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Structural Problems of Industry.

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I N D E X

INTRODUCTION

This Memo. discusses, in a general way, some aspects of the structure of industry. It is essential in development planning to pay special attention to this issue in order to be able to solve the problem of balanced growth. The latter, however, implies differentiated rates of growth, for the various sectors both of the national economy and the industry. They are determined, finally by a specific relationship amongst the various physical and value elements of production. Though planning usually is to get a maximum net product (national income) , this can be obtained provided the existing relationship between the gross and net product in each sector had been appropriately treated by the planners. The gross concept of production, therefore, is the one by means of which the structural and growth problems of industry can be understood and solved.

The reader is kindly requested to study also the Memo. No. 384 ("The Role of Industry in Economic Development") to which the present note is a suplement .

Structural Problems of Industry.

In development planning we are confronted with the problem of calculating rates of growth and to decide upon them. Rates of growth, however, are closely linked to structural shifts. Sometimes, the given structure (of industrial output) predetermines to a large extent the rates of growth of the various elements (branches) of industry.

The present note intends to give a first introduction into some basic ideas on structural problems of industry.

1. The basic elements of industrial structure.

According to their respective economic function both commodities and the branches producing them can be divided into three main categories:

(1) investment goods
(2) intermediate goods
(3) consumer goods

The first two are commonly called producer goods.

Amongst these three categories exist or should exist certain relationships which it is our intension to discuss, briefly. The relationships we have in mind are determined by, at least, two factors:

(i) the technological (technical) factor (the production of a certain volume of goods requires a definite input of investment and intermediate goods according to the average technico-economic level of production);

(ii) the national factor (any national economy should have-within the ranges of the technological factor - a set of adequately balanced industrial branches which could enable it, potentially, to produce any element of a highly-productive modern industry).

If we discuss the relationships amongst the three categories with due regard of the mentioned two factors we shall arrive at a model which serves as a guideline for making a plan in the field of production. This is not the plan itself because the number of branches (3) is too small. It offers, however, many important informations about the trends and the relative magnitudes of the inter-related structural elements concerned.

2. Concepts and symbols used.

(a) For our study it is important to cover total relationships among the three categories, i.e. total inputs and outputs. Consequently, the concept of gross production (P) is necessary. Gross production of investments goods will be indicated by P_1; that of intermediate goods by P_2 and that of consumer goods by P_3.

(b) Each gross production indicator (P, P_1, P_2, P_3) will be divided into its main value elements, namely:

investment goods consumed = inv.
intermediate goods consumed = int.
net product = n

This classification has its counterparts in accounting :

inv. = depreciation
int. = cost of raw materials and semi-fabricated goods
n = wages, profits etc.

(c) Accordingly, total (gross) production in industry has to be written in this form:

$$P_1 = inv._1 + int._1 + n_1$$
$$P_2 = inv._2 + int._2 + n_2$$
$$P_3 = inv._3 + int._3 + n_3$$
$$P = inv. + int. + n$$

3. Some minimal relationships among investment, intermediate and consumer goods production.

Actually planning of production means to fix-inter alia-the various volumes of products and how these have to be distributed. In other words: how much to produce of the various categories of goods and which branch should exchange which volumes with the other branches. For easiness of discussion we assume, first, that no foreign trade takes place and, secondly that all the net product (=national income) is consumed. Production is going on in every cycle on the same scale.

