thus (4) leads to an efficient outcome only if $P_0$ had been chosen in such a way as to be optimum for year 1. If $P_0$ were too high, too much output would be produced, and vice versa if $P_0$ were too low. The manager will act like a perfect competitor facing a perfectly elastic demand at price $P_0$, producing quantity according to his MC curve. Figure 1 illustrates his behaviour. $(p^*,q^*)$ represents the optimum price-quantity combination. If $P_0 = p^*$ this outcome will be achieved. If, however, $P_0 = p^1$, output produced would be $q^1$ and price would be $p^1$. Note that I have implicitly been assuming that the PE manager sets quantity and prices adjust. If he were a price-setter instead, he would set $P_1 = P^1$ and then $q^1$ would be the production. I am not permitting any inventory accumulation (more on that later). If $P_0$ had started out below $p^*$, say at $p^*$, production would be too low $(q^*)$ and price would rise excessively (to $P^*_1$).

I should point out that since $c_1$ appears negatively in (3), the myopic manager has the incentive to try to keep it as low as possible. Thus the X-efficiency goal of the performance evaluation system is met in this one-period model. Indeed, if $P_0$ is the true marginal social value of output, the performance criterion (3) will lead also to the correct output. For example if $p^1$ is the appropriate price, then $q^1$ is the appropriate output. At this level of output, the marginal willingness to pay is only $p^1$ and so this is the price that would have to be changed. The enterprise would run at a financial loss, but would be making public profits (since the shadow price of the output is $p^*$ then production will continue at $q^*$, and this is efficient.

So far I have dealt with only one reference year. The situation becomes a little more complicated if we allow more time periods. If the valuation price remains at $P_0$ over time, then (4) continues to be the condition which the PE will satisfy. Thus output would not change from year to year. If $p_0$ was at an inappropriate level to begin with, this simply means that the deadweight losses due to the misallocation will be incurred year after year, and the manager will have no incentive to try to reach the efficient price-quantity combination.

If, however, the previous year's actual price is always taken as the valuation price (a procedure analagous to using a chain Laspeyre index), there emerges the possibility of a cycling price. This could be converging or explosive. The myopic manager will, each year, choose a quantity level such that the marginal cost is equal to last year's price. This is a classic cob-web type of situation. In Fig. 2, if $p_0$ was the base-year price, then $(P_1, q_1)$ will be the chosen outcome in year 1. Then, with $P_1$ as the valuation price in year 2, the outcome $(p_2, q_2)$ will be chosen. The way Figure 2 is drawn, $p_2 > p_0$, so that the cycle here is explosive. If demand were more elastic, the cycle would converge to the efficient price eventually. A similar analysis could be applied to the case where the initial price $p_0$ was less than $p^*$.

