JPRS L/9159

20 June 1980

USSR Report

ECONOMIC AFFAIRS

(FOUO 10/80)

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APPROVED FOR RELEASE: 2007/02/08: CIA-RDP82-00850R000200090045-1

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INVESTMENT, PRICES, BUDGET AND FINANCE

ECONOMISTS STUDY DATA ON CAPITAL INVESTMENT EFFICIENCY

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 80 pp 112-121

[Article by I. Perepechin: "Statistical Study of the Actual Efficiency of Capital Investments"]

[Text] Increasing the economic efficiency of capital investments is one of the principal tasks in capital construction. At the same time the potential that exists for increasing the efficiency of capital investments is not being sufficiently utilized. In the current 5-year period the growth rates of capital investments have exceeded the growth rates of the national income. In the first 4 years of the 10th Five-Year Plan the growth of the national income, which reflects the return on capital investments, was even somewhat lower than the growth achieved in the 1971-1974 period. The gap has widened between the volume of fixed capital put into service and the capital investments because the volume of unfinished construction has grown. It is of paramount importance to raising the efficiency of capital investments that a study be made of the actual results of capital construction and of factors that have a bearing on those results. "It must be seen as a major oversight," writes T. Khachaturov, member of the academy, "that we do not compile operational budgets (ispolnitel'nyye smety), nor do we analyze the actual efficiency of capital investments. Without this it is not possible to monitor the results of construction."*

Evaluation of the actual results of capital construction is needed above all for monitoring the level of efficiency anticipated in project plans. When plans are being drafted, efficiency indicators are not uncommonly embellished: estimated project cost and current production cost are on the low side and the volume of output and labor productivity are put on the high side. In other words, an appearance of high efficiency of the project being drafted is created but is not borne out in practice. Yet it is a basic condition necessary to the high quality of project planning indicators that they be realistic. To discover whether a project is realistic or not, we need to know the actual efficiency of capital investments and to compare it with the projected efficiency.

* VOPROSY EKONOMIKI, No 7, 1979, p 130.

An equally important problem in studying the actual efficiency of capital investments at individual enterprises and facilities is to discover the factors affecting the level of efficiency, especially those which tend to lower it. Vigorous pressure needs to be exerted on the level of efficiency, it needs to be managed. Up to now this kind of management has been done in the stage when project plans are being drafted--through selection of the most efficient of several interchangeable technical alternatives, but this in our view is not enough. Systematic and objective analysis of the actual efficiency of capital investments for specific enterprises and facilities, above all for those most important to the national economy, is a prerequisite to the high efficiency of capital outlays.

The actual results of capital construction have been studied repeatedly. We should note the research of B. Vaynshteyn, conducted back in 1961 for the building fabrications industry; the methods developed by A. Probst; specific sections in the monographs of T. Khachaturov, B. Plyshevskiy, and others. In the first place, however, such research has in most cases been done mainly at the macroeconomic level (the national economy, the sectors of the economy, and so on); second, when it has dealt with individual enterprises and facilities, the analysis was more exploratory than systematic and regular in nature. The specific methods recommendations on procedure for studying the actual efficiency of capital investments at both the macroeconomic and microeconomic levels, published by USSR Stroybank in 1975, should be put among exploratory work of this kind. It is beyond doubt that statistical agencies, which have the right to institute the necessary reporting and to obtain a sufficiently large set of actual figures reflecting efficiency, have the greatest opportunities in this area.

The surveys conducted by USSR CSA on actual efficiency of capital investments for individual enterprises and facilities have yielded a number of interesting results. For example, at industrial enterprises and facilities put into operation in 1975 the profit earned in 3.9 years of their operation has averaged 55 percent of the capital investments, which means that approximately half of the outlays have been repaid. If the average annual profit stays at the same level in the future, then the payoff period as a whole for the enterprises and facilities studied would be 7.2 years.

It is very important to compare the actual figures with those in the design. For example, in 1978, when the period allowed for attainment of rated capacity expired for all the enterprises and facilities, profit was 17 percent of the respective capital investments, but according to the designs of these enterprises and facilities it should have averaged 31 percent. This occurred not only because of shortcomings in operation of the enterprises that were built, but also because of important oversights in project planning. It is not uncommon for the design figures already approved to be revised unfavorably. For the enterprises and facilities put into operation in 1975 as a whole, the estimated construction cost rose 18 percent as a result of these revisions subsequently allowed. Moreover, the annual volume of output envisaged by the design was raised only 14 percent

when the project plans were reapproved, and the annual profit only 8 percent. Project plans are revised not only because the estimated construction cost has been set too low (in order to ensure speedy approval), but also because construction time is long, averaging nearly twice as much as the standard time allowed.

Statistical data allow us to discover certain potential for raising efficiency. This potential consists above all of more extensive utilization of the advantages of expansion and reconstruction of existing enterprises as compared to new construction. The profit per ruble of capital investments for expansion and reconstruction average nearly threefold greater than for new construction. The time from commencement of construction to the very end of the payoff period averages half as long for expansion and reconstruction of enterprises as for new construction, that is, the outlays are repaid twice as fast.

Nevertheless, as shown by the materials of the statistical surveys conducted, payoff periods cannot be viewed as the summary indicator of efficiency, nor can its level and dynamic behavior be equated with those of the efficiency of capital investments. Enterprises in industries which are not capital intensive are repaid more quickly, as are enterprises with relatively large expenditures of live labor and comparatively low labor productivity. But to term such enterprises the most efficient would hardly be legitimate (in spite of the rapid payoff).

The shortcomings of the payoff period as an indicator come down to the following. First, the payoff period does not fully reflect differences in absolute magnitude either of capital investments or of profit. Second, it does not detect differences in the rate of profit within the payoff period. Third and finally, the payoff period does not reflect that yield which will take place after the payoff period.

We will illustrate these shortcomings with the following hypothetical example:

	Enterprise			
	I	II	III	IV
Capital investments, in thousands of rubles	1,000	3,000	3,000	3,000
Profit by years of operation, in thousands of rubles				
I	200	500	100	100
II	350	700	800	800
III	450	800	1,000	1,000
IV	500	1,000	1,100	1,100
V	500	1,200	1,200	1,400
VI	500	1,200	1,200	1,600
Total profit minus capital investments, in thousands of rubles	1,500	2,400	2,400	3,000

The actual payoff period of the first enterprise is 3 years (200 + 350 + 450 = 1,000), and of the three others 4 years (500 + 700 + 800 + 1,000 = 100 + 800 + 1,000 + 1,100 = 3,000). However, in spite of the shorter payoff period, the first enterprise is less efficient than the other three. This is quite evident from the overall result for the 6 years of operation: total profit (from commencement of operation) exceeded capital investments for the first enterprise by 1.5 million rubles, for the second and third by 2.4 million rubles, and for the fourth by 3 million rubles. In other words, by building an enterprise whose payoff period was 1 year longer, the national economy was to receive an additional 900,000 to 1.5 million rubles over the 6-year period (over and above all construction costs), and, moreover, with each subsequent year the difference to the advantage of the enterprise with the longer payoff period will increase.

It does not follow from this, of course, that a longer payoff period is always more advantageous. If the profit and capital investments of the second enterprise had been one-third as great, then by the end of the sixth year the national economy would have received from the second enterprise not more profit, but less profit than from the first (700,000 rubles less). This shows the effect of the absolute size of the results and the outlays on economic assessment. But the payoff period, as we see from the example, does not reflect this. In spite of the different payoff periods, the fourth and second enterprises are more efficient than the third.

So, payoff periods have essential shortcomings if they are to be regarded as definitive and summary indicators of efficiency. But it by no means follows that payoff periods are not necessary at all. They are not definitive indicators, but they are very important ones that play a large role in comprehensive evaluation of efficiency.

The payoff period is one of the two components of the complete investment cycle, the component which reflects the maximum length of the turnover of capital investments. The other part of this cycle is construction time. If, for example, the payoff period is 3 years, and construction time 4, then the entire investment cycle will be 7 years.

Figures on the length of the complete investment cycle are indispensable in planning both capital investments themselves and also the sources from which they are to be financed. If we look upon capital construction as a borrowing process, then the length of the complete investment cycle will show the duration of the indebtedness of the enterprise (builder) to the national economy. Shortening the period of indebtedness still does not in and of itself signify a higher efficiency of capital investments, but other things being equal, it undoubtedly helps. This is in fact the role of that indicator, which, though an auxiliary role, is a very important one.

We must also dwell on the shortcomings of the payoff period as an indicator, which are more theoretical than practical in nature. The actual length of the payoff period can be ascertained only after a more or less

lengthy period following completion of construction. That is the principal shortcoming of the payoff period from the standpoint of its practical use.

In many cases it is difficult to determine the payoff period because the process of capital investments is continuous: hardly does one project for reconstruction or expansion of an enterprise end (and sometimes it is not even finished) than the next one begins. This is especially typical of enterprises in machinebuilding, where as a rule capital investments are repaid rather quickly. But in view of the undifferentiated character of the results (the growth of profit), it is a problem to compute the quantitative magnitude of the payoff period.

Thus payoff periods, taken as periods of time, display a number of theoretical and practical shortcomings which have been fully revealed in the study of this indicator by USSR CSA. For that reason they need to be supplemented (supplemented, but not replaced) by indicators of efficiency that are more meaningful and more necessary in practice.

In our opinion statistical observation of the actual efficiency of capital investments ought not to be discrete, but continuous. This means that we should not wait until the end of the payoff period. We need to analyze the actual results of capital construction continuously, beginning with the first year of operation. Only in this way is it possible to detect in good time the factors that have an impact on the level of efficiency and to take steps to raise it. For this purpose efficiency coefficients are quite suitable on the scale of one enterprise or facility taken separately. After they are put into operation, one can compute them annually and compare them with the design coefficients and standard coefficients and discover the reasons for discrepancy between these indicators. Strictly speaking the return on capital investments continues so long as the enterprise exists. It is moreover distinguished by instability; it can move downward or upward in a broad range.

The USSR CSA chose the payoff period as an indicator of the actual efficiency of capital investments out of a desire to distinguish the idea of the efficiency of capital investments from the efficiency of utilization of fixed productive capital. We can speak of the efficiency of capital investments in this sense only up to the point when they have been repaid. This is supposedly followed by a period which has nothing in common with capital investments--a period in which it is no longer the efficiency of capital investments, but the efficiency of fixed capital.

It seems to us that this approach is an oversimplification. Capital investments are future fixed capital, and fixed capital are past capital investments. There is no fundamental difference between these indicators.

Of course, the entire magnitude of capital outlays is not reflected in the value of capital. But in principle capital investments and fixed capital are, if not identical, at least similar concepts. It is hardly legitimate

to set them in opposition to one another. The actual efficiency of capital investments comes about, in our view, under the impact of two factors: first, potential efficiency which the newly created capital assets (completed capital investments) possess, and second, the efficiency of utilization of this fixed capital.

Potential efficiency is incorporated in the design of the enterprise and in its construction. The more successful the design features adopted in project planning and the faster construction is completed, the higher the potential efficiency, that is, the greater the capability of the fixed capital to yield a beneficial return. But this is only a possibility, one which yet has to be realized.

Efficiency of utilization of fixed capital depends on the organization of production, the skill of personnel and many other factors. It is the level of utilization of fixed capital that governs the actual return on the capital investments made, but the size of that return is also determined by the potential efficiency of the capital assets. If the utilization of fixed capital is the same, the actual efficiency of capital investments increases directly with the potential efficiency of the capital assets. Capital investments in capital assets which have a high potential efficiency, but which are utilized poorly, may yield a smaller return than capital investments in fixed assets with a low potential efficiency if they are ably utilized.

Fluctuations in the efficiency coefficients show changes in the actual efficiency of capital investments. Their dynamic behavior makes it possible to assess the dynamic behavior of efficiency and to actively influence it.

At present determination of actual efficiency coefficients is part of the program of statistical surveys. At the same time the payoff periods of capital investments have, of course, been retained. In addition to the usual formula of the coefficients (annual profit divided by capital investments), two modifications of it are used: reimbursement coefficients and averaged coefficients.