(a) In this case the gross production of the investment goods branch has to be so high as to compensate all the productively consumed investment goods in all three branches; it must equal depreciation.

$$\text{(i)}\quad P_1 = \text{inv.}_1 + \text{inv.}_2 + \text{inv.}_3$$

Total intermediate goods production has to compensate all productively consumed raw materials etc. in all branches, too.

$$\text{(ii)}\quad P_2 = \text{int.}_1 + \text{int.}_2 + \text{int.}_3$$

finally, total consumer goods output has to amount to the net product of the whole industry.

$$\text{(iii)}\quad P_3 = n_1 + n_2 + n_3.$$

(b) So far, production is in line with total productive consumption of investment and intermediate goods. The next problem; however, is to distribute production. This leads us to the relationships of exchange of goods. Apparently, each branch can use one part of its production for compensation of the productive consumption of the respective value element in its own production. The investment goods branch has a demand for compensating its depreciation. As it is the sole producer

of investment goods it can take an adequate part of its production for that purpose. No exchange among the three branches takes place. This is an intra-branch exchange. Consequently, a share of P_1 which is equal to the volume of $inv._1$ remains within this branch.

Furthermore, the intermediate goods branch takes a share of P_2 to compensate its consumption of raw materials etc. This share is equal to $int._2$. Again, we have only intra-branch exchange.

The third branch uses part of P_3 to cover consumption of its net product. This part equals n_3.

Below are that parts of industrial production which are subject only to intra-branch exchange (in circles).

$$P_1 = (inv._1) + int._1 + n_1$$
$$P_2 = inv._2 + (int._2) + n_2$$
$$P_3 = inv._3 + int._3 + (n_3)$$

(c) The other parts of production are to be chanelled through the inter-branch exchange. First, the investment goods branch needs intermediate goods equal to $int._1$ for compensation. In exchange for that it has to give part of its investment goods production to the intermediate goods branch. The latter, secondly, requires new investment goods for compensation of it depreciation; this requirement is equal to $inv._2$. Consequently , $int._1$ will be exchanged against $inv._2$. If the assumption that production should continue on the same scale be met each branch needs actually the same amount of intermediate and investment goods that it had at the beginning of the previous production cycle. This is why $int._1$ must be equal to $inv._2$.

$$P_1 = inv._1 + int._1 + n_1$$
$$P_2 = inv._2 + int._2 + n_2$$

Thirdly, the last branch has to get investment goods for compensation of $inv._3$. These can be obtained only from P_1. In the investment goods branch, however, only one part of gross production has been left, namely equal to n_1. Now, $inv._3$ will be exchanged against n_1. Accordingly, part of consumer goods production (equal to $int._3$) will be exchanged against n_2.

$$P_1 = inv._1 + int._1 + n_1$$
$$P_2 = inv._2 + int._2 + n_2$$
$$P_3 = inv._3 + int._3 + n_3$$

Thus we have arrived at the basic relationships (proportions) amongst the three branches (investment goods, intermediate goods and consumer goods) that must be met if production is resumed on the same scale (with no foreign trade):

(iv) $int._1 = inv._2$

(v) $inv._3 = n_1$

(vi) $int._3 = n_2$

(v) and (vi) can be combined:

(vii) $(inv. + int.)_3 = n_1 + n_2$

(d) When using figures instead of symbols we happen to face a new technico-economic problem: Is there a definite relationship amongst the mentioned three value elements in each branch ? The normal trend is in favour of the share of inv. and int. in gross output. This is the inevitable outcome of technological progress. Moreover, the investment and

intermediate goods industries are usually better equiped ; than the others. In both sectors, therefore, the percentage of the net product is lower than in the various consumer goods industries. This has to be considered when transforming our simple model in a figurative one.

Accordingly, we assume the following relationships amongst the value elements in each branch:

	inv.	+	int.	+	n
P_1	10%		50%		40%
P_2	10%		40%		50%
P_3	5%		35%		60%

These assumptions are fairly realistic. Furthermore, we assume that the respective shares of P_1, and P_2 and P_3 in total industrial output (P) are:

P_1 = 10 units, P_2 = 50 units

and P_3 = 74 units; total= 134 units.

