Socialist Incentive Schemes and Price Planning

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I. The Hierarchical Economic Organization and its Price Setting and Incentive Problems

An economic organization is a group of individuals seeking to achieve efficiently together the production[1] of goods. So they have to maximize an objective function, even if each member has objectives of its own not coincident with those of the organization[2].

1. Hierarchy

A hierarchy is an organization, whose members are ranked along a pyramidal scheme with horizontal tiers and vertical sectors. The members belonging to a same tier and a same sector are subordinate to a head belonging to the immediately higher tier. Heads of neighbouring sectors belonging to the same tier constitute an aggregated sector lead by a head located at the second higher level and so on, until the whole network, so designed, be towered over by a unique supreme head.

Within such an organization, informations circulate only vertically, from top to bottom and reciprocally, but never horizontally. From one sector to the other, informations always have to transit through the higher level which aggregates the related sectors.

Informations circulating within an organization relate to the own characteristics of each constitutive cell (elementary members, intermediate groupings etc...), to each one's local environment and to the general environment of the whole

In a hierarchy, *decisions* are always made at a summit for the sectors and tiers which it commands and along its own preference ordering. A *centralized hierarchy* is one, where all decisions are taken at the overall summit for all the members. A decentralized hierarchy delegates decision power for some objects to various intermediate levels.

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(1) "Production" is to be considered here in its broadest meaning of transforming any inputs into usable outputs through any performing technology.

(2) This definition follows K. J. Arrow (1970)

As decisions imply information, centralization is committed to information circulation. We say that a centralized hierarchy is *closed* because it communicates with all its environment, as well local as general, only through its top. A decentralized hierarchy is open because, while the summit only communicates with the general environment, the intermediate levels communicates with their respective local environments.[3].

But if the supreme summit has the legal power to define what are "general" and "local" environments, he can reduce decentralization and opening to very little.

Soviet economic planning since 1979 has been thought and institutionalized as a closed centralized hierarchy, a "command economy" or "planification impérative" as western economists have named it. From 1965 and onwards, it has repeatedly been subject to decentralization reforms trying to conjugate hierarchy and opening. Until now these reforms have not been very successful. One of the main reasons is that they never clearly defined the way *how the various tiers* of the economic hierarchy *will establish the trade-offs* between their respective outputs on the one hand, and between these outputs and their environmental inputs on the other.

2. The price setting problem

If, as Arrow (1970) underlines, an organization aims at producing efficiently an output programm from given resource, it has, indeed, to maximize some objective function subject to productive and scarcity constraints. If the organization top or center was omniscient he could do it himself entirely through well known Lagrangean type optimizing methods. And through duality, would appear both an optimal quantities programme and an optimal shadow prices vector, the latter being the Lagrangean multipliers of the constraints. Transmitting these shadow-prices as *"transfer prices"* to the basic or intermediate levels in charge of producing outputs, the Center would so give them the possibility to determine themselves their own optimal output corresponding to the overall optimum, if well known technological conditions (convexities) are satisfied.

3. The incentive issue

But assuming this perfect information and ability of the Center, makes the whole problem disappear. If the Center can figure out all the details of the optimal physical output of the whole organization, why decentralize the programming work and use transfer prices? And if the Center has not

(3) Organizations, hierarchies and centralization have been recently defined more formally by Th. Marschak (1986). We think that our more literary definitions do not contradict his owns.

this knowledge and ability how to calculate transfer prices?

In recent years, socialist countries and western economists have concentrated their analysis upon internal organization problems, i.e. upon the link between top and basis of the hierarchical planning organization emphasizing the role of economic incentives. They are perfectly right, but we think that this is not the end of the story. How will be set the "transfer prices" that both the Center and the periphery will use for their respective calculations? How this price setting procedure will be consistent with the incentive decentralize output decision making procedure? That is the question we want to address in the following sections.

II. Incentive Compatible Mechanisms inside a Hierarchical Organization

The incentive problem arises within an organization as soon as information is asymmetrically distributed among constitutive members of the organization. Moreover as transmitting information is costly, information becomes a private good, even in socialist organization, that no member, endowed with such a wealth, will give up without receiving valuable compensation. If he does not succeed to receive it, he will cheat in order to increase his own utility. Even if incitative devices (bonus-malus systems etc...) are devised, uncertainty and unobservability of the inferior members' effort by higher hierarchical levels, make adverse selection and moral hazard situations arise and reinforce the cheating motives and strategic manipulation opportunities.

Both western and eastern[4] economic literature about incentive mechanisms within planning systems have concentrated upon the problem of avoiding strategic manipulability, neglecting somehow the pricing problem. Among this rich literature we will select only two groups of examples. The first one doesn't explicit the price variables, while the second does but in a partial equilibrium framework.

1. Non price incentive mechanisms

The first example developed by Holmstrom (1982) deals with *the functioning of a planning organization as a non-cooperative game inside the organization*, with the possibility for the peripherical members to substitute output objectives of their own to those proposed by the Center, who so "*delegates*" his decision power. But members' rewards will be function of the gaps between achieved output (x) and both centrally proposed aim

(4) By "eastern" we mean, here, "socialist Eastern Europe countries".

