The so-called "Generation of 1968" included several distinguished economists. The best ones earned such prestige that their papers were included in this volume. There were not many at that time who could publish in a company with Solow, Tinbergen, Joan Robinson, or Sen! Their spiritual impact on Czech economics survived the period of totalitarian "Marxist normalisation" after 1968, and their legacy of quantitative economic realism was reflected in the design of The System of 24 Models. Let us also mention that IES 2002 Jean Monnet Professor of European Integration ad personam, Luděk Urban, reorganised the EI after his return from the US by establishing the EI PhD Graduation School in 1968 and coached the translation of Samuelson´s Economics. This cost him the job in 1970, and the whole edition had to be scrapped and pulped.

SOCIALISM, CAPITALISM AND ECONOMIC GROWTH

ESSAYS PRESENTED TO MAURICE DOBB

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A MODEL FOR THE PLANNING OF PRICES†

O. KÝN, B. SEKERKA, L. HEJL

I. INTRODUCTION

The interest of economists has recently concentrated a great deal on the problem of prices. Under conditions of a centralized system of management of the economy it was not correct to identify the planning of prices with centralized administrative price fixing of all products. Since no adequate method of planning prices existed and since it was practically impossible to make available to the centre the huge amount of information (as well as to process such information at the centre) necessary for the fixing of prices for all products, all the centre could do was adjust prices from time to time on an 'ex post' principle. Under such conditions it was only natural that after some time the system of prices prevailing in the economy became so deformed that it almost ceased to fulfil any rational economic function.

This deformation of the price system has at present two important negative consequences for the Czechoslovak national economy: (*a*) the basic criterion for evaluating the efficiency of the economic process has been deformed, which means that under the old price system it is impossible to make rational economic decisions either at the centralized or at the decentralized level; (*b*) with the price system in operation until now, existing prices are at such variance with equilibrium market prices that it is very difficult to renew quickly the functioning of a market mechanism.

Thus the task of rationalizing the price system has become one of the basic conditions for a better functioning of the socialist economy as a whole. During the last few years this problem has, to an increasing extent, become the focus of interest among economists in the socialist countries. This was apparent in the discussions concerning the functioning of the law of value and the role of the market mechanism under conditions of socialism, as well as in the discussions concerning the so called 'rational price-formula.'

This paper aims at following up the discussions about a rational price-

† We should like to thank Martin Černý for valuable criticism of the mathematical apparatus and F. Nevařil, St. Kysilka and J. Mrenica who cooperated with us in the practical calculations.

3. ALTERNATIVE PRICE FORMULAE

We may now attempt to formulate equations for different types of prices. Let us suppose that the following indicators of the economic system are given:

the A matrix of input coefficients expressed in physical units;

the K matrix of capital-output coefficients expressed in physical units; element k_{ij} of this matrix expresses the stock of capital of i-kind necessary for the production of a unit of output in the j-sector during a given unit of time;

the l vector of labour; l_j is the volume (number of man-hours) of labour necessary for the production of a j-kind unit of output.

If we know the ω vector of average wages in the sectors (which is supposed to be constant) we can also express the labour coefficients by the vector of coefficients of wage costs

$$v = l\hat{\omega}. \tag{12}$$

We are looking for a 'rational price formula', which would assign some price system to the technological characteristics of the economic system designated by A, K, and v.

We shall investigate primarily one class of formula, which sets prices in such a way that they cover material cost and distribute income in some uniform manner into all prices. Income may be distributed according to the following principles:

(*a*) in proportion to material costs;

(*b*) in proportion to wage costs;

(*c*) in proportion to stock of capital.

From the class of formula mentioned above, we are interested mainly in those which cover not only material, but also wage costs, and distribute profit instead of income according to certain principles.

The coefficients according to which profits are distributed into prices by the various principles mentioned above may in principle differ in various sectors of the economy. But insofar as there do not exist serious factual reasons for setting differentiated coefficients, it seems much more reasonable to set uniform coefficients as a point of departure. Ricardo, Marx, Walras, Dmitriyev, von Neumann, Morishima, and Sraffa,† whose work the theory of price types directly follows, in most cases presupposed uniform coefficients.

† V. K. Dmitriyev, *Ekonomicheskiye ocherk*: (Moscow, 1904); John von Neumann, 'A Model of General Economic Equilibrium', *Review of Economic Studies*, XIII (1945–46); M. Morishima, F. Seton, 'Aggregation in Leontief Matrices and the Labour Theory of Value', *Econometrica*, 1961; M. Morishima, *Equilibrium Stability and Growth* (Oxford, 1964); P. Sraffa, *Production of Commodities by Means of Commodities* (Cambridge, 1963).

Let us first derive a general formula, a so-called *three-channel price* in which profits are distributed according to all three principles at the same time, i.e. by the following three channels:

(1) In the first channel profits are distributed proportionally to material costs

$$z_1 = \nu pA. \tag{13}$$

(2) In the second channel profits are distributed proportionally to wage costs,

$$z_2 = \mu v. \tag{14}$$

(3) In the third channel profits are distributed proportionally to capital stock

$$z_3 = \rho pK. \tag{15}$$

The sum of all three channels gives us total of profits, present in wholesale prices:

$$z = z_1 + z_2 + z_3. \tag{16}$$

ν, μ, ρ are the parameters of the model. We assume $\nu \geqslant 0$, $\rho \geqslant 0$. If $\mu = -1$, then the whole income is distributed through channels 13 and 15, i.e. $z_1 + z_3 = v + z$. We assume $\mu \geqslant -1$ but it should be realized that if $-1 \leqslant \mu < 0$ there is no guarantee that prices will cover wage costs.