Then we have:

		inv.	+	int.	+	n
P_1	10	= 1	+	5	+	4
P_2	50	= 5	+	20	+	25
P_3	74	= 4	+	25	+	45
	134	=10	+	50	+	74

The before mentioned proportions are now

(i) P_1 = $inv._1$ + $inv._2$ + $inv._3$

10 = 1 + 5 + 4

(ii) P_2 = $int._1$ + $int._2$ + $int._3$

50 = 5 + 20 + 25

(iii) $P_3 = n_1 + n_2 + n_3$

$74 = 4 + 25 + 45$

(iv) $int._1 = inv._2$

$5 = 5$

(v) $inv._3 = n_1$

$4 = 4$

(vi) $int._3 = n_2$

$25 = 25$

(vii) $(inv. + int.)_3 = n_1 + n_2$

$29 = 29$

These figures show that - within the limits of our assumptions- production by quantities and by its structural elements as well is equal to the specific requirements of each sector. Total investments amount to the real depreciation and total required investment goods are exactly produced by the respective branch (P_1). Accordingly, total requirements for compensation of productivily consumed intermediate goods can be fully met by the gross output of the respective branch (P_2). Finally, total surplus of all branched (net product or national income) can be really consumed because gross output of the consumer goods amounts to that excess.

(e) In fact , the model given does not occur in practice as such. Any growth, i.e. production at a larger scale than in the previous production cycle, however, can take place only if all physical conditions for producing the previous volume of output are given resp. reproduced. Growth thus implies by definition the proportions which we have discussed.

4. Growth and Structural Changes.

Growth depends upon an economic surplus. The latter, however, must be produced in a specific form, so that it can actually be invested. It is , therefore, a surplus of investment and intermediate goods which we are in need of in order to achieve growth because consumer goods cannot be invested . The basic condition for growth must be given now in that way:

$$n_1 > \text{inv.}_3 \quad \text{and}$$

$$n_2 > \text{int.}_3 \quad \text{or}$$

$$n_1 + n_2 > (\text{inv.} + \text{int.})_3$$

$$n_1 + n_2 \geq 29$$

This means to increase the share of investment and intermediate goods in total net product (or national income). Apparently, we cannot manage this by a modified distribution of the national income. It is the structure of production of income which has to be accordingly changed. Consequently, not any increase in national income is a wise target for development planning but rather an increase predominantly in the form of investment and intermediate goods.

Development planning usually starts with setting a desired increase of national income (net product). The higher it is all the more we can invest provided the increase is mainly in investible goods. Let us assume now that consumption will be on the same level (in absolute terms) as against the previous period and that the desired increase in net product be 6 (six) units. Consequently, total increase is in both investment and intermediate goods ($n_1 + n_2$) only. Apparently, the total increase income is 8,1%. If we follow the general idea of this discussion, i.e. not to forget about the physical structure of the national income we have, first, to decide upon, though tentatively, the physical structure of the increase in net product. In our case the increase in n_1=1 and in n_2 = 5.

The following example is based on the same assumptions we have made earlier. But another will be added, namely, no technical progress takes place. The relative share of inv. and int. in gross production is still unchanged . This assumption is practically corrst in short run; in long-term planning, however, it is basically wrong.

What the following discussion has to show are the main economic problems and technico-economic implications of the physical and value structure of production which planners face when starting their activities from the end, i.e. from an ex ante target of growth of national income. Our specific example has to tell us whether or not under the present conditions of production (volume, structure) the planned increase of national income is really feasible and within which limits we have to make our calculations for preparation of the plan.

4.1. The increase of the net product and its structural implications.

(a) Accrding to the set target

$n_1 = 4 + 1$ and

$n_2 = 25 + 4$.

n_1 is equal to 40% of total output of investment goods; n_2= 50% of total output of intermediate goods (cf. p. 6.).