($\bar{t}$) and locally one ($\hat{t}$).

The traditional soviet bonus formula was:

$$(1.1.) \quad S_0(x) = \hat{B} + (\beta - \alpha)(x - \bar{t}), \text{ when } x > \bar{t}$$

$$(1.2.) \quad = \hat{B} + (\gamma - \alpha)(x - \bar{t}), \text{ when } x < \bar{t}$$

where $\hat{B}$ is the fixed remuneration of the firm's manager, and $0 < \alpha < \beta < \gamma$.

The new bonus formula, introduced by 1972 Soviet proposals, was:

$$(2.1.) \quad S_1(x) = \hat{B} + \beta(x - \bar{t}) - \alpha(x - \hat{t}), \text{ when } x > \bar{t}$$

$$(2.2.) \quad = \hat{B} + \beta(x - \bar{t}) - \gamma(x - \hat{t}), \text{ when } x < \bar{t}$$

It is easy to check that $S_1(x)$ dominates $S_0(x)$ in the sense that it induces the management to propose bigger objectives than the Central ones did i.e. $\hat{t} > \bar{t}$. In any case, indeed, that is whatever be the firms' achievement x, $S_1(x) > S_0(x)$ when $\hat{t} > \bar{t}$ and $S_1(x) < S_0(x)$ when $\hat{t} < \bar{t}$. The new bonus formula seems therefore more advantageous both for the members (the firms) and the whole organization, if we admit that its welfare is a growing monotonic function of the output targets $\bar{t}$[5].

Holmstrom goes on and demonstrates that, not only the possibility for firm mangers of setting targets of their own is better than the old bonus formula considering the gap between achievement and centrally set targets, but also that a target revision procedure dominates (in the Pareto sense) a fixed target scheme and finally he shows that, under some specific assumptions, "a linear revision scheme in which the targets only may increase, can be dominated by a delegation scheme with this same restriction".

A delegation scheme is one in which the Center refrains from setting targets and leaves the firm to do it, but builds a reward mechansim whose parameters are set so that society desires increases in the target whenever the firm does.

Apparently prices do not enter into such mechanims. In fact they do, as soon as there are more than one output so that x, $\bar{t}$ and $\hat{t}$ are vectors whose components have to be valued in order to calculate the bouns S(x). They do enter also, even for monoproduction firms, as soon as technology allows some variable combinatins of inputs and has to satisfy the efficiency rule of equating MTR and related prices.

At the very end of his paper, Holmstrom mentions the "coordina-

(5) Exposals and demonstrations of these formulas may be found in Weitzman (1976), loeb and Magat (1978), Holmstrom (1982) and Kotulan (1985).

tion" problem which he does not study. If this means harmonizing the various delegate output decisions in a general equilibrium framework, the price setting problem has just been delayed.

2. Non price incentive strategy proof mechanisms

Another group of non-price incentive mechanisms studies goes further by considering situations where uncertainly leads to *"adverse selections"* and (or) *"moral hazards" behaviours.*

Loeb and Magat (1978), L. M. in the following, starting from Weitzman formulation of soviet bonus systems, showed that if the Central Planner keeps the right to allocate to firms some general physical resource (such as basic equipments or key raw materials) and makes this allocation based upon firms proposals, then even the "new" bonus formula, such as Holmstrom's one, giving to firms the possibility to substitute their own targets to the Central Planner's ones, will not be strategy proof.

The only way to avoid this strategic manipulation risk is to introduce into the bonus formula, a *"pivotal mechanism"* of the Clarke-Groves family.

For instance, if the output of every firm i is linked to some capital input K_i which is centrally allocated to it, the bonus formula (2) must know be written:

$$(3.1)\quad S_i(x_i, \hat{t}_i) = x_i(K_i) + \sum_{j \neq i} \hat{t}_j(K_j) - A_i(\hat{t}_{-i})$$

with the notation $-i$ for the whole set of enterprises $j \neq i$.

In equation (3.1.) the success or bonus indicator for the firm i, has three components:

— the achievements of the firm (output or profit) from the allocation of central resource K_i i.e. $x_i(K_i)$;

— the total of targets proposed by all the other firms from their own allocations of central resources $\sum_{j \neq i} \hat{t}_j(K_j)$

— minus an amount, function of the proposals of all the other enterprises but independent of the proposal made by i, i.e., $A_i(\hat{t}_{-i})$.

So defined the "pivotal bonus" measures the loss which the whole eonomy would incur if enterprise i could not work because no central resource would have been allowed to it ($K_i=0$). It is the social opportunity cost of firm i.

It has been demonstrated (L. M. 1978 and Conn 1979) that such a pivotal bonus mechanism is strategy proof since its warrants to any firm a lower reward if it cheats than if it tells the truth.

More recently, D. Conn (1982) has gone still deeper into the complex

issue of principal agent relations inside the hierarchical planning system. As may be frequently observed, the firm's achievements are function not only of resources rotations and technology but also of hidden parameters such as *managers' effort*. In that case, even the Groves pivotal incentive mechanism as devised by Loeb and Magat is no longer strategy proof. For recovering this property is most be extended to effort disutility.