Both modifications differ from the usual coefficient in the calculation of the numerator. The numerator of the reimbursement coefficient is not the profit of the given year, but total profit from commencement of operation. Aside from its independent significance, this indicator is used in calculating the payoff period. Up until the end of the payoff period the reimbursement coefficient is less than unity, thereafter it is greater than unity. Instead of the profit of the given year, the averaged coefficient has in the numerator the average annual profit from commencement of operation. The denominators of all these coefficients are the same (total capital investments made). Efficiency coefficients, reimbursement coefficients and averaged coefficients answer different questions and complement one another. But at present only the customary efficiency coefficients are comparable with project plans and standards.

Technical difficulties do not allow annual computation of values for these indicators. Enterprises put into operation are first surveyed after 3 full years of operation. Those of them which have not repaid the investment in that time are surveyed again after 6 years. Enterprises which have been surveyed twice, but which still have not paid off the investment, are surveyed for the third time after 9 years of operation. Then the surveys are terminated; that is, actual payoff periods are not calculated for enterprises which pay off after more than 9 years of operation or which do not pay off at all. As a rule such enterprises are inefficient, since they did not pay off in the allowed period (taking into account the period allowed for attainment of rated capacity and the average standard efficiency coefficient at 0.12, the normal payoff period is about 9 years). In each survey efficiency coefficients and their modifications are calculated for all the previous years (that is, they show dynamic behavior from year to year).

At the present time the program for statistical surveys also includes a question concerning the reasons why the actual indicators used for calculating efficiency coefficients (capital investments, volume of output, production cost and profit) differ from the respective data anticipated in the design. In our opinion these materials have great practical value, since they make it possible to take responsive steps to improve utilization of fixed capital and consequently to raise the actual efficiency of capital investments expended to build those capital assets.

At the same time cases are found when actual efficiency coefficients deviate from the projected level not because of poor utilization of fixed capital, but because the design figures were unrealistic. This may be detected in the very first years of operation, that is, at a point which as a rule is long before the end of the actual payoff period. And if an active effort to raise the level of efficiency at the given specific enterprise is unfortunately impossible in this particular case, sufficiently early detection of the defects in the design can be used for administrative and financial pressure on the work of project planning organizations. To be specific, it would be advisable to set up a system of material incentives for project planners as a function of two factors: the level of anticipated efficiency and the extent to which that efficiency is realistic (we are, of course, not equating the latter with the actual yield, which also depends on the efficiency of operation of the capital assets).

Use of efficiency coefficients to characterize the dynamic pattern of efficiency of a single enterprise is in our view legitimate because the volume of capital investments is in this case stable as a rule. In other words, the denominator of the coefficient remains unchanged, while the numerator varies, so that the higher the numerator (profit), the higher the efficiency coefficient and the higher the return on the capital investments.

But aside from analyzing efficiency for a single enterprise, there is an equally important task of comparing the level of actual efficiency of capital investments at different enterprises. Here again, in our opinion, it is not sufficient to use efficiency coefficients.

Indicators of the overall efficiency of capital investments, a group to which the efficiency coefficient, as is well known, belongs, are not suitable for comparative evaluations in all those cases when the volumes of capital investments are unequal in the decisions being compared (it does not matter whether they are intended or have already been made). The reason is that efficiency coefficients reflect the yield per unit of capital investments regardless of the absolute number of those units. But for the national economy the difference in the absolute value of the outlays (and consequently of the results as well) has great importance.

We will illustrate this with the following example. There are three enterprises with equal actual efficiency coefficients, but with different absolute quantities (in thousands of rubles) from which these coefficients are derived:

$$\frac{1,000}{5,000} = 0.2; \qquad \frac{1,200}{6,000} = 0.2; \qquad \frac{1,500}{7,500} = 0.2.$$

The yield per unit of capital investments of these enterprises is the same--20 kopecks of annual profit per ruble of capital investments. But are these enterprises actually of equal benefit to the national economy? If the capital investments in these enterprises are efficient (their yield is higher than the standard, which, say, is 0.15), then the enterprise with capital investments amounting to 7.5 million rubles is the most efficient. If the capital investments in these enterprises are inefficient (if their yield is below the standard, which, say, is 0.25), then the higher the efficiency of the capital investments, the better. Consequently, the enterprise with capital investments amounting to 5 million rubles is better in relative terms. And only if the efficiency of capital investments at all these enterprises is at the level of the standard can we assume that they are equally efficient.

But in all cases the efficiency coefficients (actual) are identical, and reflect neither growth nor drop in efficiency of capital investments (not to mention the unlikely third situation). But if that is the case, then cases are quite possible in which an enterprise whose coefficient is not so high has higher efficiency, and vice versa.

The inadequacy of the efficiency coefficients for comparative assessments of different enterprises does not mean that they are not at all necessary in comparative analysis. Efficiency coefficients, in our view, make it possible to ascertain one of the two factors in efficiency--specific (intensive) efficiency, which has a bearing on the final results.

Is it possible in studying the actual efficiency of capital investments to use the level of imputed costs for comparative evaluations? In our opinion imputed costs properly reflect the comparative efficiency of capital investments only under the condition of equal volumes of output. This condition is typical of calculations of efficiency made in the project planning

stage, when one runs down different combinations of one-time and current outlays for a strictly fixed volume of production (capacity) given in advance. That is why the use of sound imputed costs is altogether legitimate in justifications of project plans.

The situation is quite different with actual indicators of enterprises that have been built, whose output volumes are always different. In this situation errors crop up when imputed costs (computed, naturally, per unit output) are used. The difference is that where efficiency coefficients do not take into account the relative advantage of increasing or decreasing the size of the capital investments, the imputed costs do not reflect the relative advantage of decreasing or increasing the volume of production. We will give an example. Suppose we are comparing two enterprises which have been built. At one of them the capital investments amounted to 2 million rubles, and the volume of production 3 million rubles, and the production cost 2.46 million rubles; at the other enterprise capital investments were also 2 million rubles, the volume of production is 4 million rubles, and the production cost 3.36 million rubles. The standard efficiency coefficient is 0.12. Imputed costs per unit output will be equal at these enterprises:

$(2.46 + 0.12 \times 2)/3 = 0.9$; $(3.36 + 0.12 \times 2)/4 = 0.9$.

Supposedly we should conclude that these enterprises are equally efficient because they have the same imputed costs. As a matter of fact, their total costs (one-time and current) per unit output are equal--90 kopecks per ruble. But in actuality the second enterprise is more efficient than the first. Given the same capital investments (2 million rubles at each), annual profit at the second enterprise is 640,000 rubles (4 - 3.36 = 0.64), while at the first it is only 540,000 rubles (3 - 2.46 = 0.54). For that reason the domain in which imputed costs per unit of output can be used in analyzing the actual efficiency of capital investments is still more limited than that of the efficiency coefficients. As a rule the latter are quite suitable for a summary assessment confined to a single enterprise. Yet imputed costs cannot be used even for that purpose. Their level reflects only the degree to which the volume of costs to produce one unit of output affects the overall assessment of efficiency. Cases are quite possible in which an enterprise with higher imputed costs, but with a larger scale of production, will have higher efficiency than an enterprise with lower imputed costs, but a negligible volume of production.

Both efficiency coefficients and imputed costs are specific or unit indicators. Their difference is only the correlative in question. In the case of efficiency coefficients this is the capital investments, while in the case of imputed costs it is the volume of output. Accordingly the absolute "supplement" (necessary to fully characterize economic efficiency) is different: in the case of efficiency coefficients it is the volume of capital investments, and in the case of imputed costs it is the volume of production.

It has been discovered in a study of actual results of construction that the domain in which efficiency coefficients can be applied is still broader than that of imputed costs, since capital investments may be stable (confined to one enterprise), while the volume of production is very variable (the reverse is the case in justifications of project plans: fixed volume of production and variable--within certain limits--volume of capital investments).

We should note that the role of the absolute factor is increasing constantly. At the 25th CPSU Congress emphasis was put on the importance of precisely the absolute figures in economic development. For that reason assessments made on the basis of efficiency coefficients and imputed costs (going outside those narrow limits in which these indicators are suitable) will lag further and further behind the real growth of the economic efficiency of social production, capital investments and new technology. This is felt first of all in analyzing and assessing the actual results of construction.

In our opinion absolute figures on efficiency, reflecting the full yield on capital investments, should replace (or, more accurately, supplement) the specific or unit indicators. It should also be borne in mind that under the decree of the CPSU Central Committee and USSR Council of Ministers dated 12 July 1979 the principal indicator of production for both planning and norm-setting purposes is to be the growth of net output in comparable prices. Indicators reflecting the efficiency of capital investments, in our view, should therefore reflect directly the growth of net output resulting from outlays for construction. The net result, taken as the difference between the result obtained and the respective outlays (one-time and current), made comparable, could, for example, be used as the principal indicator (both for sectors and industries, ministries, and so on, as well as for individual enterprises and projects).

The net result can be described in the following notation:

$$E_{ch} = (D - D_o) - ([D/F] - [D_o/F_o])F_o - (Ch - Ch_o)(Z/Ch) - Ye_n(K - H_1 + H_2 + KYe_pL_s - A_v),$$

in which D is the net output in the given year; D_o is the net output in the base year (in calculations at the macroeconomic level the base year is the previous year; in calculations at the microeconomic level the base year is the year preceding the beginning of construction, and in the case of new construction the indicators of the base year are equal to zero); F is fixed productive capital in the given year; F_o is fixed productive capital in the base year; $([D/F] - [D_o/F_o])F_o$ is the growth of net output by virtue of improved utilization of fixed productive capital; Ch is the average annual size of the work force in the given year; Ch_o is the average annual size of the work force in the base year; Z is the wage fund in the given year; $(Ch - Ch_o)(Z/Ch)$ is the growth of net output by virtue of higher expenditures of labor (measured approximately in terms of the size of the labor

force); K is capital investments for productive purposes made in the period since the end of the base year and up until the end of the given year; H_2 is unfinished construction at the end of the given year; H_1 is unfinished construction at the end of the base year; Ye_p is a coefficient for taking into account the different times at which the capital investments were made (at the present time $Ye_p = 0.08$); L_s is the size of the construction lag in years; A_v is the value of depreciation of fixed capital retired during the period in which the capital investments (K) were made; Ye_n is the standard efficiency coefficient of capital investments (subject to revision on the basis of the tasks of evaluating efficiency on the basis of net output; until such revision is made, ordinary standards for evaluation of overall efficiency of capital investments, cleared with USSR Gosplan, can be used). The net effect can be calculated and totaled for any number of years.

Its content corresponds to the principle formulated back at the 22d CPSU Congress to the effect that efficiency comes down to achieving the maximum result at minimum cost, or, more accurately, to attaining the maximum gap between the results and the costs. In actuality the net result increases, first, when there is a growth in the volume of production (taking into account a rise in product quality), and second, when current outlays to produce it drop (production cost), and third, when the capital investments are reduced. All three of these factors do not necessarily change in the same direction, but their optimum combination yields the maximum size of the net result, the maximum gain.

This indicator is also suitable because it combines the functions of indicators of overall and comparative efficiency. As we know, indicators of overall efficiency are intended to answer the question (by comparison to a standard) of whether capital investments are efficient or inefficient, while indicators of comparative efficiency are to discover where efficiency is higher and where it is lower. The net result gives answers to both questions. If it is greater than zero, capital investments are efficient. The higher the positive value of the net result (or the lower its negative value), the higher the efficiency. The standard efficiency coefficient is incorporated in this indicator, because without it it is not possible to put one-time outlays (capital investments) and current costs (production cost) into comparable form. Without a standard coefficient, it would obviously be altogether difficult to make any sort of summary evaluations of efficiency.

The net result fully accounts for the absolute (extensive) factor of efficiency. By contrast with the efficiency coefficients and imputed costs (per unit output), the net result detects the entire difference in the absolute value of capital investments and the absolute volume of output and makes it possible to correctly evaluate the actual results of capital construction.