It is interesting to note that, by the

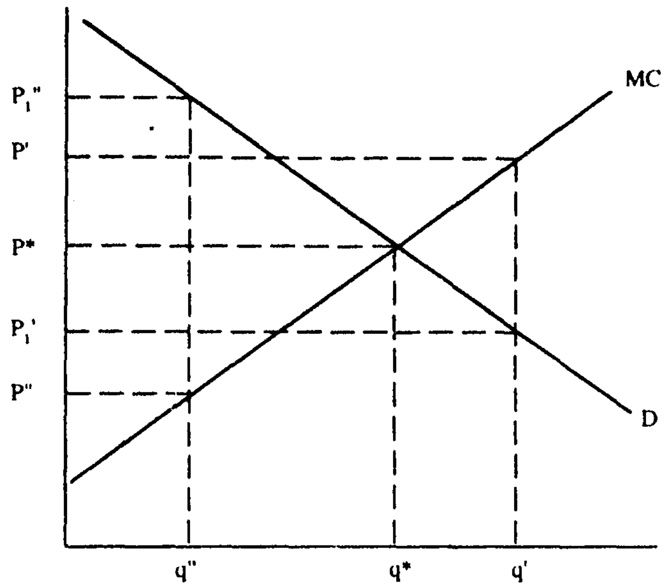



Fig. 1

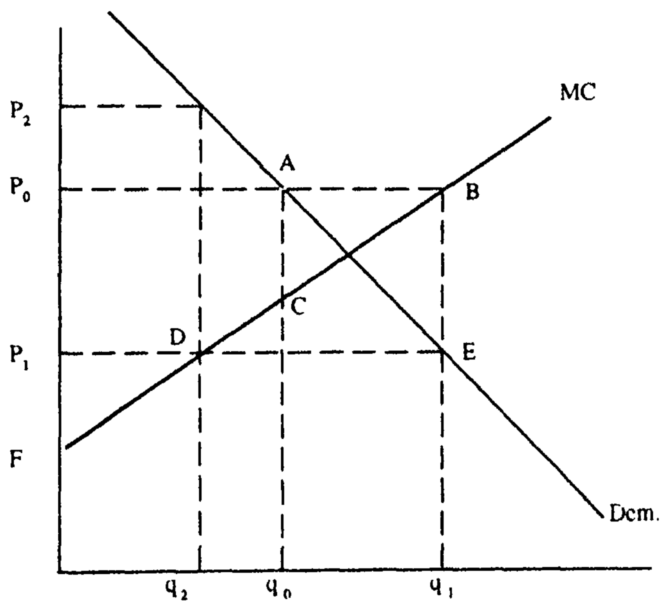



Fig 2

performance criterion (3), the enterprise is performing well each year of the cycle. One might expect that the performance index would suffer in years when output were cut severely, say, for example, from $q_1$ to $q_2$, because of the term $P_1(q_2 - q_1)$ in (3). This is more than counteracted, however, by the saving in costs $(c_1 - c_2)$. Thus the net increase in public profit, as measured by (3), would be the area BDE in Fig 2. In year 1, the increase in public profit was ABC, even though the enterprise was making losses of BDE - DFP.

### Strategic Behaviour

The discussion of the last paragraph raises the possibility of strategic behaviour on the part of the manager since $c_1$, the total costs in year 1, enter with a positive sign in the year-2 performance index, $V_2$, the manager begins to have an incentive to increase year-1 costs. Note, however, that this will not lead to X-inefficiency. If $c_1$ were simply allowed to increase without any corresponding increase in output, the manager would be worse off, since $V_1$ would be negatively affected by exactly the same nominal amount as $V_2$ would increase. For any positive discount rate, this would make the manager worse off.

Let us therefore assume that the enterprise continues to be X-efficient. There will nevertheless be introduced an allocative inefficiency as a result of the strategic behaviour. Consider Fig.3. If the enterprise produced a level of output $\pi/q$ in time period 1 instead of $q_1$, the performance index in year 1 would fall by the area ABC, the amount by which the cost of producing the additional output exceeds the gain in value of output at price $P_0$.

But $V_2$, the index for year 2, would rise by the entire shaded area. $V_2$ benefits not only by the fact that $C_1$ was higher, but also by the lower $P_1$ being used as the valuation for the fall in output. This rise in $V_2$ may be larger than ABC even when it is discounted. In this case, the manager will tend to overproduce in year 1. Note that there is never an incentive in such a situation for the manager to produce less than $q_1$ - the effect of such an action would be to reduce both $V_1$ and $V_2$.

A similar analysis applies in the case where the initial price was below the efficient level. Now the manager has an incentive to cut output more than before. In Fig. 4, the myopic manager would produce $q_1$. The strategic manager, however, has the incentive to cut output further. A cut to $\underline{q}$ would lower $V_1$ by ABC but raise $V_2$ by the shaded area. There is no incentive to produce more than $q_1$.

A formal analysis of strategic behaviour would be cumbersome, and not necessarily more insightful. The key point in the foregoing discussion is that strategic behaviour on the part of the manager will lead to outcomes that are more perverse (from society's point of view) than those that follow from myopic decision-making. If the discount rate were sufficiently high, of course, strategic behaviour would be no different. If, on the other hand, the discount rate is low, it is possible that this simple model would predict wide swings in quantity produced. This does not appear realistic, and leads to a discussion of cases where the manager is capacity constrained.

### Capacity Constraints

As a general rule, managers of PEs do not have the power to make investment decisions. Thus, they must work within the capacity constraints given to them by the central authorities. This does ameliorate the problem of perverse managerial behaviour and, in one case, eliminates it.