Assuming that each manager i maximizes a separable and additive utility function.

$$(3.2.) \qquad U_i = S_i - V_i(e_i)$$

where S_i is his bonus and $V_i(e_i)$ his disutility function of effort, while the Center will allocates scarce resource K along;

$$(3.3.) \qquad \text{Max } W\ (K, e) = \sum_i x_i(K_i, e_i) - \sum_i V_i(e_i)$$

$$\text{s.c. } \sum_i K_i < \bar{K}$$

Conn shows that the corresponding pivotal bonus formula must write

$$(3.4.) \qquad S_i(x_i, y_0) = x_i[K_i(y_0);\ e_i] + \sum_{j \neq i} \hat{t}_j[K_j(y_0);\ e_j(y_0)] - \sum_{j \neq i} m_j[e_j(y_0)]$$

where $y = [\hat{t}_1 \ldots t_n;\ m_1 \ldots m_n]$ is the vector of both targets ($\hat{t}_j$) and of effort disutilities (m_j) as declared by the firms and, so, known by the Center. With these declared values the Center will solve model (3.3.) i.e. allocate the resource K among the firms. This allocation, together with the effort disutilities, and the term A_i (which must be independent of $\hat{t}_i$ and m_i but may depend on $\hat{t}_j$ and m_j for $j \neq i$), does appear in the bonus formula.

Quite clearly, formula (3.4.) is a clearer extension of formula (3.1.) to the manger's effort disutility. As the previous one, it is a Clarke-Groves pivotal mechanism and, as all the decision mechanisms belonging to this class, it is both "strongly, individually, incentive compatible" (siic) and "satisfying", i.e. is strategy proof and Pareto optimal.

Again, as for Weitzman and Holmstrom mechanisms, Loeb-Magat and Conn mechanisms implicitely assume that the price system, which has to ponder the various outputs and inputs of the firm.[6] are determined elsewhere in a consistent manner, either through a market system, a centrally planned pricing system or a regulated market one. But they don't say anything about it. They work in a partial equilibrium setting, while planning needs to achieve a general equilibrium.

(6) In a recent survey of Planning theory R. G. Heal notices that Loeb-Magat must assume monoproduction and one input only in order to avoid the aggregation problem without market prices (Heal, 1986: 1505).

3. Price incentive mechanisms

At the other extreme of the organizational spectrum, the centrally set targets disappear and firm managers are allowed, not only to choose freely their production vectors (outputs and inputs) but also to set prices. They are supposed to do so through maximizing their rewards. The Center now has just to design a rewards scheme so as to induce price-setting managers to produce at the socially optimal output level.

Ms. Mo Yin Tam (1981) proposed a "negative price incentive structure" (NPIS) which, with the previous notations, may be written in the following way; where S is the bonus, π the profit of the firm; q the output and p the price.

$$(4.1.) \qquad S(p) = \hat{B} + \alpha\,\pi(p) - \beta p = \hat{B} + \alpha\,[pq(p) - C(q(p))] - \beta p$$

So the manger is given a reward which is directly proportional to the firm's profit and inversely proportional to the price he will set; maximizing this reward through differenciating S for p pleads to:

$$(4.2.) \qquad q + (p - C')\,q' = \frac{\beta}{\alpha}$$

with $C' \equiv \frac{dc}{dq}$ = marginal cost, and $q' \equiv \frac{dq}{dp} < 0$ = price sensitivity of output demand. Aiming at social welfare optimum, the planner wants $p = C'$ which leads (4.2.) to

$$(4.3.) \qquad q^* = \frac{\beta^*}{\alpha^*}$$

Unfortuantely the planner dosen't know the cost function of the firm C(q) so that he cannot maximize (4.1.) nor solve (4.3.).

He then engages an iterative process, modifying α and β, from one step t to the next t + 1, by applying the simple rule:

$$(4.4.) \qquad \frac{\beta_{t+1}}{\alpha_{t+1}} = q_t$$

from an initial step t=0, where he observes the quantity fixed by the manager, to a terminal step T where $q_T = q^*$.

Tam demonstrates that such a dynamic procss monotonically converges towards the optimum q^* where the condition $p = C'$ is satisfied.

As it is easy to check, NPIS happens to be equal to the producer marginal surplus minus its total cost in the previous period

$$(4.5.) \qquad S_t(p) = \Delta\, PS_{t-1} - C_{t-1}$$

where $\Delta\, PS_{t-1}$ is the variation of producer surplus for price variation $p_t - p_{t-1}$.

In a subsequent discussion (QJE, Feb, 1985), Finsinger and Vogelsang (F. V. in the following) as well as Gravelle showed that such a mechanism was efficient only for a myopic behaviour of the manager. If the latter maximizes the discounted flow of his future rewards, the mechanism must be modified for taking account of the *variations* of profit and prices. The bonus formula proposed by F. V. is, for every future period t:

$$(4.6.) \qquad I_t = \hat{B} + (\pi_t - \pi_{t-1}) + q_{t-1}) + q_{t-1}(p_{t-1} - p_t)$$

$$I_t = S_t + C(q_{t-1})$$

which, combined with (4.5.), gives:

$$(4.7.) \qquad I_t = \triangle PS_{t-1}$$

This incentive is just equal to the producer surplus variation. The non-myopic manager will maximize

$$(4.8.) \qquad \underset{p}{\text{Max}} \ I = \sum_{t=0}^{\infty}(1 + i)^{-t} I_t(p_t, p_{t-1})$$

Neglecting the income effects upon consumer demand and surplus, F. V. demonstrate that such a formula leads the manager to revise the price P_t from period to period until it equals marginal cost.