Actual data obtained as a result of statistical surveys afford the possibility of calculating the value of the net result of different enterprises

and of comparing them with one another. A comparison of changes in the net result with changes in efficiency coefficients makes it possible to analyze the influence of particular factors on the actual yield of capital investments.

At the present time statistical study of the actual efficiency of capital investments for individual enterprises and facilities is entering a new stage. Its principal peculiarity is that it is making this field of statistics more relevant and bringing it closer to practical problems, transforming it into a decisionmaking tool, an instrument for managing the actual efficiency of capital investments. Though the methods used will first have to be improved.

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INVESTMENT, PRICES, BUDGET AND FINANCE

IMPACT OF QUALITY IMPROVEMENT ON PRICE CONSIDERED

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 80 pp 16-23

[Article by A. Akhmeduyev: "Product Quality and the Improvement of Prices"]

[Text] In recent years the process of improving the quality of industrial output has accelerated considerably. Throughout industry as a whole, output in the highest quality category accounted for 1.5 times as great a proportion of total production volume in 1978 as it did in 1975. The state Seal of Quality was awarded to 20,900 different items in 1976, 29,100 in 1977, and 38,700 in 1978, and at the beginning of 1979, 62,400 items bore the Seal of Quality.* However, the problem of improving product quality is still urgent. The number of products and volume of output bearing the Seal of Quality have mainly been increasing on the basis of items previously put into production. Thus, in 1976-1978 the Seal of Quality was awarded to 88,700 different items, while 10,300 new types of products were put into production.

The CPSU Central Committee and USSR Council of Ministers' decree "On Improving Planning and Strengthening the Economic Mechanism's Influence in Enhancing the Efficiency of Production and Quality of Work" provides measures for increasing the role of economic levers and incentives in expanding the production of high-quality products and bringing about a systematic updating of the product assortment. This will be

* See the statistical collections, "The USSR National Economy in 1977," Izdatel'stvo Statistika, 1978, p 100; and "The USSR in Statistics in 1978," Izdatel'stvo Statistika, 1979, p 74.

fostered in many respects by the further improvement of price formation, including the reflection of products' quality in their prices.

As a rule, the improvement of product quality requires additional outlays of material, technical and labor resources. Therefore, taking product quality into account in the wholesale prices of new products stems first of all from the need to compensate producer enterprises fully for outlays connected with the improvement of product quality. In a number of cases an increase in outlays (and, consequently, in prices) for the production of higher-quality products over outlays (and prices) for the products that they replace is economically substantiated. But, as noted in the decisions of the 25th CPSU Congress, an extremely important principle in establishing wholesale prices for new items, especially machines and equipment, is the lowering of price per unit of useful effect.

In providing for the compensation of additional outlays connected with the improvement of quality, prices should give producers an economic interest in the production of high-quality products and give users an economic interest in their use. In order to increase the interest of both in high-quality products, the economic effect must be optimally distributed between them, and part of this effect must be reflected in wholesale prices. The following basic guidelines for the reflection of product quality in products' wholesale prices can be identified: (1) the establishment of a definite connection between the consumer properties of a product and outlays for its production, as well as between consumer properties and the absolute amount of normative profits; (2) the incorporation of above-normative profits in prices in a differentiated fashion, depending on products' socioeconomic effectiveness.

The unit-cost of products is an extremely important component of and the basis for calculating the lower-limit price. Production and marketing costs come to as much as 86% within the structure of enterprises' wholesale prices. In a number of cases, improvements in product quality depend on improvements in the quality of raw materials and other materials, manufactured components, etc. This is reflected to a certain

extent in the unit-cost of finished products. Improving the quality of manufactured items often results in raising pay per unit of expended labor, since highly skilled manpower is required in order to do so. Through the average branch unit-cost, increased outlays are taken into account in the prices of new, higher-quality items.

However, the amount of outlays and the complexity of a product and of the technological process required to produce it are not directly related to the level of the product's consumer properties. An absolute increase in outlays and improvement in the quality of the means of production do not, in and of themselves, guarantee an improvement in the quality of the product produced. This pertains not only to outlays of material and technical resources, but also to basic wages and supplementary wages paid out when an item meets technical conditions and standards.

In the practice of price formation, outlays are often regarded apart from their connection with the quality and consumer properties of products and their economic effectiveness. Therefore, the price of a product does not significantly reflect the social evaluation of its quality through its unit-cost, and the level of the lower-limit price bears little relationship to the social evaluation of a product's useful properties.

Normative profits in prices (as percentages of unit-cost) reflect the technical and economic level of products only to the extent that unit-cost reflects product quality. As already noted, this is utterly insufficient. Since wage outlays are weakly linked to the technical and economic level of products, product quality also has no significant effect on profits, which are determined in accordance with normative percentages of unit-cost, net the value of material outlays. In calculating profitability (relative to production assets), the amount of normative profits incorporated in prices is practically unrelated to the quality of products produced. Consequently, such a component of the lower-limit price as the normative size of profits does not adequately reflect product quality.

Wholesale prices usually are not revised when products become obsolete; therefore, these prices do not adequately take into account the quality of products during the period of their series production, in addition to the moment that these prices are approved. As is known, 1955 prices were in effect for 12 years, and 1967 prices for most items are not scheduled to be revised until 1982. Experience has shown that such prices become divorced from value, provide unjustifiably high or low profitability, fail to reflect product quality and real economic processes, weaken the measuring and incentive function of prices, and make it more difficult to evaluate and provide incentives for the performance of enterprises and associations. Therefore, increasing the influence of prices on product quality and technical progress is related more closely to the planning of prices and the substantiation of their level in accordance with the extent to which products become obsolete.

Under the conditions of accelerating scientific and technical progress, time periods for the updating of products are reduced; a significant number of these products (especially in the machine-building branches) become obsolete in a short time. For example, when new prices for machine-building output took effect on 1 January, 1973, it turned out that in comparison to the makeup of output included on the price lists that had taken effect on 1 July, 1967, the products list had been updated by 45%, on the average, and by 60% to 80% in certain machine-building branches. Obsolescence tends to accelerate. One can fully agree with the view that "the time it takes for products to become obsolete will be shortened in the future, and in principle this tendency may encompass an increasingly wide range of items.*

This circumstance makes it especially urgent to solve the problem of taking product obsolescence into account in planning prices for the machinery industry, whose products predetermine the technical level of production in the economy. At present, the increase in the productivity of new machinery in comparison to that which it replaces amounts to 5% to 20%

* A. Koshuta and L. Rozenova, "The Obsolescence of the Means of Labor and Price Formation," VOPROSY EKONOMIKI, No 9, 1975, p 65.

throughout the machinery industry as a whole.* The CPSU Central Committee and USSR Council of Ministers' decree "On the Further Development of Machine Building in 1978-1980" provides for increasing the productivity of machine-building output in 1985 by a factor of 1.5 to 2 over the 1975 level and lengthening its operating life prior to complete overhaul. The need to take the obsolescence factor into account in setting prices for products is dictated by the objective conditions of the development of production. Let us examine, from these positions, the formula for the lower-limit price, which determines, in practice, the level of a new product's wholesale price:

$$P_{11} = U (1 + N_1), \text{ or } P = U + NC, \quad (1)$$

where U is a new product's unit-cost that is taken as the basis of its wholesale price; N_1 and N are the normative profitability that is established for a given branch in accordance with unit-cost and the value of production assets; and C is the capital-output ratio of a new product, taking into account the additional capital investments required to produce it. As a rule, the lower-limit price (P_{11}), taken as a second-stage price (with normative profitability), is not revised for a long period (up to 10 years or more). Meanwhile, both individual and average branch unit-costs (U) decline every year, and what's more, decline substantially, under the impact of various factors. This is evident from the data cited below from a study of the dynamics of the unit-cost of the products of enterprises in various machine-building branches:

*See PLANOVOYE KHOZYAISTVO, No 7, 1979, p 108.

Name of product	Unit-cost of product as a percentage of its unit-cost in first year of series production					
	1st	2nd	3rd	4th	5th	6th
Screw-cutting lathe	100	90.2	89.1	87.7	85.8	
Digitally-programmed screw-cutting lathe	100	87.5	85.7	82.1	83.5	
Gear-milling machine	100	88.7	85.3	83.5	79.5	
Universal tool grinder	100	94	85.1	76.4	66.1	63.7
Iskra-III computer	100	85.4	46.1	38.2	35.3	27.2
Passenger car	100	93.0	72.9	63.9	61.1	61.6
Tractor A	100	77.2	66.4	62.8	58.7	
" B	100	52.6	43.2	39.7	34.8	32.6
" C	100	51.1	43.7	40.1	36.1	32.5
" D	100	46.4	38.0	34.7	33.1	30.4
Single-bucket excavator	100	84.4	83.3	80.4	82.2	

As the total production volume of a new product rises and the technical level of production increases, the capital-output ratio per unit decreases. Both factors (U and C) that are related to the production of the product are dynamic and over a period of time deviate significantly from the magnitudes initially built into the lower-limit price. As the production process is smoothed out and the volumes and duration of a product's production increase, the cost of production declines; usually the stable price deviates from this cost in an upward direction. This often results in increasing the relative cost of products that have previously been put into series production and have grown obsolete, and in causing them to realize a high profitability.

The profitability of such products sometimes exceeds several times the normative rate, whereas the profitability of high-quality new products is presently limited to double the normative rate, together with the incentive markup. The excessively high level of prices for old output improves a number of the manufacturers' principal performance indices. In these conditions enterprises often have no interest in taking insufficiently effective or simply obsolete products

out of production, since the economic measures aimed at accelerating the development and putting into production of new products are not proving to be effective enough.

With the development of the production of any given product and the increasing satisfaction of the economy's needs for it, the appearance of similar or substitute products and materials, and the rise in the requirements and demands that are made on the product as to quality, etc., the product's economic effect declines even though its technical parameters remain unchanged. In these conditions, if the existing wholesale price is not revised for a long time, the relative cost of the product gradually increases, and its price per unit of useful effect rises. This is why, in our view, it is entirely correct to reduce existing prices to the extent that products become obsolete and their economic effectiveness declines, even if the outlays for a product's production remain on the original level.

The provision that the CPSU Central Committee and USSR Council of Ministers' decree makes concerning the maintenance of stable wholesale prices in industry over the course of a five-year plan period is important for strengthening the influence of prices as incentives for production efficiency and product quality. It must be noted first of all that the stability of wholesale prices does not mean "freezing" them on some constant level, e.g., the level of prices existing as of the beginning of the five-year plan period. Stability requires that existing prices be revised and that fixed five-year prices be planned and approved prior to the next five-year period in light of objective factors affecting the level and dynamics of prices over the course of the plan period.

Evidently, it is a good idea to plan stable wholesale prices for no less than the upcoming five years by setting graduated prices. Graduated prices do not contradict but presuppose price stability. The system of graduated prices provides for the planned regulation of the wholesale price level for the plan period, taking into account proposed changes in the quality of products, their economic effectiveness, and outlays for their production. According to the Guidelines for Determining Wholesale Prices for New Technical Industrial Products, the incentive-stage wholesale price may be replaced

by a second-stage price within a stipulated period. At the same time that the first-stage price for a new product is set, second- and third-stage prices may also be set, to take effect after specific time periods. When a general or partial revision of existing wholesale prices is carried out, a graduated price may also be set for products previously put into series production, with an indication of the time periods during which each price stage will be in effect. Consequently, most products in series production will, over a period of time, have a series of graduated prices, which will be successively revised (usually reduced) after predetermined periods.

As has been proposed in the economics press, five-year plans should be drawn up in terms of planned prices, which will guarantee the plans' stability. Price adjustments not provided in the plan should not lead to the amendment of production plans, since this would weaken the influence of prices and plan indices as incentives for increasing production efficiency and product quality. Thus, the stability of both prices and plan indices will be ensured for the five-year period. The approval of graduated prices for a five-year period makes it possible, on the one hand, to solve the problem of the stability and flexibility of wholesale prices, and on the other, to reflect product quality in prices by differentiating profitability in accordance with the socio-economic effectiveness of products and the social evaluation of their consumer properties.