Consider first the case where capacity becomes constraining at an output level above the efficient level. This is represented in Figure 5 by a marginal cost curve that becomes vertical after intersecting with the demand curve. In this case,

Fig. 3

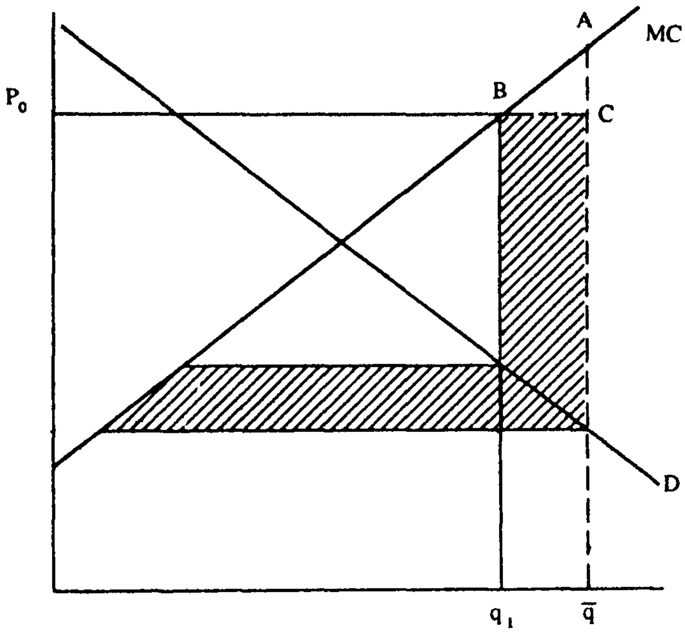
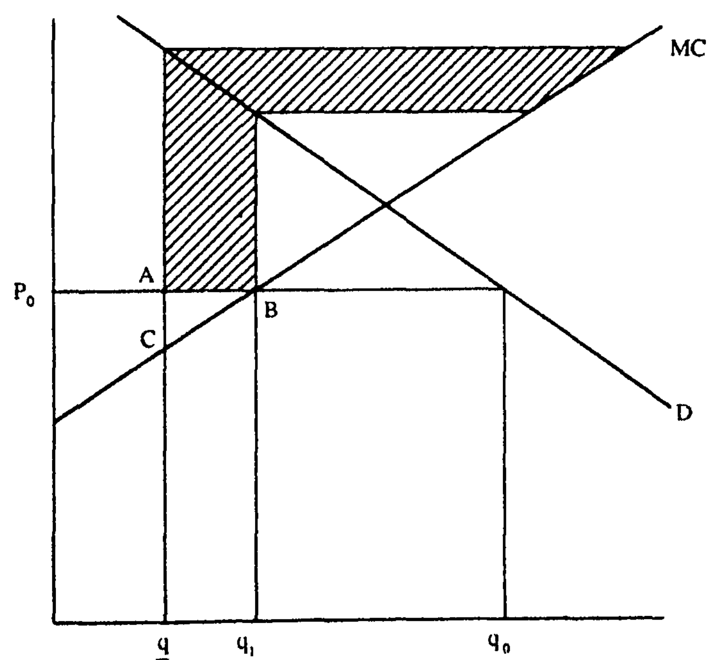



Fig. 4



the simple model with a myopic manager would lead to a repeating closed cycle between $q_1$ and $q_2$ (unless the constraint becomes ineffective, in which case we would have a convergence to the efficient point). The repeating cycle is also the likely outcome with a strategic manager, although the amplitude of the cycle will be larger. The capacity constraint will serve a damping function, however. For prices such as $p_0$ or $p_2$, the manager will be forced to produce $q_1$ even though he would like to produce more.

When capacity becomes a constraint while there is still excess demand, the Jones evaluation system will lead quickly to the allocatively efficient outcome. If the initial price $p_0$ is above the efficient rationing price, we will converge immediately the efficient output $q_1$. If for some reason we started with a price such as $p_1$, below the efficient price (although demand could not be satisfied at that price), we will converge to the efficient solution in two steps. In a way, this quick convergence to the optimum seems to create a case for having capacity constraints. This adds to Jones's argument that capacity constraints may be desirable because they would allow an enterprise facing increasing returns to scale to make a financial profit while setting prices efficiently. However, a simple modification of the performance index can solve the problem of incentives anyway.