The existing value composition of output requires, therefore, the following output magnitudes if the preliminary target be reached:

	inv.	+	int.	+	n
P_1 12,5	= 1,25	+	6,25	+	(4+1)
P_2 60	= 6	+	24	+	(25+5)
P_3 74	= 4	+	25	+	45
P 146,5	=11,25	+	55,25	+	80

(b) We have now to check the proportions:

(i) $P_1 > inv._1 + inv._2 + inv._3$

12,5 > 1,25 + 6 + 4

(ii) $P_2 > int._1 + int._2 + int._3$

60 > 6,25 + 24 + 25

(iii) $P_3 < n_1 + n_2 + n_3$

74 < (4+1) + (25+5) + 45

or

(i) 12,5 > 11,25 excess = 1,25 inv.

(ii) 60 > 55,25 excess = 4,75 int.

(iii) 74 < 80 deficit = 6 c.g.

(iv) $int._1 > inv._2$

6,25 6 deficit = 0,25 int.

(v) $inv._3 < n_1$

4 < (4+1) excess = 1 inv.

(vi) $int._3 < n_2$

25 < (25+5) excess = 5 int.

The last two proportions have to be dropped from our check because they had been assumed. But we can answer the question concretely whether this target given in the form of the latter two proportions can be reached.

The result tells us that the basic proportion of growth, namely $(n_1 + n_2) > (inv._ + int._)_3$ can be met by a surplus of 6 units of investment and intermediate goods as a whole. This so because gross production of both investment and intermediate goods definitely is 6 units ahead (1,25 inv. + 4,75 int.). However, the share of either kind of output within this

surplus does not correspond to the target (cf. (i) and (ii)). The reason for this is that the respective requirements of the investment and intermediate goods branches are not equal to each other . For producing a total net product of 5 the investment goods branch needs 6,25 intermediate goods. The other branch, however, has to spend only 6 units of investment goods for producing a net product amounting to 30. As int.$_1$ (6,25) have to be exchanged against inv.$_2$ (6) it is obvious that the 6,25 of intermediate goods (which have to be given to the investment goods branch) can be taken from inv.$_2$ (6) and from the surplus or net product (0,25). Consequently, the total excess in intermediate goods totals 4,75 (or 29,75 if we take the net product). The real excess of investment goods, however, is not 1 but 1,25 (or 5,25 net product).

The tentative target has to be abandoned since the actual structure of production predetermines an increase in n_1 and n_2 which is largely different from it, although total increase of the net product corresponds to the target. The practical solution of the problem will be either to set another target or to resort to foreign trade with the view to abolish the discrepancies between the value and physical structure of gross industrial production in the investment and intermediate goods branches. If we make up our minds to set the actual results as the final target, this would imply a redistribution of 0,25 n_2 in favour of the investment goods branch (in financial terms: redistribution of part of profits of the intermediate goods branch). Apparently, this can be managed only by a centralized planning system which has a direct command of most resources in the national economy.

4.2. Rates of Growth.

Our example offers some ideas about the rates of growth of the various branches of industry. According to the definition of growth on page 8, $n_1 + n_2 > (\text{inv.} + \text{int.})_3$, which is a basic physical proportion in economic development, the share of investment and intermediate goods in gross production of industry must increase. This, however, will result in differentiated rates of growth which are as follows (in our example):

$$P_1 \quad \frac{12,5}{10} = 1,25$$

$$P_2 \quad \frac{60}{50} = 1,2$$

$$P_3 \quad \frac{74}{74} = 1,0$$

$$P \quad \frac{146,5}{134} = 1,09$$

We may state now that growth in economies with a poorly developed investment and intermediate goods (the latter to a lesser degree) production requires the following relationship amongst the various rates of growth (Δ'):

$$\Delta' P_1 > \Delta' P_2 > \Delta' P > \Delta' P_3.$$

This conclusion however can be drawn not only from our simple model for which, naturally, certain assumptions with the view to developing economies had been made. The figures given in I.N.P. - Memo. No. 384 ... on "The Role of Industry in Development' on p.p. 16/17. confirm that we have arrived at a general rule. And this should be adequately used and obeyed in any development planning activity.

The absolute differences depend on the actual level of development and they will be the greater all the less developed on economy is and vice versa.