As the experience of a number of ministries has shown, the introduction of a system of graduated prices and incentive markups in wholesale prices, the improvement of the planning of product-quality indices and of the evaluation of the fulfillment of these indices, and the use of markups in combination with other measures to improve the management of production and scientific and technical progress have made it possible to increase enterprises' interest in improving product quality and developing new, highly effective products and putting them into production. For example, in the electrical equipment industry, where incentive price markups have been used since 1969, the level of product quality has risen substantially, the process of updating products has been accelerated, and the economic effectiveness of new products

has risen. Products in the highest quality category rose from 4.2% of total production volume in 1968 to 42.7% in 1978, and over the same period the proportion of products in the second quality category dropped from 23.1% to 1%. In 1978 the number of new products in the branch was approximately three times as high as it was in 1968, and the economic effect obtained from the production and use of these products in the national economy was nearly 10 times as high. In 1969-1978 the average annual rate of increase in products in the highest quality category was 35%, whereas the average branchwide rate of increase in total production volume was 8%.

Positive results have also been achieved in other industrial branches. Thus, in the Ministry of Heavy and Transport Machine Building, the proportion of output in the highest quality category increased by a factor of 4.3 from 1973 through 1978 and reached 28.5% of total production volume; the economic effect obtained from products bearing the Seal of Quality increased by a factor of more than 12; and the total amount of incentive price markups received for product effectiveness and quality rose by a factor of more than 5.

An analysis of the establishment of incentive wholesale-price markups shows that graduated prices are an important direction for the further improvement of prices and the enhancement of their incentive function. However, the principle of graduated prices is far from being fully implemented, as a result of the fact that enterprises and ministries avoid the application of price markdowns (frequently by delaying certification or systematically postponing the deadlines for taking obsolete items out of production). This is precisely why wholesale-price markdowns have not received widespread practical application, although at a number of enterprises output in the second quality category makes up a significant proportion of total output volume.

The decree on improving planning and the economic mechanism provides for increasing the influence of prices as incentives for systematically updating products lists and removing obsolete items from production. Wholesale-price markdowns amounting to 50% of profits are established for products in the second quality category, and after the expiration of

deadlines for taking products out of production, these markdowns rise to 100% of profits. In our view, in order to implement this measure the procedures according to which manufacturing ministries submit proposals for reducing previously approved prices ought to be changed. It would be a good idea for certification commissions to make decisions on the deadlines for making first and second wholesale-price markdowns on products at the same time that they assign them to the second quality category.

The reduction in the wholesale prices (the application of markdowns) of products in the second quality category mainly affects the size of profits and the level of profitability. Evidently, prices also should be reduced through a reduction in the production outlays that are taken as a basis for calculating wholesale prices. In our view, such an approach is fundamentally important. In the first place, the wholesale price of an obsolete product would be reduced even if it was unprofitable for an enterprise. In the second place, this would make it possible strictly to regulate and restrict outlays for the production of obsolete products. Thus, if production of an obsolete product continued, its price could be used to regulate outlays for its production, instead of the other way around.

Moreover, enterprises have an interest in maintaining a high level of prices by means of increased profitability, which makes it possible for them to weaken the negative effect of price markdowns on their performance indices, since when profitability is high a 10% or greater reduction in wholesale prices allows them to maintain profitability at half the normative rate. This may be eliminated by reducing price by the method of adjusting unit-cost in accordance with the actual level and correspondingly reducing unit-cost in accordance with the extent of a product's obsolescence. In this connection, a price may be reduced by limiting profitability and correspondingly adjusting the outlays that are taken as a basis for calculating price.

A first-stage wholesale price with an incentive markup over the lower-limit price amounting to 20% to 100% of normative profitability is established for highly effective new products and products in the highest quality category. The

decree on improving planning provides for an incentive markup of 50% to 125% of normative profitability, but no more than 70% of annual economic effect. The amount of the markup will be increased 1.5-fold if the production of new, highly effective products and products bearing the state Seal of quality is based on developments that have been accepted as discoveries or inventions according to established procedures. This will make substantial changes in the markup system and make it possible for the technical and economic level of new products to be reflected more fully in prices.

The CPSU Central Committee and USSR Council of Ministers' decree sets the period for which an incentive markup is in effect at up to four years, and up to five years for especially complicated products. When a product is recertified and awarded the state Seal of Quality a second time, the incentive markup is maintained at the same level on the condition that the technical and economic parameters of the product in question have been improved. However, if the technical and economic parameters have not been improved when a product is awarded the state Seal of Quality for the second time, the amount of the markup and the period for which it is in effect are halved. The implementation of this measure will help give enterprises a greater interest in maintaining high product quality during the period that products are in series production.

Until the present time, wholesale-price markups have usually been set for periods of up to three years. Following the expiration of this period, they are removed, even though products bear the state Seal of Quality. This has violated the principle of taking product quality into account in prices. Moreover, wholesale prices do not reflect the relative appraisal of a new product's quality, since the factor of consumer properties is not taken into account in lower-limit prices.

The maintenance of incentive price markups on items in the highest quality category for the entire period, i.e., until they are transferred to the first category and second-stage prices are established for them, will unquestionably play a positive role in increasing the production of high-quality products. In our view, it would also be a good idea to

continue to maintain a certain price markup if a product meets the requirements of the highest quality category and is awarded the Seal of Quality in subsequent (third, etc.) certifications. This procedure would make it possible to implement more consistently the principle of taking product quality into account in prices and would give enterprises a greater interest both in developing and putting into production high-quality products and in maintaining product quality at an up-to-date level during the period of series production.

The establishment of a direct link between the amount of incentive markups and economic effectiveness is an important condition for correctly reflecting quality in the price of items. The size of the distributed economic effect is taken as constant over the entire period in which the first-stage, incentive price is in effect. Evidently, this procedure ought to be revised in connection with the increase that the new decree stipulates in the period for which markups are in effect.

The amount of a new product's distributed effect (E_d) is determined according to the formula:

$$E_d = P_{ul} - (P_{ll} + O_{sp})(1 + K_m), \qquad (2)$$

where P_{ul} is the upper-limit price; P_{ll} is the lower-limit price, O_{sp} represents planned (on the basis of estimated) outlays of enterprises connected with preparing for and starting up the production of a new product; and K_m is the coefficient of the minimum increase in a new product's upper-limit price above the sum of its lower-limit price plus outlays for preparing for and starting up its series production.

An analysis of this formula shows that the factors determining the lower-limit price (P_{ll}) change substantially as an item is put into production and continues to be produced; consequently, P_{ll} should also change. The factors affecting the upper-limit price (P_{ul}) are equally dynamic, and this price also changes, if one calculates according to figures for the second, third and subsequent years in which a product is produced and used. Consequently, as a new product is put into production and continues to be produced, not only the

absolute amount of the distributed economic effect (E_d) changes, but the ratio of the upper-limit price (P_{ul}) to the sum of the lower-limit price plus outlays for putting the product into production ($P_{ll} + O_{sp}$) also changes.

All this is of fundamental importance and, in our view, indicates the necessity and possibility of changing the amount of markups in accordance with the dynamics of economic effect over the period in which the first-stage price is in effect, or of establishing several price stages, with the amount of incentive markups changing in a planned fashion in accordance with the reduction in economic effect.

The extent to which the economic effect should be reflected in prices in the form of incentive markups is an urgent question. The existing scale of markups is set up in such a way that the better a new product's consumer properties are in comparison to the one it replaces and the greater $P_{ul} / P_{ll} + O_{sp}$, the lower the share of economic effect taken into account in the wholesale price in the form of incentive markup. If $(P_{ul} / P_{ll} + O_{sp}) > 3$, then no matter how this ratio increases and differs among various items, the size of a markup will be the same and is presently equal to normative profitability. Thus, the share of economic effect incorporated in the incentive markup may fluctuate among different products from the maximum of 50% (according to the decree--70%) to several fractions of a percent. This may distort the measuring function of prices to a certain extent and substantially weaken the incentive influence of markups. For example, in 1976-1977 more than 4,000 wholesale prices with incentive markups were approved for machinery, equipment and instruments. They took into account only 10% of economic effect, and the average amount of markups was 4% of wholesale prices.*

At enterprises in the electrical equipment industry, where the system of incentive markups has been widely adopted, additional profits in the form of incentive markups amount to only 7% of the distributed economic effect. The rest is transformed into quantitative and qualitative indices of the

* See VOPROSY EKONOMIKI, No 4, 1978, p 103.

enterprises that produce the new products. In addition to weakening the incentive function and distorting the measuring function, the distribution of the economic effect of new and highly effective products in such proportions does not contribute to the correct formation of indices and complicates evaluation of the performance results of both producer and user enterprises.

In our view, proposals that have been expressed in the press that not only $P_{ul} / P_{ll} + O_{sp}$, but also the absolute amount of the annual economic effect obtained from the production and use of new products be taken into account in determining the amount of wholesale-price markups merit attention. In this connection, it would be a good idea to allow the amount of wholesale-price markups for fundamentally new and highly effective products to be increased up to twice normative profitability, within the limits of 70% of the distributed economic effect.

At the same time, the economic effect of new machinery, net the portion that is placed at the disposal of producer enterprises in the form of the incentive markup, should not be fully accumulated by user enterprises and fully reflected in their performance indices. As the natural result of increasing the social productive force of labor, this economic effect should evidently be redistributed among all the participants in production and, in the final analysis, be turned into the social effect of an improvement in the population's living standard. To the extent that outlays are reduced, the prices of products produced with the use of new machinery should be reduced in such a way that the economic effect connected with the use of new products has no greater impact on the performance indices of user enterprises than on those of producer enterprises. This situation can be achieved by means of the extensive use of markups and markdowns and the planning and approval for five-year periods of graduated prices not only for new products but also for products previously put into production.

The improvement and practical implementation of a system of graduated prices will help enhance the economic substantiation of prices and increase their role in providing incentives for product quality, and in accelerating technical progress.

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INDUSTRIAL DEVELOPMENT AND PERFORMANCE

COMPONENT STANDARDIZATION AS ELEMENT IN PRODUCTION EFFICIENCY

Moscow VOPROSY EKONOMIKI in Russian No 3, Mar 80 pp 24-32

[Article by A. Gusarov and A. Stoynik]

[Text] Standardization of components is one of the important ways of raising the efficiency of social production. It makes it possible to eliminate the duplication and unjustifiable diversity of products and elements and also types of technologies. This type of standardization guarantees a large economic benefit and a high rate of return on the small capital outlays and is among the most highly intensive factors of economic growth. It is therefore important to clarify the real role of the use of standard components and assemblies and to adopt measures to assure development of this process.

It may seem at first that the scientific-technical revolution runs counter to the use of standard components and assemblies or even precludes it. In actuality matters stand differently. The complexity of the problem is that the scientific-technical revolution is accompanied by a virtual explosion in the list of products. In our country between 1966 and 1976 more than 28,000 new industrial products were put into production. This is a normal phenomenon, since mechanization and automation are embracing ever new areas of social production in which sectors and subsectors of the economy are rapidly taking shape, consumer demand is experiencing qualitative changes, and so on. But there is also another aspect of the problem generated by shortcomings in designs and in the organization of production, the result being the emergence of products which do not meet the requirements of present-day production. This unfavorable side of the growth of the products list and product assortment in the context of scientific-technical progress is an obstacle to higher efficiency. The problem is to combine the explosion in the products list with standardization of products and product components.

The effectiveness of this type of standardization is achieved in all stages of the production and use of the social product. Experience shows that the labor intensiveness of scientific research, design and process engineering projects are reduced to one-third--one-fifth. At the same time new product

design times are reduced to two-thirds--two-fifths, which brings about a reduction of total costs of preparing production. Moreover, the use of standard components and assemblies makes it possible to increase series size and on that basis to reduce the level of the load on equipment and to drop the production cost by more than 20 percent. At the same time, when a new product is to be manufactured, the mobility of production increases, and that plays an important role in the context of the scientific-technical revolution. And finally, in the stage of the finished product's use, the use of standard components and assemblies guarantees a reduction of the list of replacement parts, reduces repair costs to two-thirds--two-fifths, increases the length of the repair warranty and service life, and improves the quality of attendance of machines, instruments and units.