They also show that this process is monotonous. Moreover, it cannot be strategically manipulated as was NPIS, for it is never more advantageous for the manager to set prices in another way.

Both Tam and Finsinger-Vogelsang bonus formulas are very attractive, since they do include explicit reference to prices, and are informationaly quite simple since the second, is not strategically manipulable. The Central Planner does not need to know the firm cost or production function; he has just to monitor its production q from period to period and to adjust consequently the parameters ratio: β_{t+1}/α_{t+1}.

Unfortunately for a Central Planner who is logically in charge of the whole economy and of the whole price system, this is not sufficient.

Let us notice first that, meanwhile the Weitzman-Holmstrom formulas were static-game rules allowing to reach the solution in one step, we face here *a dynamical iterative procedure* that may last a long while. Fortunately, as it is monotonous, it way however be interrupted, if necessary, before getting the optimal solution; it is "well defined" in the Malinvaud sense. But, contrary to classical decentralized planning procedures, such as Lah, Heal or Malinvaud, *this dynamics is not "ex-ante", it is not a "tâtonnement"* procedure where no production, exchange and effectve pricing are made before the terminal equilibrium, i.e. the optimum, has been reached. It is an "expost" dynamic procedure, since,

before modifying the bonus parameters α, β, the Central Planner must have observed the effective produced quantity q_{t-1}. It is a "non-tâtonnement" process leading to "fixed prices equilibria" or to "equilibria with rationaning" and these temporary equilibria are not Pareto efficient, as we know from the theoretical work of Benassy (1976), Dreze (1975), Grandmont (1977) and others.

A second remark is that the firm considered by Tam and F. V. is either a monopoly or at least a monopolistic competitor.

The bonus formula is designed for preventing its manager to behave as a monopolist, reducing the output and charging the price but for inducing him to price at marginal cost. But *with a natural monopoly* this policy would lead to optimal deficits and lump-sum transfers, which is unfeasible. At the same time, it would be prone to strategic manipulations.

This defect may be suppressed by imposing to the natural monopoly firm a *budgetary constraint* which appears in the bonus formula, through a high penalty on losses. Then the mechanisms will converge towards a second best optimum and prices will be of the Ramsey-Boiteux type.

But, once more, as F. V. underlined it in their 1981 article "all (these) incentive mechanisms are discussed in a *partial equilibrium framework*" (p. 390). This is an important point which we will discuss now.

III. Hierarchical Economic Organization and Price Planning. Necessity and Drawbacks

1. Theoretical possibility of production price uselessness

Let us assume a perfectly centralized closed hierarchy ruling all the production sectors of a national economy without foreign trade. The Central planner knows all the technologies and is able to command labour spending and effort at work everywhere inside the production sector.

Let also the production technology be represented by a fixed coefficients model of static Ieontieff type both for intermediary and for labour inputs:

(5.1.) $(I - A)\, X = \bar{K} + \bar{C}$

(5.2.) $NX = \hat{L}$

where X is the vector of output

$\bar{K}$ and $\bar{C}$ the respective exogeneous investment and planned final consumption vectors;

$\hat{L}$ the (endogenous) vector of planned labour input of various skills;

$I - A$ the Leontieff static matrix;

N the labour coefficients matrix.

As I − A is "productive" it can be inversed so that the Center can immediately calculate his physical production plan:

$$(5.3.) \qquad X = (I - A)^{-1} (\bar{K} + \bar{C})$$

But this physical equations system has to be connected with two external variables that the Center does not command: the final (private) consumption demand (C) and the labour supply.

Both appear, on markets, outside the hierarchical organization. These markets are very imperfect, in fact quite monopolistic for the consumption goods and quite monopolistic for labour, but they exist.

For easing calculations, we shall represent the private consumption demand system by a vectorial linear function:

$$(5.4.) \qquad C = Ry + S\pi$$

where C is the physical consumption demand vector;

y the private income distributed by the production system (it is a scalar);

π the consumption price vector;

R the vector of income demand sensitivity coefficients;

S the (square) matrix of price demand sensitivity coefficients.

We know that, if individual utility functions have the usual properties, matrix S is non-singular and, so, can be inversed.