**A suggested improvement to the performance index.**

The suggestion to improve the incentive effects of the Jones performance index is a simple one: Rather than evaluating quantities at base-year prices, use current prices instead. Thus the index given by (3) would change to

$$V_t = P_t q_t - P_t q_{t-1} - c_t + c_{t-1} \quad \ldots \qquad (5)$$

The remarkable thing about this apparently small change is that it converts the index into one proposed by Finsinger and Vogelsang (FV) (1982) as having certain ideal properties. Since this alternative index has been discussed elsewhere, I will mention only the key points.

First, the index gives full incentives for x-efficiency. In fact, a comparison of (5) and (3) shows that the cost terms enter into the two indexes in exactly the same way. Second, the FV index also creates an incentive for the manager to move the price quantity combination towards the socially efficient one. With this index, the manager has no incentive to deliberately overshoot the efficient point, nor does strategic behaviour alter the qualitative outcome. It should be emphasized that this index does not guarantee a one-step convergence to the efficient solution. The myopic manager, for example, in maximizing (5) will set

$$\delta V_t/\delta q_t = P_t + q_t \,.\, dP_t/dq_t - q_{t-1} \,.\, dP_t/dq_t - dc_t/dq_t = 0 \quad \ldots \ldots \qquad (6)$$

or

$$(P_t - MC_t) = (q_{t-1} - q_t)\, dP_t/dq_t \quad \ldots \qquad (7)$$

(7) is shown diagramatically in Figures 7a and 7b. The shaded area in each case represents the performance index. When output has been raised, prices will remain above marginal cost, and vice versa for when output has been reduced. Each of these processes converges to the efficient solution. If the manager had a zero discount rate, he would take infinitely many steps to perform this convergence, however, in order that he may capture the entire triangle ABC as incentive payments. With a positive discount rate, however, the number of steps would be finite, and the manager would sacrifice a series of small triangles such as AEF.

Turning briefly to the case of capacity constraints, consider the type of situation represented in Figure 5 where capacity is not a

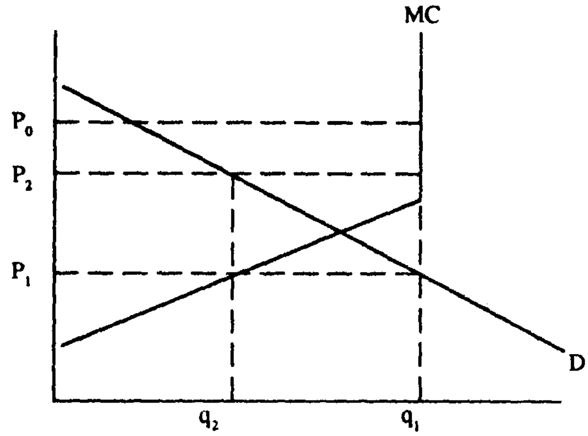
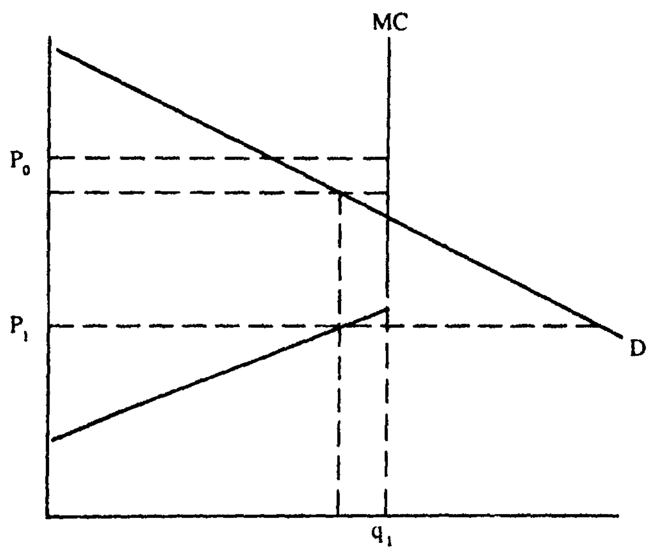