The problem of the capital intensiveness of production has become much more severe in the context of intensive economic development. The use of standard components and assemblies makes it possible to transform production with relatively small capital outlays. For instance, 70-80-percent use of borrowed standardized parts reduces by 40-50 percent the work of preparing production, and the development and production of standardized jigs, tools and fixtures reduces to one-tenth--one-twelfth the cost of their manufacture; this could release 200,000 workers employed in making tools available for other work by 1983, and their number by 1990 would be 1 million. Experience shows that the production of standardized jigs, tools and fixtures is repaid in 5 months.

One of the important conditions for raising production efficiency is to raise the level of utilization of production equipment. In the Report Address of the CPSU Central Committee to the 25th party congress L. I. Brezhnev noted: "Because of underutilization of production capacities our output is many billions of rubles less than it might be every year. These can be termed direct losses. But actually the losses are just as great because far from all ministries and departments are undertaking a vigorous effort toward specialization, to redistribute resources in favor of interindustry production operations, and to set up plants specialized in the production of jigs, tools and fixtures and standardized assemblies and parts. Repair facilities are fragmented beyond all measure. Such tendencies result in a considerable squandering of all types of resources."

The organizational structure of production that was historically shaped in the country on the basis of self-sufficient enterprises producing their own intermediate products, assemblies, parts and tools has resulted in fragmentation of the production of products which have the same functional purpose and a situation in which individual enterprises manufacture an excessively high number of products. Identical products are produced at different enterprises in many industries. Parts production averaging less than 100 units per item per year represents the following proportions of total output in these industries: 66 percent in heavy machinebuilding, 61 percent in electrochemical machinebuilding, 70 percent in chemical machinebuilding, 62 percent in machine tool building, 43 percent in instrumentmaking, 40

percent in motor vehicle building, 52 percent in agricultural machine and tractor building, 60 percent in road machinebuilding, and 50 percent in machinebuilding for light industry and the food industry.* Under those conditions equipment, specialized and highly productive equipment in particular, cannot be utilized at full capacity. In the industrial sector the total use of equipment in two shifts averages 45-50 percent.

Machine tools with digital programmed control are also being used inefficiently. It is an important problem of the national economy to increase the load on equipment. One of the principal conditions for solving this problem is to sharply increase the size of the production series through maximum standardization of products similar in their design and manufacturing technology. This will make it possible to reduce the number of their types and sizes, to increase the size of the production lot, and to reduce the number of setup changes. For example, calculations made at the Leningrad Pnevmatika Plant showed that reduction of the number of setup changes from three to one makes it possible to double labor productivity.

Concentration of products similar in design and manufacturing technology to the level necessary for efficient utilization of new equipment and the most recent manufacturing technology is a precondition for development of present-day specialization. Organizing specialized production of products on the basis of their similarity of design and manufacturing technology will make it possible to reduce by 45-55 percent the production cost of machinebuilding as a whole.**

The increase in the size of the production series through the use of standard components and assemblies is a highly effective condition for setting up specialized production operations. For example, in tractor and agricultural machinebuilding the size of the production series of many types of interindustry products increased between fivefold and 12-fold thanks to development of this kind of standardization, and this made it possible to concentrate their manufacture at specialized enterprises. Moreover, the production of almost all tractor diesels has been transferred to the large new plants which have been built. Similar organizational changes are taking place in the motor vehicle industry, the electrical equipment industry, heavy machinebuilding and other industries.

Specialized production operations which have been set up frequently serve not only the industry to which they belong, but others as well. In this way large-scale interindustry enterprises or shops manufacturing interindustry products in volumes exceeding the requirement of the industry are

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* D. I. Polyakov and A. I. Kostin, "Spetsializatsiya v mashinostroyenii" [Specialization in Machinebuilding], Izdatel'stvo Mashinostroyeniye, 1975, p 26.

** Yu. K. Kozlov, "Organizatsionnyye problemy nauchno-tekhnicheskogo progressa" [Organizational Problems of Scientific-Technical Progress], Izdatel'stvo Mysl', 1972, p 377.

coming into being within the existing industries. For example, the Yaroslavl' Motor Plant is producing a line of motors for tractors, motor vehicles, diesel locomotives, motor launches, railroad transport, and construction and road machines. Development of the use of standard components and assemblies is bringing about more elaborate division of labor and substantial structural changes in social production.

Optimum reduction of the list of finished products, raw materials and supplies increases the level and quality of cooperative efforts, augments the size of the production lot and improves the regularity of deliveries. For example, efforts to standardize components and assemblies at Leningrad enterprises reduced the number of types and sizes of parts and materials received by 27,000 and types and sizes of fastenings by 16,000 items. Enlarging the size of the production lot of components, raw materials and supplies of the same type reduced shipping costs and production stocks at enterprises and increased the rate of turnover of working capital.

Raising the level of concentration thanks to standardization of components and assemblies and the use of progressive equipment will bring about an improvement in the quality of the products produced and fewer rejects and customer complaints in the production process. Nor is this any accident. The stability of production makes it possible to do a good job of working out the production technology and design of parts and assemblies, and the increase in the relative share of these elements improves the quality of the end product. Experience has shown that using base models to create a line of tractors, motor vehicles, diesel locomotives, motors, tower cranes and other machines has made it possible to sharply increase the warranty period and to improve the quality of machines to the level of world standards. For example, the operating life of a standardized motor doubled, its warranty period increased 70 percent, the need for spare parts was 23 percent smaller, and its quality and performance improved.

The mobility of production depends largely on standardization of components and assemblies, which speeds up the rate of renewal of the products of the economy and reduces the time required to assimilate progressive technology. This is an important factor in the development of scientific-technical progress and in making our products more competitive on the world market. For instance, building metal-cutting machine tools from standard units reduces the average time required to design them and put them into production from 2-3 years to 2-4 months, the reduction for automatic production lines is from 3-4 years to 6-10 months, for trucks it is from 2-3 years to 5-6 months, for tractors from 5-6 years to 1 year, and so on. According to figures of the Scientific Research Institute for Standardization, widespread use of standard components and assemblies will make it possible to reduce to two-thirds--one-half the time required to assimilate new technology.

Product standardization and standardization of manufacturing processes raised the level of quality of personnel training for various industries.

The substantial reduction in the diversity of production thanks to the performance of these projects improves the teaching of skills to personnel and increases the number of occupations which are interchangeable or which can be combined. Performance of this kind of standardization on a broad scale makes a large number of workers available for other work. This makes it possible to redistribute manpower resources optimally into those production sectors where an acute shortage of manpower is being felt.

Standardization is at present developing along the following main lines: standardization of a "family" of machines for different purposes using a single base model; maximum utilization of assemblies and parts of the same kind in different machines; and development of standard designs containing common elements, that is, standardization of manufacturing processes.

Another promising direction in the building of present-day machines of high quality is to build them up from standard units. At the present time many types of machines, appliances, instruments and consumer goods are being developed and produced starting from base models. For example, a "family" of trucks with 39 modifications has been created in the AvtoZIL Association. Moreover, the level of standardization of parts has reached 96.4 percent, which yields an annual saving of 80 million rubles. Mechanical engineers of AvtoZIL have also created 15 base models of KamAZ trucks using only 2 modifications of the engine, steering gear, cab, and so on. The level of standardization for the 15 base models is about 90 percent.

At the Krasnyy Proletariy Plant 26 modifications of lathes for different purposes have been developed and put into production on the basis of a single base model. In all the variants more than 90 percent of the parts of the base machine tool are borrowed, which makes it possible to organize large-series production with the most up-to-date technology. The economic benefit runs to 80,000 rubles in the stage of design and development alone.

Standardized motors have been created at the Yaroslavl' Motor Plant for different pieces of equipment: motor vehicles, tractors, truck tractors, launches, truck cranes, power plants, and so on. The level of use of standard components and assemblies has reached 90 percent, and motor operating life has doubled. Between 1965 and 1970 the economic benefit from increasing the operating life of motors accumulated in an amount sufficient to build two motor plants with the same capacity as that in Yaroslavl'.

At the present time there are a large number of different types and sizes of assemblies and parts for the same functional purpose used in different industries. For instance, enterprises are producing about 480 types and sizes of nuts, 1,000 types and sizes of electric motors, 1,300 screws, 18,000 bolts, 25,000 wire springs, and so on. It is well known that interindustry products comprise about 40 percent of the production of machine-building, and products confined to the industry approximately 20 percent. This makes it economically indispensable and possible to undertake type standardization of interindustry and industrywide products for exactly the

same purpose. Today certain types of products which have broad interindustry and industrywide uses have been standardized: reducers, gears, bushings, hydraulic drives, pumps, crawler track links, plows, etc.

Work done to standardize parts of automatic equipment is becoming very important. This equipment is manufactured at different enterprises. Moreover, enterprises are making 43 percent of the new equipment they need for themselves. Automatic equipment is manufactured at specialized plants under individual designs on the basis of customer requests, so that there are 130 types of electronic computers of different designs in operation. Automatic equipment of different models but an identical purpose is in use at enterprises, which makes operation and repair considerably more difficult. It seems to us that it is high time to develop automatic equipment, instruments and apparatus with kindred design and manufacturing technology. This in turn will make it possible to organize their series manufacture using progressive equipment and technology, to reduce production costs, and to increase the quality of the automatic equipment. Research shows that the standardization of the assemblies and parts of the automatic equipment to be produced reduces the products list to one-eighth--one-tenth and shortens the average design time to one-sixth--one-eighth.

As production is made more mobile, new requirements are being imposed on the construction of production buildings and structures. At the present time buildings are designed for a service life of more than 50 years. They are built with permanent walls and partitions, and they are planned only for a certain set of equipment. Often production buildings of this kind are unsuitable for the installation of new equipment, especially if the production process is continuous or on a flow line. This is an obstacle to technical reconstruction of production.

Our country's progressive know-how and also foreign experience (the United States, West Germany, Japan and the GDR) confirm the efficiency of building production buildings with alterable ceilings and floors, movable walls, external hoisting machinery and standardized utility installations for enterprises for different industrial purposes. Standardization of elements in the designs of buildings and utility installations makes it possible to make the transition to the conveyor method of building them using team assembly, which considerably reduces construction time. In view of the new requirements of the national economy applying this principle to construction will make it possible to alter the character and structure of production of an enterprise in a short period of time and to improve the list of products being produced.

Given the objective persistence of small-series and single-unit production, it will be very important to raising efficiency that maximum use be made of the continuity of manufacturing processes. Research shows that as much as 80 percent of the entire list of parts can be produced with standard

manufacturing processes already developed.* Introduction of these manufacturing processes will make it possible to solve an important problem of the national economy--putting the manufacture of tools and production jigs and fixtures on a present-day technological foundation.

In the USSR tools, jigs and fixtures are manufactured at almost all industrial enterprises. Specialized production accounts for 4.4 percent of the jigs and fixtures and 35.1 percent of the tools manufactured. Moreover, the tool plants as a rule have a large products list, but the size of the series of the individual tools, jigs and fixtures is small. The labor intensiveness of designing and manufacturing tools, jigs and fixtures is about 80 percent of the total labor intensiveness of the preparation of production and exceeds by a factor of 2-2.5 the labor intensiveness of a product design that has been developed. The low level of standardization of manufacturing processes does not allow for reuse of tools, jigs and fixtures. Only 20 percent of all the manufacturing attachments are reused, while the other 80 percent are scrapped.

In spite of the large economic benefit achieved by individual enterprises in the field of component and part standardization, this process is going slowly. Serious shortcomings in management account for poor work on standardization of components and assemblies, and in many cases this effort has been intolerably neglected. Moreover, the present economic mechanism not only fails to guarantee that projects be set up for component and assembly standardization, but it even stands in their way. It is therefore necessary to improve the mechanism for management of component and assembly standardization. This applies above all to drafting a unified goal-oriented program for component and assembly standardization.