As private income is entirely distributed by the production sectors to their workers (and salaried managers) with wage rates (by skill) represented by the row vector W′ we have:

$$(5.5.) \qquad y = W'NX$$

The market equilibrium for private consumption goods, which implies $C = \bar{C}$, will then be achieved for the consumption price vector π such that:

$$(5.6.) \qquad \pi = S^{-1}[\bar{C} - RW'N(I - A)^{-1}(\bar{K} + \bar{C})]$$

So the Central Planner, if he knows both the production equations system (5.1.), (5.2.) and the consumption demand functions system (5.4.), can calculate the equilibrium prices, which adjust private demand to the discretionary planned consumption supply. Notice that nothing here warrants the positivity of each component of π. It may happen that the planned consumption supply of some goods has to be heavily subsidized to be demanded so that their markets be cleared.

Let us notice also that in equation (5.6.) the consumption price vector π is determined only by physical variables and coefficient except for the

wage rate vector W′. But this price variable will soon disappear.

The other "external" final market relates to labour supply (L). Again we represent it through a linear vectorial system.

(5.7.) $L = -Hy + TW$

where $-H$ is the vector of income sensitivity coefficients of labour supply
T the (square) matrix of wage sensitivity of labour supply (here made of non negative fixed coefficients).

As demand for labour is given by eq. (2.2.) the labour market equilibrium results from:

(5.8.) $NX = -Hy + TW$

which gives finally for the equilibrium wage rate vector:

(5.9.) $$W' = [(\bar{K}' + \bar{C}')(I - A')^{-1} N'T'^{-1}] \\ [I - N(I - A)^{-1}(\bar{K} + \bar{C})H'T'^{-1}]$$

where, as usual, the prime indicates transposed vectors or matrices.

Substituting this expression for W′ into eq. (5.6.) we get the value of π exclusively function of physical terms. As the vectorial equation is rather heavy, though simple, we don't write it here.

So the equilibrium consumption prices and wage-rates depend only on physical coefficients and variables. They are the equilibrium values consistent both with the planning targets ($\bar{K}$ and $\bar{C}$) and with the households market demand of consumption goods and supply of labour.

No internal price system for outputs and intermediary inputs has been needed. In that sense, J. Stalin (1952: 23) and other classical marxist stalinist followers were right when they asserted that, within a centrally planned economy, prices were necessary only at the edges of the system, where markets survived, and had nothing to do inside.

But for implementing such an equilibrium, the Central Planner must know, not only the production sector technical characteristics (matrices A and N), but also all the parameters of the households' demand-supply system, (matrices R, S, H and T) which, of course, is out of his reach.

2. The necessity of production prices

Let us assume now, that the planner knows only (but perfectly) the internal production sector coefficients (A and N) and, through trials and errors, can discover approximate equilibrium values for consumption prices $\tilde{\tilde{\pi}}$ and for wage rates $\tilde{\tilde{W}}$, such ad $C = \bar{C}$ and $L = \hat{L}$. He then wishes to check that these values do not jeopardize his planned production physical equilibrium. For achieving this aim, he then has to introduce

production prices whose vector P must satisfy the double equation system:

(5.10.) $P' = (\tilde{\tilde{W}}'N + V')(I - A)^{-1} = \tilde{\tilde{\pi}}' - \theta$

where: V' is the row vector of profit rates, subject to $V'X = P'\dot{K}$ global value of forecasted investments.

θ' the row vector ($\lesseqgtr 0$) of indirect taxes or subsidies.

The first part of vectorial equation (2.9.) is clearly the transposed version in price terms of physical vectorial system made of (2.1.) and (2.2.). The second part connects production prices P and consumption prices π through the buffer tax-subsidy variables θ.

In (5.10.) both P' and θ' are unknown variables. If θ' is given exogeneous a priori values, it is clear that (2.9.) then determines V', vector of profit rates always subject to the investment financing condition. Otherwise V' has to be set exogeneously, with this same condition.

3. The soviet pricing method and its drawbacks

Instead of using (5.10.) we might have referred to the official soviet pricing system introduced in 1967 and known as the *"two channels" pricing method.* It combines the two marxian pricing formulas, this of "labour value" raising the direct labour cost with a "surplus value rate", m, and that of "production price" raising the total cost with a "profit rate" r.

With such a "two channels" formula, the scalar expression of any price p_j is:

(5.11.) $P_j = \sum_i P_i a_{ij} + (1 + m) \sum_q \tilde{\tilde{w}}_q n_{qj} \; r \; \Sigma_i p_i b_{ij}$

where we meet again the previous variables and coefficients, plus b_{ij} which is the capital coefficient of good j in terms of investment good i. Translated into vectorial expression, eq. (5.11.) becomes:

(5.12.) $P' = (1 + m) \tilde{\tilde{W}}'N(I - A - rB)^{-1}$

Equation (5.12.) is equivalent to the first part of equation (5.10.) provided that

(5.13.) $m \; W'N + rP'B = v'$

But nothing changes as for the link with consumption prices π, through the taxation vector θ.

Anyhow we see that:

1) Theoretically, with full knowledge and control of the productive sectors and full knowledge (but not control) of the external markets for labour and consumption goods the Central Planner can equilibrate the

whole system by calculating equilibrium prices for these two markets and dispensing of setting internal production prices.

2) If he does not know enough about supply and demand functions on the external markets, he is compelled to set internal production prices, expressing the cost structure of his overall physical production plan.

3) For setting these prices he needs a huge amount of detailed technological and accounting valuable information, that he can't neither collect nor treat and revise in due time.