Setting (13), (14), (15) and (16) into (4) we obtain:

$$p = (1+\nu)pA + (1+\mu)v + \rho pK. \tag{17}$$

The solution for p gives us the following general formula for a three-channel price:

$$p = (1+\mu)v[I-(1+\nu)A]^{-1}\{I-\rho K[I-(1+\nu)A]^{-1}\}^{-1}. \tag{18}$$

This formula expresses the dependence of wholesale prices on the technological characteristics of the economic system A, K and v, and on the three parameters ν, μ and ρ. If we also take into consideration that in order to find a system of retail prices we must also know the vector of the turnover tax rate δ, we can briefly describe the whole price system in the following way:

$$\left.\begin{aligned} p &= F(A, K, v, \nu, \mu, \rho), \\ \pi &= G(A, K, v, \nu, \mu, \rho, \delta). \end{aligned}\right\} \tag{19}$$

By choosing parameters ν, μ, ρ and δ we can then make the price system a definite one, or in other words for a given A, K and v we can choose specific price relations and levels.

The formula for a three-channel price (18) is a general formula, which includes special cases of simpler types of prices—so called two-channel prices, as well as elementary types of prices such as value price, production price, income price and cost price.

Formula (18) looks complicated, but its composition is advantageous from the point of view of economic interpretation. This economic interpretation is especially evident if we choose $\nu = 0$. In such a case we see that besides the parameters, prices depend only on two factors:

$v(I-A)^{-1}$ the vector of full wage costs coefficients,

$K(I-A)^{-1}$ the matrix of full capital-output coefficients.

The parameters μ and ρ are specific kinds of 'weights' by which full wage cost and full capital-output ratios enter into the setting of a price.

If we investigate the possibility of $\nu \neq 0$, we then come to the conclusion that the parameter ν does nothing more than change the weight by which direct material costs A influence full wage costs and full capital-output ratios.

From equation (18) we see that the parameter μ influences only the level of prices, but not their relations, while parameters ν and ρ influence both the level of prices and price relations.

If in equation (18) we make any of the parameters equal to zero, we obtain a so called *two-channel price*. There exist three possible types of two-channel prices. We shall investigate especially the following two types:

By an N-two-channel price,† we mean a price which keeps the channel proportionate to material costs and the channel proportionate to wage costs. Putting $\rho = 0$, in (18) we obtain the following formula:

$$p = (1+\mu)v[I-(1+\nu)A]^{-1}. \qquad (20)$$

By an F-two-channel price† we mean a price which keeps the channel proportionate to wage costs and the channel proportionate to capital.

Putting $\nu = 0$ we obtain the following:

$$p = (1+\mu)v(I-A)^{-1}[I-\rho K(I-A)^{-1}]^{-1}. \qquad (21)$$

From equations (20) and (21) it is evident that in both types of two-channel price there can exist different price relations and price levels for the same technological circumstances, depending on how we choose the various parameters. In an N-two-channel price, price relations will depend wholly on v, A and the parameter ν. At the same time price relations are in effect equal to the relations between hypothetical full wage costs, which would exist if technological consumption in all sectors was $(1+\nu)$ times larger than it is in reality.

On the other hand the relations between F-two-channel prices depend on v, A, and K. In this type of price two elements are evident: full wage costs and the full capital-output ratios. The parameter ρ gives the weight, by which the full capital-output ratios influence prices.

† Costs in Czech: 'náklady' (N); Capital in Czech: 'fondy' (F).

In both types of two-channel price the parameter μ influences only the level of prices and not price relations. Each of the two-channel price formulae contains, as special cases, 'elementary' types of prices.

If, in formula (20), for an N-two-channel price we put

(1) $\nu = 0$, we obtain a *value price* (in the labour theory of value sense of the word), in which profits are distributed only by one channel, proportionally to wage costs. The formula for a value price reads as follows:

$$p = (1+\mu)v(I-A)^{-1}. \tag{22}$$

In a one-level price system the number μ has an evident economic interpretation—it expresses the rate of surplus value.

(2) Similarly if we put $\mu = \nu$, we obtain a so-called *cost price*, in which profits are distributed in proportion to total costs (the sum of material and wage costs). The formula for a cost price reads as follows:

$$p = (1+\nu)v[I-(1+\nu)A]^{-1}. \tag{23}$$

The number ν in this case expresses a uniform rate of rentability i.e. the ratio of profits to total costs.

(3) If we distribute total income $(v+z)$ into prices in proportion to material costs, we obtain a type of price, which we shall call an *N-income price*. Take (17) and put $\mu = -1$ and $\rho = 0$. This is a formula for N-income price, from which we can obtain

$$p[I-(1+\nu)A] = 0. \tag{24}$$

The number ν in this case evidently expresses a uniform rate of income in relation to material costs. An N-income price also means that the relative share of income in all prices is the same. From formulae (22), (23), and (24) it is evident that: (*a*) the relations between value prices are determined only by the relations between full wage costs, (*b*) the relations between cost prices are equal to relations between value prices which would exist if direct consumption of material were $(1+\nu)$ times higher than it is in reality, and (*c*) the relations between N-income prices depend only on the properties of the A matrix.

With value prices the parameter μ has no influence on price relations, which means that the value price formula gives us the same price relations whatever the price level is. This does not hold true for the cost price, where it is evident that the size of parameter ν influences the price level as well as the relations between prices. We assume that parameter ν in a cost-price formula can be arbitrarily chosen, provided $\nu \geqslant 0$.

With N-income prices the situation is somewhat different. Here the parameter ν cannot be set arbitrarily. The condition for the existence of a non-zero p vector, according to equation (24), is the following:

$$|I-(1+\nu)A| = 0.$$