Component and assembly standardization is a complex process in which production undergoes alteration throughout the entire vertical chain of a product's manufacture. But standardization of components and assemblies results in improvement not only of vertical, but also horizontal relations--it brings about a reduction in the number of types and sizes of identical assemblies, parts, and tools produced at enterprises of different industries. Therefore projects to standardize components and assemblies should be carried out only in an interrelated fashion so as to achieve the optimum benefit. Development of component and assembly standardization is above all an industrywide and interindustry problem, and to limit such projects to the framework of individual enterprises or groups of enterprises reduces their potential benefit.

Widespread component and assembly standardization presupposes changes in the engineering, technological and organizational levels of production, and therefore the comprehensive national economic program for component and

* B. D. Rabinovich and B. V. Donskoy, "Ekonomika zavodskoy standartizatsii" [The Economics of the Adoption of Plantwide Standards], Izdatel'stvo Znaniye, 1974, p 37.

assembly standardization should be closely coordinated with other programs aimed at improving social production. At the present time there is no interindustry national economic program for assembly and component standardization. In our opinion a purposive national economic program should include a set of measures to develop and interrelate the most important lines of product and assembly standardization and also to give them scientific, organizational and economic, and material support. Such a program might contain the following main directions for development of component and assembly standardization in the future: systematization on the principle of common function of all products (parts, assemblies and tools) of interindustry importance and their subsequent standardization by developing parametric series, and unit-standardized systems of machines or groups of finished products; the publication of books of standardized products and base models; the drafting and adoption of state and industrywide standards governing standardized products, parts, assemblies, tools, etc.

The economic section of the program should include measures aimed at developing comprehensive component and assembly standardization and related to improvement of planning, material incentives and pricing. Moreover, in all stages from design to operation of the product it is indispensable that the manufacturer and consumer have an interest in the inclusion of a larger number of standardized elements in the product and in new designs. Increasing the use of standard components and assemblies should be an important parameter in planning and incentives.

The comprehensive program should provide for a broad range of qualitative transformations of production interrelated in terms of participants and times. Of course, it takes a lot of time to draft such a program. If a program meeting present-day requirements is to be drafted in a short time, a large group of specialists who have accumulated experience and professional knowledge in this field need to be enlisted in the effort.

Interindustry planning of component and assembly standardization needs to be combined with planning on the basis of special-purpose programs. At the same time the present principle of drafting the national economic plan by sectors and industries does not allow for optimum utilization of the advantages of component and assembly standardization, since no separate industry can correctly outline the direction for development of component and assembly standardization as a comprehensive intersector process. The present system for drafting industrywide plans is based on planning the development of component and assembly standardization on the basis of the level already attained. In the absence of intersector programs for component and assembly standardization planning indicators of industries in this field are actually incorporated into the national economic plan without changes.

These shortcomings are manifested with particular vividness in the drafting of annual national economic plans for component and assembly standardization. For certain products the level of assembly and component standardization is planned on the basis of different methodological principles.

For instance, standardization of certain groups of products is planned by types, others by classes, still others by types and sizes, and so on. In this situation putting the planning targets in specific terms is directly bound up with the scale of projects for component and assembly standardization in the relevant industry or at the enterprise. For example, the level of component and assembly standardization in the national economic plan for certain types of motors is set for specific enterprises and even makes, while for passenger cars and for trucks the planning indicator pertaining to component and assembly standardization is set for groups as a whole. In the motor vehicle industry there is frequently no standardization of components and assemblies of motor vehicles in the same class.

There are also differences in the scale, character and methodology of planning component and assembly standardization at the level of industries and enterprises. In some industries they are limited only to planning adoption of unified design and manufacturing documentation, and in others to the system for technological preparation of production. At many enterprises plans for component and assembly standardization are not included in the technical, industrial and financial plan as an organic part of it. Consequently, there is a diversity of systems for planning component and assembly standardization. This kind of planning lacks a unified set of goals and principles and a uniform methodological approach, and therefore it cannot arrive at the optimum result.

The system of planning indicators has great importance to planning and evaluating the activity of enterprises and industries in developing component and assembly standardization. The present economic indicators do not always orient the producers toward seeking a feasible similarity in design and manufacturing process, nor does it make it necessary for them to borrow, since it allows for plan fulfillment to be achieved even in cases when projects for component and assembly standardization are inadequately carried out. The point is that the principal indicator of component and assembly standardization used at all levels of planning is the coefficient of applicability (proportion of products governed by standards, containing standardized components and assemblies, borrowed or purchased to the total number of products in the enterprise's finished product), but it does not make it possible to determine--and therefore to plan--the actual level of component and assembly standardization. First of all, this coefficient does not reflect the relationship between the planned or actual component and assembly standardization and that which is optimally possible in the design being developed in a given stage of technical development. Second, the elements comprising the coefficient make it possible to speak at best about an indicator of component and assembly standardization and the adoption of standards governing the products of the enterprise, but not the level of component and assembly standardization, since products subject to standards do not automatically contain standardized components and assemblies, especially when the standards are those at the enterprise level. The system whereby standards can be adopted for identical component products allows the existence of different standards.

Component and assembly standardization is among the technical-and-economic factors in development of social production whose scale and pattern of effect are not the same at different levels of management. As a consequence different indicators should be used for judging development of component and assembly standardization at the level of the enterprise, the industry and the national economy. At present consolidated indicators of the process of component and assembly standardization at the enterprise are used as industrywide coefficients. The result is that favorable results in industrywide development of component and assembly standardization are achieved though for all practical purposes the industry has not carried out projects for component and assembly standardization of products of interindustry and industrywide importance.

Consequently, the system of indicators of component and assembly standardization must be differentiated as a function of the particular features of conducting these efforts at the level of enterprises, the industry and the national economy. For example, within industries the following levels might be the planned indicators of the development of component and assembly standardization: component and assembly standardization of products of industrywide and interindustry importance; intermodel component and assembly standardization; the design of products using standard units for the principal groups of products; and the standardization of manufacturing processes. In our opinion the use of these indicators would make it possible to determine the actual scale of the effort being made by each industry.

Shortcomings in the system of material incentives of designers and process engineers are a serious obstacle to development of component and assembly standardization. The present practice in the material incentives of designers has the result that every year a sizable portion (as much as 85 percent) of the total amount of new technology constitutes modifications of prototypes created previously and actually lacking any fundamental innovation: the composition is changed, additional parts are added to the design, and a "new" machine is drafted. The level of component and assembly standardization of such modifications is nevertheless rather low.

The principal effort toward component and assembly standardization of products is being conducted in the stage of project planning and the preparation of production. It is therefore indispensable to relate the system of incentives of designers and process engineers with the enterprise's effort on component and assembly and process standardization. Finished designs should be thoroughly sound whenever they use original components. The material incentives of designers and process engineers must be based on the awarding of bonuses, first, for creation of products containing a fundamental innovation and competitive on the world market; second, for the maximum possible utilization of the analogs that exist in the designs being developed; and third, for the saving the enterprise has achieved through component and assembly standardization.

But underutilization of available analogs in designs does not always depend on the designers and process engineers. The level of the data base for developers of new products is extremely low; cases are not uncommon when for all their efforts they cannot obtain the information that interests them on a particular product. Moreover, information is lacking on products assembled from standardized components and assemblies and there is no method for substantiating the efficiency of using them, which is a serious obstacle to developing the design of products from standard units.

Many enterprises themselves are compiling classifiers of applicable products. They do not have mechanized data retrieval systems, nor normative and reference documentation. There is not even an organization where they might order such a system. That is why a tremendous amount of time is spent tracking down the necessary reference material, and at large enterprises, where the list of parts and assemblies runs to the thousands, it is not efficient at all to do this by hand. In the absence of centralized scientific information the effort toward component and assembly standardization can be conducted only locally, within enterprises or at best within an industry for those types of products on which systematic information is available. It is especially important that plans for component and assembly standardization include the drafting of classifiers for the various types of products containing standardized components and assemblies, that all interindustry and industrywide products gradually be covered and that resources be made available from funds for technical development to carry on this effort.

Taking into account that component and assembly standardization is lagging behind present-day possibilities and needs, a system of measures should be drafted and carried out to speed up development of this process and to accomplish it in two stages: the first should cover that portion of the measures which can be carried out at minimum cost on the basis of generalization and widespread dissemination of advanced know-how; the second would include the broader range of problems involving more thorough component and assembly standardization and supported by the appropriate development of production. The main thing in this stage might be a national economic program for component and assembly standardization, which would be correlated with the State Product Quality Control System, plans for technical development, the specialization of production, etc.

The following are necessary to speeding up the development of component and assembly standardization: raising the level of management of component and assembly standardization, directing it toward solving large-scale comprehensive problems; improvement of the system of planning component and assembly standardization of products and their elements and manufacturing methods; raising the quality with which national economic and industrywide plans are drafted on the basis of a single methodological approach and altering the system of planning indicators according to the level of management; structuring a system of material incentives for designers, developers and manufacturers so that other things being equal there would be an

incentive for a high level of utilization of standardized parts, assemblies and technological solutions; and improvement of the quality of the information base, which is an indispensable prerequisite to the widespread development of component and assembly standardization.

Enhancement of the role of component and assembly standardization in production of the social product is an important condition for utilizing the substantial potential for comprehensive development of this process.

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CSO: 1820

INDUSTRIAL DEVELOPMENT AND PERFORMANCE

BETTER INCENTIVES NEEDED FOR INDUSTRY

Moscow VOPROSY EKONOMIKI in Russian No 4, Apr 80 pp 134-138

[Article by T. Ergashev (Tashkent): "Improvement of Economic Incentives in Industry]

[Text] The decree of the Central Committee of the CPSU and the USSR Council of Ministers "On Improving Planning and Strengthening the Effect of the Management Mechanism on Increasing the Efficiency of Production and Improving the Quality of Work" specified a considerable strengthening of the relationship between material incentive and the efficiency and quality of work, and the final results of productive activity. Measures to increase the role of economic levers and stimuli make it necessary to rebuild the mechanism of economic incentives of production associations (enterprises) in accordance with the new requirements.

Material incentives in industry include the following: bonuses for fulfilling and overfulfilling norms and tasks; wages on the basis of pay rates; various kinds of allowances; bonuses for the results of the current cost accounting activity of the enterprise (association) and for creating and introducing new equipment. Each of these incentive forms has its own financial sources -- wage fund, enterprise profits (or savings due to a reduction in production costs) and extra charges on production costs.

The basic shortcoming of the existing incentive systems of enterprises and production associations is their contradiction and the separation between them. Thus, the contradiction between incentive systems for current results of production and the introduction of new equipment produces a temporary deterioration of current activity indicators of an enterprise (association), including also the fund-forming, as a result of which the sizes of deductions from profit to the material incentive fund decrease. In this case, a paradoxical situation is created -- the production collective is interested in achieving high results of economic activity, while measures for scientific-technological progress become unprofitable because they temporarily depress the cost accounting indicators.

Also contradictory is the incentive system for supplying products for export because the production of products intended for foreign markets is connected in most cases with expenditures which affect production cost and profit. Moreover, there are other negative sides to the existing systems of economic incentives -- an insufficient tie with the increase in the labor productivity indicators, complexity of accounting, and monitoring the bonuses, etc.

It should be noted that the implementation of the new decree will facilitate the elimination of many of the above shortcomings. It specifies measures on the further development of cost accounting and the strengthening of the role of economic levers and stimuli in accelerating scientific-technological progress. It must be stressed that there is still a lack of proper coordination in planning between the cost accounting indicators of the enterprise activity and indicators for introducing new equipment. This leads to weakening the cost accounting stimuli for new equipment. For example, not over one to two percent of the material incentive fund formed as a result of cost accounting activity is spent for awarding workers for creating, assimilating and introducing new equipment and technology.