**Fig. 5**




**Fig, 6**

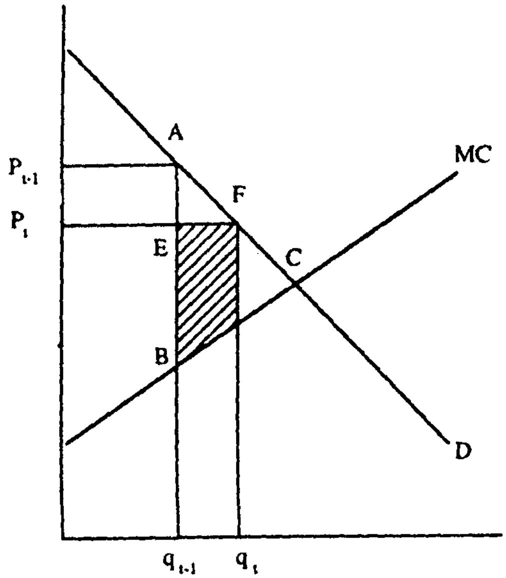



Fig. 7a

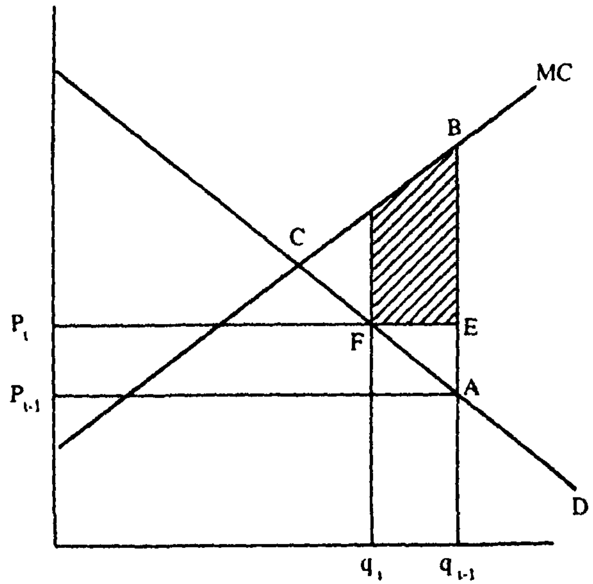



Fig. 7b

binding constraint at the efficient point. In this case, the FV index performs just as before (i.e. as in Fig. 7). There is no danger of cycling. In the case where capacity does become a binding constraint, the enterprise will converge to the efficient income in a series of steps (possibly one). This is one case where the Jones index in fact performs better than FV, since it converges in one step.

Consider next the properties of the FV index in a regime where prices are indeed exogeneously determined, the case for which the Jones index was explicitly designed. I would argue that the FV index is superior even in this case. Recall that we are implicitly using shadow prices in all these discussions. If the shadow price of a good has changed from year 0 to year 1, either because the international price has changed or because the price-control authority has detected such a change, we would like the PE manager to produce to the point where the marginal social cost is equal to the *current* shadow price. By using $P_0$ as our evaluating price for performance in year 1, we encourage the manager to delay his adjustment to the new prices. Using $P_1$ instead encourages the manager to make adjustments quickly and to be concerned more about anticipating price changes. This may be particularly important when prices are internationally determined. Adjustments may also be important when input prices are changing. As far as purely theoretical considerations about the appropriate weights for aggregation are concerned, the use of current versus base-year prices is equally abitrary. It is analagous to the use of a Paasche as opposed to a Laspeyre index.

The main advantagous of the Jones index may be thought to be that it is fairer to the manager, since it does not penalize him for sudden, unanticipated changes in prices. I would contend, however, that the appropriate point to make fairness judgements is at the review meeting at which the performance index is discussed. If a long adjustment period was truly needed, the manager ought to be able to make his case. The FV index will, however, place pressure on the manager to try to make quick adjustments and therefore to get society to its desirable solution sooner. Further, where PE managers have price-setting power or can at least influence prices, this index would encourage more appropriate pricing also.

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