In detail, these absolute differences between the rates of growth (and the absolute rates as such, too) are determined by three factors, at least:

- the value composition of each branch output;
- the existing share of P_1, P_2 and P_3 in total industrial production (P);
- the investment requirements per unit of increase of production.

In order to fix the growth rates of the various branches the planner should start this activity by estimating the minimal output of each branch according to the proportions (i), (ii) and (iii). In fact, a developing country will face the following relationships:

$$P_1 < inv._1 + int._2 + inv._3$$

$$P_2 < int._1 + int._2 + int._3$$

$$P_3 > n_1 + n_2 + n_3$$

The first and second proportion offer a certain range (in absolute terms) for the increase of output which is the initial practical step in this field.

Total deficit of P_1 (and P_2, respectively), should be taken as the minimal increase in output over a longer period. This is to have a material basis of its own for production at the same scale. Apparently, we thus can calculate the first, though tentative, rates of growth.

Next comes the calculation of investment requirements per unit of increase of output in both branches ; $\frac{I}{\Delta P_1}$ and $\frac{I}{\Delta P_2}$, which is an important step towards the estimation of total investment requirements with respect to the already roughly estimated total increase of output.

Thus, we arrive at that fund which has to be taken from the net product (national income). It is now the planner's business to find out whether the desired fund can be raised from the net product provided this will not imply any decrease of consumption. Moreover, he has to check to what extent the physical structure of the (investible) surplus is in accordance with the investment needs.

For this verbal discussion we shall give now an example which is based on the same value composition of all output indicators as it was the case in the first example, but is has a higher share of consumer goods' production in total output of industry.

4.21 Survey of the Existing Relationships

	inv.		int.		n
P_1 10 =	1	+	5	+	4
P_2 50 =	5	+	20	+	25
P_3 100 =	5	+	35	+	60
160 =	11	+	60	+	89

Investment goods' output is not able to cover the full demand of respective goods which would be needed for replacement in all branches;

(i) $P_1 < inv._1 + inv._2 + inv._3$

$10 < 1 + 5 + 5$

There is a deficit of 1 (one) unit investment goods.

Accordingly, production of intermediate goods falls short of the requirement of 60 by 10 (ten) units. No full replacement of the productivity consumed intermediate goods can take place.

(ii) $P_2 < int._1 + int._2 + int._3$

$50 < 5 + 20 + 35$

The deficit equals 10 units.

(iii) $P_3 > n_1 + n_2 + n_3$

$100 > 4 + 25 + 60$

Consumer goods' production exceeds total national income by 11 units. This surplus is equal to the deficit in investment and intermediate goods. If production is to continue an adequate exchange with the outside world is essential (cf. Memo. No. 384 p.p.14/15) in order to adapt the physical structure of output to the requirements of all production branches.

(iv) $int._1 = inv._2$

$5 = 5$

(v) $inv._3 > n_1$

$5 > 4$ Deficit = 1

(vi) $int._3 > n_2$

$35 > 25$ Deficit = 10

4.22 First estimates of the rates of growth

With the view to the existing physical structure of industrial output our calculation will be based on the modest target to increase production to the extent that local output can, at least, meet the demand for replacement (compensation) of investment and intermediate goods. The survey reveals that this demand for continuing production at the same scale depends partly upon imports (either goods or/and by credit and loans). In this case any extension of output is completely dependent on outside sources.

In order to reach this goal the production of both branches must grow in such a way that the following proportions will be met :

(v) $inv._3 = n_1$

(vi) $int._3 = n_2$

The deficit of investment goods was 1 (one) unit. This production should grow accordingly by 1 unit or 10%:

$\Delta P_1 = 1$ unit

$\Delta' P_1 = 10\%$.

The deficit in intermediate goods was 10 units. This production should grow accordingly by 10 units or 20%:

$\Delta P_2 = 10$ units

$\Delta' P_2 = 20\%$.