And last, but not least, such a pricing system based upon fixed technical coefficients in the production sector, *cannot provide optimal prices,* unless the fixed coefficients be those defining the most economically efficient technology in each sector, a very unrealistic assumption. So these prices cannot help the firms to be efficient.

In fact, even if we confine ourselves to the equilibrium problem (be it efficient or not) and if we consider only the above second, and more realistic, hypothesis about the planner's limited knowledge of the terminal markets, we see that he cannot equilibrate them only by modulating indirect taxes and subsidies, in order to connect their market prices to the planned production ones.

As it is well known and documented and as it has been recently remarkably analysed by J. Kornai (1984), such pricing has to be heavily supplemented by various forms of *rationing.* Queuing, waiting lists, special stores, are typical on the consumption side. On the labour side, former "labour domestic passports" fortunately seem have disappeared but more subtle forms of occupational assignments still subsist. Disequilibrium rather than equilibrium, seems anyway, to be the general rule and the official price system does not seem to be efficient as an equilibrium device.

IV. Joint Determination of Optimal Quantities and Prices through Theoretical Decentralized Procedures

Could another system of planned price setting play an equilibrating and optimizing function?

1. The decentralized dynamic procedures

Apart transfer prices calculated as shadow prices of an optimization megamodel for the whole economy, which still seems unfeasible, we are left with the so-called dynamic decentralized planning procedures. No need to present them nor their properties[7]. Let us just recall that most of

(7) For an accurate presentation and analysis, see in English language:

them belong to *gradient type procedure,* where the planner has just, at each successive step, to adjust either prices to the gap between aggregate supplies and demands proposed by the firms, or quantities to the gap between firms' own MTRs which they send to the Center and the corresponding average MTR centrally computed. The first type methods are *"price procedures"* and were initially devised by Lange, Taylor, Lerner, refined later by Arrow and Hurwicz and now known as Lah procedures. The second type methods are *"quantity procedures"* such as Heal (1973) and Malinvaud-Dreze, De La Vallee Poussin (1971) known as MDP.

Decomposition programming procedures give to the Central Planner a more important role by letting him approximate the firms production sets in the neighbourhood of their optimal program, from their successive proposals. Again we meet "price procedures" (Malinvaud, 1967) and "quantity procedures" (Kornai-Liptak, 1965); Weitzman (1970).

As is well known, all these procedures *determine iteratively both an optimal allocation of physical goods,* i.e. an optimal production program for each firm, *and an optimal price vector.* There is no ranking neither split between these two operations; they are intimately connected through the various iterative steps. Only the task of adjusting either prices or quantities is devoted to the Central Planner, while the one of making related proposals either for quantities or for prices is left to the firms. And, as it is a *"tâtonnement"* procedure, nothing is implemented before the whole chain of calculations has been worked out. Optimal quantities and prices are *mutual dual variables.* Consequently the Center cannot limit itself to price calculations, ignoring the quantity proposals issued by the firms, neither these ones can limit themselves to quantity programing, ignoring prices adjustments resulting from the central balancing of their proposals.

2. Their drawbacks

Although theoretically satisfying because they lead to general equlibrium and Pareto optimum, the decentralized planning procedures have several drawbacks, which prevent their practical use[8].

First of all, *none existing theoretical procedure is universal* in the sense

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Heal (1973) and in French language Picard (1979).

(8) These drawbacks don't seem to have played a major role in the soviet planners' refusal even to try them. Ideological reasons (Marxian theory of value against marginalist one) and politico-sociological factors (weight of partitocracy and bureaucracy) have certainly be more powerful.

that they deal with informational exchanges either between the Central Planner and the firms (all of them except MDP) or between the Central Planner and the households (MDP). Their inner logic should make them encompass both exchanges. And, as only Heal and MDP can successfully deal with increasing returns, they would be the best candidates. But this extension of the iterative procedure to the households would be cumbersome and costly and might be feasible only in the age of generalized home computerization.

The second drawback of decentralized planning procedures, even limited to the firms, is *their heavy information and calculation cost.* For instance, with H firms and n products and factors, the number of messages circulating (both ways) between the Center and the firms would at each step amount to $n(H + 1) - 1$ in LAH and to $(2n - 1)H$ in Heal. As for the Center's calculations they would, at each step again, amount to $n - 1$ in LAH and to $(n - 1)(H + 1) + nH$ in Heal. One way of reducing these costs is to shorten the procedures when the progression towards the social optimum is considered as satisfactory enough. But, for doing so, the planner must be sure that, in Malinvaud's words, the procedure is "well defined", i.e. feasible in every step and monotonously increasing in social utility. As we know, this is warranted only for "gradient quantity type procedure" (Heal and MDP) and for "decomposition price procedure" (Malinvaud).

The third defect is *their strategic manipulability* as soon as we assume that firm mangers don't behave "competitively" or, as it would be better to say in a socialist planning framework, "faithfully". Here we meet again the incentive problem.