An analysis of the activity of enterprises and production associations of the Uzbek SSR industry indicated that the size of the material incentive fund for paying bonuses to workers has an upward trend. For example, during the past years of the Tenth Five-Year Plan period, at most agricultural and textile machine building enterprises, the size of the bonuses paid out from the material incentive fund reached ten to twelve percent of the wage fund. At the same time, bonuses from the incentive fund for new equipment was below even one percent. This is due to the insignificant size of the fund itself, the relatively small scale and lack of efficiency in implementing measures for scientific-technological progress. In 1978, in USSR industry, money spent on awarding workers for creating and introducing new equipment was 3.7% of the material incentive fund.*

The economic incentive system is being called upon to subordinate the interests of production collectives and each worker to solving general government problems and to increasing labor income which depends upon the increase in the productivity of labor and personal contributions to social production. In our opinion, the solution of these problems would be facilitated by the orientation of production collectives not only toward fulfilling national economic plans, but also toward the development and implementation of long-range programs of scientific-technological development, improvement of consumer properties of the output, the interest of each worker in the results of his labor and in the best final results of the economic activity of the association (enterprise).

* See "National Economy of the USSR in 1978." Statistical Annual Handbook. Izdatel'stvo "Statistika," 1979, page 530.

The system of economic incentive depends on how much the components of the management mechanism, particularly planning, facilitate combining the interests of labor collectives and each worker with the interests of the entire society.

Experience indicates that the system of plan indicators has certain negative aspects. There are frequent cases where enterprises increase profit by disrupting the assortment of products (making the more profitable products), by not fulfilling the plan for supplying labor-intensive products, etc. Moreover, violations of government price discipline are also observed.

The device specifies measures whose implementation makes it possible to convert five-year plans into the main form of government planning. This is important for the efficient functioning of the whole management mechanism, in particular, of the economic incentive system. The development and solution of large scientific-technological problems stipulate the necessity of establishing long-range stable economic norms. The decree stresses the great importance of further development of cost accounting on the basis of the five-year plan goal and long-term economic norms that guarantee an increase in the resources which remain at the disposal of production associations (enterprises) which depend upon the final results of their management activity, with a simultaneous increase in the monetary deductions for the government budget.

These and other measures will provide economic conditions for increasing production efficiency by accelerating scientific-technological progress. In our opinion, the involvement of scientific-technological progress in the sphere of cost accounting relationships will become possible due to the creation of a single system of economic incentive and a reduction in existing autonomous incentive systems. The problem may be solved by forming and utilizing, in production associations and enterprises, a single fund for material incentive (YeFMP).

The expediency of creating the YeFMP from profit obtained by the enterprise (association) is due to the fact that good final results are impossible to obtain without introducing scientific-technological achievements in production. The YeFMP must become the source of bonuses for all categories: workers, employees, management, engineers and technicians as a result of current economic activity, as well as due to achievements in the area of scientific-technological progress.

In experiments conducted in electrical equipment production associations, for example, the "Zaporozhtransformator" and "Uralelektrotyazhmash," the money for all bonus systems above deductions from profit was directed to this fund, made in accordance with basic regulations on forming and utilizing the material incentive fund. Experience has shown

that creating the YeFMP in associations improved the material incentive system as a whole and increased the interest of the workers in the subdivisions (scientific research institutes and plants) in accelerating the rates of scientific-technological progress. At the same time, when creating the YeFMP, it is necessary to proceed on the basis of preserving the present incentive systems and its formation by adding all incentive funds. In our opinion, the system of the fund-forming and fund-correcting YeFMP indicators at associations does not fully respond to accelerating scientific-technological progress and requires further improvement. The efficiency of an economic incentive system depends on the selection of fund-forming indicators which must be established by solving the following problems: increased labor productivity, better quality of products, reduced production cost, increased volume of production, increased efficiency of utilizing production capital increased profit and profitability of production. In this case, the number of fund-forming indicators for each production (scientific production) association and enterprise must be minimal and reflect in its dynamics an improvement (deterioration) of these or other aspects of the production-management activity of the enterprise (association). The basic fund-forming indicators for most sectors of industry may be: productivity of labor, ratio of products of the highest category of quality in the total volume of production and the net profit. However, for individual sectors and groups of enterprises (associations) another combination of fund-forming indicators may be used, taking into account specific conditions of their work and concrete production-economic problems.

Using the net profit indicator has a number of advantages. First, this indicator has a moderating effect on extensive factors for increasing profit so that its use provides for keeping the interest of the enterprise in reducing the capital-output ratio compared to the average value of the industrial sector. Secondly, the value of the net profit is inversely proportional to the cost of the fixed capital and turnover capital used in the process of production. In this case, the more resources used to obtain a unit profit, the smaller the net profit, all other conditions being equal and vice versa. Thirdly, the net profit indicator provides coordination between the cost accounting of the incentive and its source. Fourthly, increasing the role of the net profit indicator in the system of cost accounting relationships prevents enterprises and associations from being interested in artificially increasing the cost of raw materials and expansion of cooperative deliveries.

The question of using net profit indicator as a criterion of the efficiency of cost accounting link and stimulating its activity was discussed after the September (1965) Plenum of the Central Committee of the CPSU. Proponents of the net profit indicator considered it almost the only criterion in the system of cost accounting incentive.

Their basic error is that they idealized the advantages of this indicator. Actually, however, no indicator is capable of taking into account all the multiplicity of problems to be solved in the national economy. The advantages of all indicators, including the net profit, are relative. Therefore, it can function efficiently as a fund-forming indicator in combination with others.

An important role in the economic incentive system of an enterprise (association) is given to fund-correcting indicators that must serve as conditions for deductions from profits in the YeFMP. The size of the actual deductions depends on their fulfillment. In this case, deductions from profits to the YeFMP should fully implement tasks on creating, assimilating and introducing new equipment, technological processes and other measures of technical improvement of production. In case they are not completed on planned schedules, deductions to the YeFMP may be made in accordance with norms reduced by ten to forty percent depending on the degree of incompletion. Providing a relationship between the size of the YeFMP and the schedules of putting the new productive capital into operation is of exceptionally great importance for taking into account the time factor in the production incentive system. This is due to the fact that the efficiency of any measure on scientific-technological progress is so much higher the earlier an economic effect is obtained from it. Incompletion of the plans for new equipment on the planned schedule causes great harm to the national economy.

Another, no less important, fund-correcting indicator is fulfilling the plan of delivering products in accordance with the product list (assortment) and schedules in the concluded contracts. When production associations, enterprises and organizations do not fulfill these tasks and obligations, it is expedient, in our opinion, to reduce the deductions for all fund-forming indicators by ten to forty percent (depending upon the nature of the violation of the contract terms). Evidently, the volume of the YeFMP money should be determined by the USSR Gosplan and sent to ministries (departments) together with norms for forming this fund.

Norms should be established for forming the YeFMP by industrial sectors by taking into account the most important national economic proportions (between consumption and savings in the national income, between the increase in wages and productivity of labor, between the increase in monetary income and the production of consumer goods, etc.); the share of bonuses not to exceed thirty to thirty-five percent of monthly wages; gradual equalization of differences in wages in various industrial sectors; and planned rates of increase in the fund-forming indicators. Control figures and norms for forming the YeFMP will be given to ministries (departments) prior to their development of the five-year plan and serve as a initial base for its preparation.

In their turn, ministries (departments) must, on the basis of this data, determine corresponding indicators and norms for industrial production (scientific production) associations and their directly subordinated enterprises and refine them before the beginning of the five-year plan development.

Ministries (departments)must also develop scales for reducing the norms of deductions from profit to the YeFMP for the unfulfillment of the plan in introducing new equipment, tasks and obligations on delivery of products in the assortment specified by contracts and orders of export organizations. Rates of increase in the productivity of labor and estimated profit are calculated by increasing the totals since the start of the five-year plan period.

Incentive norms should remain stable during the whole five-year plan period. They create an interest of production associations and enterprises in developing and implementing not only current, but also long-range programs for social-economic development that provide for accelerating the rates of scientific-technological development and improving qualitative work indicators. At the same time, if the five-year plan specifies a smaller increase in rates of the fund-forming indicators due to implementing measures on assimilating new capacities, introducing new equipment, etc., then the incentive norms for the corresponding period should be increased somewhat.

It is also good practice to introduce incentive norms for enterprises and organizations within the production associations. Deductions from profit to the YeFMP should be set for groups of enterprises or the industrial sector as a whole. In setting these norms for production associations and enterprises, it is necessary to create priveleges for those collectives who not only adopt intensive plans, but also tasks on creating, assimilating and introducing new equipment and technological processes, and improving the quality of the products.

The new decree specifies the establishment of norms in a percentage of profit (estimated profit) and in individual industrial sectors -- in a percentage of the wage fund of the industrial-production personnel for the year preceding the new five-year plan period.

Ministries (departments) and production associations must get the right to create, within the limits of the YeFMP norms determined for them, centralized material incentive funds made up of deductions from the profit of their subordinate production associations and enterprises. In this case, they should not exceed ten percent of the total YeFMP of the associations and enterprises.

The creation of the YeFMP in production associations (enterprises) will require considerable changes in the distribution and utilization of incentive funds: current bonuses to workers, management and engineering-technical workers and employees, taking into account the quality of labor and products, in accordance with the bonus systems developed by associations (enterprises); a one-time bonus for introducing new equipment and technological processes and participating in measures for further improvement in production; bonuses to workers for results in intraplant socialist competition; material help; payment to workers and employees for vacations in part, corresponding to their share of average wages, paid from the YeFMP; bonus payments to workers for the general results of the operation of the enterprise (association) for the year and the five-year plan period.

Taking into account the special features of the industrial sectors and concrete production-technical problems, it is necessary to develop allowable limits for using the YeFMP for various kinds of incentives. Here, it is good practice that not less than forty percent of the fund be used for current bonuses to workers according to the quality of the work and the products.

We think that up to twenty percent of the YeFMP should be reserved for paying bonuses to workers for the operating results of the enterprise (association) for a year and for the five-year plan period. These incentives should be related to the length of service of each worker at the given enterprise and his contribution to the implementation of the annual and five-year plans.

Reserving a part of the YeFMP until the end of the five-year plan period will make it possible to pay workers considerable (up to two-three month's wages) rewards, which is important in increasing the interest of workers in developing and implementing long-range programs. This measure is also justified by the fact that it may have an important effect on reducing the turnover of cadres and strengthen production and labor discipline. It is obvious that with greater ability to pay, consumer demand for goods will increase, with the structure of the demand being sharply different from current demand. However, with a planned economy, the problem of supplying goods to cover the additional monetary income of the people is entirely solvable.

The solution of this problem will be facilitated by strengthening the economic interest of heavy industry enterprises in increasing the production of consumer goods due to the creation of the YeFMP and simplification of the order of setting prices for cultural-personal service and household goods. At the same time, it is necessary to create a mutual economic interest of industrial and commercial workers

in increasing production and improving the quality of those goods in greater demand by the people. This may be achieved by making long-range contracts between the USSR Ministry of Commerce and industrial associations on the basis of which commercial enterprises must conclude contracts with production associations. Obviously, the share of the YeFMP and incentive fund for workers in commerce must be established for bonuses to implement long-range agreements.

The size of the funds allotted for a one-time bonus to workers for new equipment should be related to the scale and rate of implementation of measures on scientific-technological progress and be not less than twenty to thirty percent.

The proposed methodological approach to the formation of a YeFMP will facilitate further improvement in stimulating production.

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CSO: 1820

REGIONAL DEVELOPMENT

IMPACT OF PRODUCTION FACTORS ON UNION REPUBLIC GROWTH

Moscow VOPROSY EKONOMIKI in Russian No 4, Apr 80 pp 104-112

/Article by Ye. Silayev and A. Baramidze: "The Effect of Production Factors on the Economic Growth of the Union Republics"/

/Text/ Measures on the rational combination of territorial and sectorial planning, which are aimed, on the one hand, at the concerted participation and coordination of sectorial ministries and departments in planning and management on a specific territory and, on the other, at enhancing the role of local economic organs, are specified in the decree of the CPSU Central Committee and the USSR Council of Ministers, "On Improving Planning and Strengthening the Influence of the Economic Mechanism on Increasing Production Efficiency and Work Quality."