The check of all proportions revealed that we need this increase for meeting the requirements of investment and intermediate goods in the consumer goods' branch only. This increase, however, represents only part of total production of investment resp. intermediate goods. In order to produce these lacking quantities ($\Delta n_1 = 1, \Delta n_2 = 10$) for inter-branch exchange we need an even higher increase of production in the two branches which is definitely determined by the value composition and share of either as well.

In figures we shall have now :

	inv.		inv.		int.		n
P_1	12,5	=	1,25	+	6,25	+	(4+1)
P_2	70	=	7	+	28	+	(25+10)

Now all requirements of the consumer goods' branch can be met. Due to the existing shares of P_1 and P_2 and either value structure a new discrepancy came into the picture, namely $\text{inv.}_2 > \text{int.}_1$. This actually means a deficit of 0,75 investment goods. Int._1 must be , therefore, 7 units ($\text{int.}_1 = \text{inv.}_2$). This value element, however, represents 50% of total P_1. Then we have:

		inv.	+	int.	+	n
P_1	14	= 1,4	+	7	+	5,6
P_2	70	= 7	+	28	+	35
P_3	100	= 5	+	35	+	60
P	184	=13,4	+	70	+	100,6

We have arrived at the target to produce all investment and intermediate goods which locally will be needed for replacement. Yet, we have a surplus of 0,6 unit investment goods ($n_1 > inv._3$), which leads to an excess of P_1 over $inv._1 + inv._2 + inv._3$ and to a deficit of 0,6 unit consumer goods as against total net product.

The final growth rates are:

$P_1 \quad \frac{14}{10} = 1,4$

$P_2 \quad \frac{70}{50} = 1,4$

$P_3 \quad \frac{100}{100} = 1,0$

$P \quad \frac{184}{160} = 1,15$

The share of each branch in total output was:

$P_1 = 6,25\%$

$P_2 = 31,25\%$

$P_3 = 62,5\%$

Now it is

$P_1 = 7,7\%$

$P_2 = 38\ \%$

$P_3 = 54,3\%$

4.23 Calculation of the investment requirements:

For each branch investment requirements per unit of increase of production should be calculated = $\frac{I}{\Delta P}$. If these indicators are multiplied by the already estimated increase (in absolute terms) in the respective branches the result shows total investment requirements.

Another analysis which goes beyond the scope of the present discussion has to define how much of the net product (national income) can be invested (in our model this would mean how much of the surplus in the form of consumer goods has to be exchanges against investment goods on foreign markets) and which other sources (credits and loans from outside) can be mobilized. It depends upon these analysis and adequate decisions as well when the original target will be materialized.

5. Final Remarks.

It is essential that planning of production should be based on gross output. In case it will be limited to the net (value added) only we would encounter various difficulties. This, so, because the trends of the net product are not identical with those of the other value elements of production. Moreover, the share of each value element (and the share of each branch in total production) plays an important role in production planning. In general, the rate of growth of national income is lower than that of gross production. The reason for this phenomena is the simple fact that growth nowadays is mainly the result of technological progress (apart from the social factors). This, however, implies by definition that production (total and net as well) can be managed only by means of a relatively expanding use of machines etc. This expansion has two aspects:

First, the relative increase in the share of all producer goods (P_1, P_2) in total output of industry. This was exactly the case in our last example where the modest target to cover all replacements (of investment and intermediate goods) by domestic sources changed the physical composition of P in favour of P_1 and P_2. Consequently total net product has grown by 13% which is less than the grow rate of gross production (P), 15%. Secondly, if the assumption of no changes in the value structure is dropped (which would be in full accordance with reality) the differences amongst all growth rates would be even greater.

Accordingly, the general rule for growth ($n_1 + n_2 > inv._3 + int._3$) will read now as follows:

$$\Delta\,'P_1 > \Delta\,'P_2 > \Delta\,'P > \Delta\,'N > \Delta\,'P_3$$