Recently systematic studies (mainly by French economists[9] have been devoted to the strategical properties of two gradient procedures: a quantity one (MDP) and a price one (LAH). Limiting to three possible strategies (in terms of theory of games); dominant strategies, Cournot -Nash strategies and maxi-min strategies, played by the firms, we can summarize the results arrived at by J. J. Laffont (1984).

1) With maximin strategies, MDP procedure is strategy proof globally as well as locally.

2) With Cournot-Nash myopic strategies, MDP may be manipulated, but the manipulation effect will be limited. It will affect more the planner's distributive objectives than the paretian efficiency of the plan. If Cournot -Nash strategies are global (i.e. extend to the whole iterative sequence) the terminal equilibrium will be competitive, therefore pareto-optimal,

(9) Let us quote the works of Champsaur, Laroque, Laffont, Rochet.

but without any planned redistribution. The planner's distributive role is then entirely swept out.

3) With dominant myopic strategies, MDP manipulation possibilities appear as soon as the firms are more than two and in any case with global dominant strategies.

4) As for LAH procedure, Laffont and Rochet (1984) have shown for a two goods economy that it could be made locally incitative within dominant strategies, if the Center sends to the firms "non linear prices" instead of mere provisional prices, all along the iterative process.

So in both respects, information and calculation cost and strategy-proofness, the decentralized planning procedures are more attractive from a theoretical view point than from a practical one.

3. Pivotal incentive mechanisms and general equilibrium

May incentive mechanisms, that we discussed formerly, lead to a general equilibrium (and to Pareto optimal) price vector?

If prices which they use (implicitely as in Holmstrom, Loeb-Magat and Conn or explicitely as in Tam, Finsinger-Vogelsang and Kotulan) are given exogenously to them and are arbitrarily determined, no hope.

But if firms do negociate among themselves through a generalized market system, prices will become equilibrium prices.

This is clear in the Tam, and F. V. mechanisms, as firms' marginal costs do converge towards their respective prices. This may be obtained through market, if oligopolistic coalitions are excluded and the incentive bonus rule is enforced. The only difficulty is that the economy will confront temporary disequeilibria on the way to equilibrium.

As for the Groves pivotal mechanisms advocated by Loeb-Magat and Conn we have to distinguish between their Pareto optimal result and their general market equilibrium achievment. The first quality is always achieved: a Clarke-Groves pivotal mechanism always leads to a Pareto optimum and it does it through only one exchange of messages between the Center and the agents (in this sense it is a static procedure and it is cheaper than a dynamic one). As for its possible decentralization through a general equilibrium system, a difficulty arises since it generates a global non-zero surplus which cannot be redistributed without inducing agents to anticipate it and, so, to manipulate. This global surplus can be considered as the social opportunity cost of the strategy proof mechanism. So the whole economic system is not equilibrated, since, the Central Planner or the Government's budget which receives the pivotal tax has an excess surplus. Meanwhile Green and Laffont (1979) consider that this difficulty can be overcome in two ways.

The first consists to show that in economies with a large number of agents the pivotal mechanism incurs a relatively small aggregate surplus so that, once redistributed to the agents, the latter will neglect this additional transfer when devising their optimal answer to the Center. So a general approximate equilibrium will be reached.

Going further, the authors demonstrate that, even if the agents take into account the redistribution of the aggregate pivotal surplus, "their optimal strategies will be approximately truthful in large economies and that the decision taken as a result almost always coincides with the true optimal decision" (Green and Laffont, 1979: chap. 9).

So we may conclude that if it was practically possible to use Groves pivotal mechanism everywhere it would be necessary with adverse selection and moral hazard arising from hidden information or action(free rider possibilities etc...) this mechanism, which has been proved to be strategy proof and Pareto optimal, would not seriously disturb general equilibrium.

4. Increasing return pricing

Before we leave the price planning procedure, we must consider the theoretical and paractical important point of *increasing returns and natural monopoly.* Socialist planning cannot let socialist firms behave as capitalist monopolies, but as a first best policy with pricing at marginal cost would entail losses for natural monopoly firms and would stimulate strategic behaviour, a *Ramsey-Boiteux (RB) price rule,* with budgetary constraint, seems to fit better, though leading to second best optimum. More or less complicated, according as the concerned firm environment is competitive or monopolistic, as the priced goods are independent or have substitutes or complementary goods etc,[10] the RB pricing formulas have to be combined with incentive mechanisms, for instance of the F. V. type, in order to ease their implementation by making them strategy proof.

It is to be noted that if socialism precludes private ownership of productive capital assets, it cannot utilize competitive entry into markets to regulate them. So the case of BAUMOL's "contestable competition"[11] which theoretically could dispense with regulating natural monopolies, cannot be considered here. For the same reason, if socialist competition is not allowed to hire and pay the best managers and to lead badly managed firms to bankrupcy, it will not act as an operational selection device of

(10) On this topic see: R. Guesnerie (1980), D. Bos (1986).

(11) Baumol (1982).

efficient and devoted managers. In such an organization the incentive and antimanipulating mechanisms keep all their utility.

V. For a Cooperation between an Old Lady and a Young Boy

1. Why simulate and not practice competitive market pricing?

At the end of this overview of the planned price issue, we cannot forget that all the decentralized gradient palnning procedures finally amount to simulate perfect market functionning. On the other hand, incentive compatible mechanisms aim at eliminating strategical behaviours which preclude market functioning to lead either to first best Pareto optimum or to second best ones when natural monopoly situations or other non convexities cannot be dealt with by first best pricing rules.

So everything does push competitive general equilibrium into the foregournd. Under these conditions it looks strange to postulate that market mechnisms must necessarily be excluded from the inner planning organization, i.e. from the economic interrelations among socialist firms.

A more logical and economically more efficient way of dealing with this organization issue, would probably be to set it in terms of benefit-cost analysis. We don't claim to do this here but wish only to propose some tentative thoughts inspired by our survey.

2. Some tentative proposals

1) Incentive compatible mechanisms are quite necessary in order to stimulate socialist firms managers to be efficient. The best mechanisms are those which "delegate" to the managers the task of determining the firm production program and reward them with bonus formulas fitted to this delegation process.

2) Every time the firm may behave strategically, the incentive system must include a pivotal mechanism.

3) Every time natural monopoly situation is to occur, second best pricing rules with incentive compatible reward systems are to be devised for the related firms.

4) Consumption goods prices and labour wages would have to balance their respective markets and to enter into the production prices computation.

5) Fixed equipment and land use will have to be compensated through rental payments, as well as financial loans through interest rate. As socialist state is considered as the owner of production means it must receive these rental payments.

6) All production prices should be computed through first (or eventually second) best optimizing devices either centralized or decentralized. As centralized optimal pricing devices cannot be run independantly of iterations dealing both with quantities and prices, which is costly and prone to strategic behaviours, it seems better to use such methods only for some key products such as: energy, transportation, credit and foreign exchange and for some "merit goods". All other current products would be priced by the firms themselves, trading on actual socialist markets, always with incentive compatible reward mechanisms.

7) When competition between socialist firms would appear too weak, splitting enterprises into smaller units would be necessary, every time actual increasing returns would not be present. Another incentive for more competition is foreign trade widening, as European Common market experience has proved.

8) A corollary of this reform would be the discontinuance of administrative material allocating and rationing institutions such as Gosnab in Soviet Union.

9) As soon as physical and price central planning leaves the stage, the taxation problem comes in. The government budget will continue to be supplied by direct levies upon firms' planned profits and by indirect buffer taxes between production and consumption prices. But in a would-be optimal planning system, the tax rates and basis cannot be arbitrary any longer. In order to achieve economic efficiency, and if we leave aside the distributive problem[12], they should be structureprice neutral. In this respect, a uniform value added tax (VAT) seems to be the best practical instrument, while excise taxes and subsidies should be limited to a minimum.

10) In fact historical experiments of planning decentralization in socialist countries, such as those experienced in Yugoslavia and more recently in Hungary and possibly in China, have more or less follow this scheme. No theoretical decentralized procedure has been applied, just various kinds of actual market have been run.

3. The remaining role of central planning

If such a reform, which some people might call a "revolution" and others a "restoration", would be developed with the necessary gradual implementation steps, what would be left to central planning?

(12) As already said, we don't disregard the importance of distributional problems for socialist economies nor the big theoretical (and applied) literature on the subject. We just chose to limit this paper to efficiency issues.

In our personal view, rather little in the field of current (short term) ex act detailed planning and still less in current implementation or bureaucratic control tasks. At the opposite, a large range of economic analysis, observation and computation would be opened to it, relative to short term macroeconomic control and to medium and long term planning.

There, the mathematical tools of economic modelling, both for multi level programming and for applied general equilibrium models, would be very useful as it has been already experienced both in eastern and in western governmental or academic economic research institutes.

As a corollary of such a refrom of the planning system, the present socialist economies would not be any longer pure "hierarchical organizations" for their current functionning. Not only their opening would have increased, but an element of "polyarchy" would have come into, since socialist firms would directly transact with each other, although under some central control.

But as long as the collective ownership of production means and enterprises continues, with its corollaries for creation mergers, splitting and disappearance of the firms, the hierarchical organization is maintained but transfered to the long term domain.

Will this transfer prove to be viable? This is an open question.

4. Needed behavioral changes

Another one, closer at hand, is relative to the necessary transformation of agents' economic behaviour. Will it prove easy and fast to request socialist firm managers to take risks and financial responsabilities, to negociate contracts, to be attentive to demand and supply fluctuations, even to price fluctuations etc? Until now, most of them have been used, instead, to fill administrative files, memorandas and reports, to find out the best channels for pushing their projects along the bureaucratic labyrinth or for discovering the raw materials or equipment they need in order to implement the planned targets before the end of the year. And still more challenging, how to transform bureaucrats into efficient managers? These are more sociological problems than strictly economic ones, and that is why we consider that we are not entitled to deal with them. Anyhow we sincerely wish that they can be easily solved; so that it could be proved that, as A. Smith might have said, a long day today working of the old central planner's "visible hand" nicely paved the way to the market old lady's "invisible hand", leaving to long term planner young boy to help with his "econometric socialist radar".

Let Gorbachev be the magician who will give life to this fairy tael!

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