The improvement of sectorial and regional planning should be aimed at increasing the efficiency of the entire national economy of the country and its union republics. At this time mainly sectorial planning prevails, but this is inadequate for objectively evaluating the end results of social production, since the process of reproducing material and spiritual wealth takes place not only in the sectors of the national economy, but also on a specific territory, in the unity and interdependence of all socio-economic factors.

New methods of calculating a number of indicators of the economic growth of the union republics are set forth in the article. In our opinion, they make it possible to determine the impact of physical production by republics and for the country as a whole; to determine the degree of influence of the factors of economic growth, including some components of technical progress, on the end result of physical production; to predict the amounts of national income (the net production) and the main parameters of economic growth (the number of employed, the fixed capital, labor productivity, the capital-labor ratio and others) by republics.

The regression analysis method was used for studying the effect of production factors on the end result of the production process. All the factors of the growth of production can be included in the formula of multiple

regression and their influence on the process of production both independently and together can be determined. It is possible to solve the equations stage by stage. At the first stage it is possible to determine the effect on the growth of the national income of the factors obtained on the basis of primary data (the number of employed, the amount of fixed capital and others), at the second--the factors calculated from derived data (labor productivity, the output-capital ratio, the capital-labor ratio and others).

The statistical data for 1960-1975 for sectors of physical production of seven union republics were used for the calculations. The chosen multiple regression equations conform to the empirical data of the mentioned indicators.

Coefficients of elasticity, which show the dependence of the change of the amounts of net production in percent during the desired period of time on the change of the values of the primary and estimated indicators by 1 percent, were obtained in the process of building the selected equations.

Table 1

Coefficients of Elasticity of the Growth of the Net Production (National Income) of the Sectors of Physical Production From the Growth of the Number of Employed and the Fixed Production Capital (1960-1975)

	Physical production--total		Including					
			Industry		Agriculture		Other sectors	
	From growth of number of employed	From growth of productive capital	From growth of number of employed	From growth of productive capital	From growth of number of employed	From growth of productive capital	From growth of number of employed	From growth of productive capital
USSR.	0.555	0.647	0.129	0.703	-5.076	0.149	0.548	0.137
Lithuanian SSR.	1.769	0.282	0.548	0.356	-4.228	-0.185	-0.577	1.076
Estonian SSR. .	0.072	0.674	0.617	0.908	-0.102	-0.149	-0.051	0.889
Georgian SSR. .	1.616	0.667	-0.734	1.434	0.080	0.442	2.471	0.125
Azerbaijan SSR.	1.675	0.030	-1.842	2.200	-2.920	0.646	1.537	0.213
Armenian SSR. .	0.230	0.672	0.582	0.764	-0.051	0.351	-0.233	0.778
Tadzhik SSR . .	2.727	-0.096	1.339	0.140	0.124	0.113	-0.675	0.691
Moldavian SSR .	2.500	0.317	0.890	0.432	0.111	0.255	1.334	0.217

Calculations show that for the USSR national economy as a whole with an increase of the number of employed in physical production by 1 percent the national income increases by 0.555 percent ($\vartheta = 0.555$), in industry accordingly by 0.129 percent ($\vartheta = 0.129$). At the same time for agriculture the coefficients of elasticity have a negative value, which might be caused either by

a decrease of the number employed or by a reduction of the amounts of net production of the sector. During 1971-1975 the net production of agriculture owing to unfavorable natural and climatic conditions and the increase of the materials-output ratio of production declined slightly.

The Lithuanian SSR, the Estonian SSR and the Azerbaijan SSR also have negative coefficients of elasticity for agriculture. In the Lithuanian SSR in the past five years the growth rate of the net production of agriculture and the number of employed have declined appreciably. Structural changes (the increase of the proportion of animal husbandry), which caused an increase of the materials-output ratio and, consequently, of the production cost of the sector, also occurred. Approximately the same economic process can also be traced in the Estonian SSR, but it is less pronounced. In the Azerbaijan SSR the formation of new capital-intensive sectors (viniculture and fruit growing) changed the structure of agricultural production significantly, while due to adverse weather conditions in 1971-1975 the absolute amounts of the net production declined.

The negative coefficients of elasticity of the growth of the net production from the growth of the number of employed in the industry of the Georgian and Azerbaijan SSR's ($\vartheta = -0.734$ and $\vartheta = -1.842$) are explained either by the lag of the growth rate of the capital-labor ratio behind the growth rate of the number of employed or by the formed structure of industrial production of the indicated republics. Thus, in the Azerbaijan SSR during the period 1960-1975 the growth rate of the number of employed in industry exceeded the growth rate of the capital-labor ratio, which had a negative influence on the growth rate of the indicator of labor productivity in this sector. It is possible to examine these trends in greater detail by calculating the indices of the growth of the capital-labor ratio and the number of employed.

Table 2

Index of the Growth of the Capital-Labor Ratio and the Number of Employed (1960-1975)*

	Physical production (total)	Including				
		Industry	Agriculture	Transportation and communications	Construction	Other sectors
USSR.	2.01	1.70	4.08	1.42	1.24	1.17
Lithuanian SSR.	1.90	1.15	6.39	0.86	0.98	0.84
Estonian SSR. .	1.83	1.91	7.76	1.20	1.34	0.45
Georgian SSR. .	2.68	1.49	3.60	2.39	1.89	1.82
Azerbaijan SSR.	1.60	0.82	1.80	1.05	0.98	3.44
Armenian SSR. .	1.46	1.04	3.10	0.90	2.86	0.31
Tadzhik SSR . .	2.10	1.39	3.11	1.86	0.77	0.68
Moldavian SSR .	3.82	1.29	6.29	1.03	3.93	1.33

*The indices were obtained by dividing the growth rate of the capital-labor ratio by the growth rate of the number of employed.

From Table 1 it is evident that in the republics, where the index is less than 1, the coefficients of elasticity of the growth of the net production from the growth of the number of employed are mainly negative. Precisely this explains the negative value of the coefficient of elasticity of the growth of net production from the growth of the number of employed for industry of the Azerbaijan SSR and for other sectors of physical production of the Lithuanian SSR, the Estonian SSR, the Armenian SSR and the Tadzhik SSR (see Table 1).

Some republics have a negative value of the coefficients of elasticity of the growth of the net production from the growth of the number of employed in some sector of physical production due to their formed structure. For an example let us illustrate the efficiency of the sectors of industry of the Georgian SSR. The coefficient of elasticity of the growth of the net production of the industry of the Georgian SSR from the growth of the number of employed for 1960-1975 was negative. However, industry consists of a large number of sectors, which participate in different ways in the creation of its aggregate economic impact, therefore it is important to identify the sectors which reduce the amount of the impact (see Table 3).

Table 3

Coefficients of Elasticity of the Growth of the Net Production of the Sectors of Industry of the Georgian SSR in 1960-1975 From the Growth of the Number of Employed ($э_1$) and the Industrial Productive Capital ($э_2$)

Sectors of industry	Coefficients of elasticity of the growth of the net production	
	From growth of number of employed	From growth of fixed production capital
Industry, total.	-0.734	0.883
Including:		
Electric power engineering	0.202	0.464
Fuel industry.	-10.560	-6.910
Ferrous metallurgy	3.557	0.482
Nonferrous metallurgy.	1.220	4.341
Chemical and petrochemical industry. . . .	0.218	0.864
Machine building	1.917	-0.012
Timber and wood processing industry. . . .	3.459	-0.259
Construction materials industry.	-0.474	0.503
Light industry	0.415	0.749
Food industry.	0.528	0.620

As the data of the table show, the sectors, which governed the negative value of the coefficient of elasticity of all industry of the Georgian SSR, are the fuel industry ($э = -10.560$) and the construction materials industry ($э = -0.474$). Coal production during the period in question declined as a

result of the depletion of reserves at all deposits. At the same time the decline of the production volumes was not accompanied by a decrease of the number of employed, which, in turn, caused a reduction of labor productivity. In the petroleum industry--a new sector of the republic--considerable capital investments were channeled into geological prospecting and the creation of fixed capital. The sector attracted a large number of workers, but due to the untimely increase of the commercial reserves of raw materials the yield of finished products lagged. The materials-output ratio, the labor-output ratio and correspondingly the unprofitableness of production increased, which was reflected in the overall indicator of efficiency.

The negative value of the coefficient of elasticity of the growth of the net production from the growth of the employed in the construction materials industry is explained by the higher growth rate of the number of employed with respect to the growth of the capital, which caused a decrease of labor productivity and, consequently, a decline of the growth rate of the net production.

Such important sectors in the structure of industrial production of the republic as light and the food industry, machine building and ferrous metallurgy have comparatively high positive values of the coefficients of elasticity. These sectors also govern the magnitude of the economic impact of industrial production of the republic. This impact would be even higher, if the fixed capital were used more intensively in machine building by means of the improvement of the processing method, modernization, the increase of the degree of the workload of production capacities and the increase of the machine shift coefficient.

In the future the change in the structure of industrial production of the Georgian SSR and the commitment of new material, raw material and manpower resources will have an appreciable influence on the increase of economic efficiency. This will also be promoted by the fact that certain shifts will take place in the fuel industry, first of all by means of the accelerated development of the production of high quality grades of petroleum.

The interdependence of the growth of the national income (the net production) on the growth of labor productivity and the output-capital ratio is of interest. Only their combination can explain the efficiency of physical production (see Table 4).

As is evident from the table, the coefficients of elasticity of the growth of the net production of industry from the growth of labor productivity in all the union republics are positive, since the growth rate of the net production exceeds the growth rate of the employed. At the same time the coefficients of elasticity of the growth of the net production from the growth of the output-capital ratio are negative, which can be explained by the fact that the growth rate of capital exceeds the growth rate of the net production. The decrease of the output-capital ratio depends on the structure and level of technical and technological perfection of the fixed capital. The question is, to what extent does the increase of this capital provide a

saving of living labor. Therefore, it is important to identify the dependence of the increase of the value of labor productivity on the increase of fixed capital. The example of the Azerbaijan SSR, where the coefficient of elasticity of the growth of the net production from the growth of the output-capital ratio has the lowest value ($\vartheta = -1.532$), while the coefficient of elasticity of the growth of the net production from the growth of labor productivity has the highest value ($\vartheta = 2.340$), is the most indicative. In this case the efficiency of industrial production of the republic, which is expressed by the growth of the net production, is declining. In examining the analogous indicators for the Armenian SSR it is evident that along with a significant growth of the net production from the growth of labor productivity the negative influence of the output-capital ratio on its growth is minimal.

Table 4

Coefficient of Elasticity of the Growth of the Net Industrial Production of the Sectors of Physical Production From the Growth of Labor Productivity and the Output-Capital Ratio (1960-1975)

	Physical production--total		Including			
			Industry		Agriculture	
	From growth of labor productivity	From growth of output-capital ratio	From growth of labor productivity	From growth of output-capital ratio	From growth of labor productivity	From growth of output-capital ratio
USSR	1.329	-0.186	1.410	-0.447	0.978	0.193
Lithuanian SSR	1.358	-0.257	1.250	-0.330	0.903	0.371
Estonian SSR	1.042	-0.644	1.250	-0.176	0.635	0.235
Georgian SSR	1.149	0.094	1.394	-0.439	0.913	0.086
Azerbaijan SSR	1.020	-0.674	2.340	-0.532	0.940	-0.257
Armenian SSR	1.577	-0.612	2.030	-0.230	0.926	-0.130
Tadzhik SSR	1.296	-0.386	1.792	-0.401	1.242	0.008
Moldavian SSR	1.205	-0.025	1.960	0.281	0.974	0.560

Thus, the factor analysis of the efficiency of physical production of the union republics makes it possible to determine the degree of influence of one factor or another on the end result of the operation of physical production. Statistical data were analyzed for seven union republics, where production has basically be stabilized and the proportion of new capital construction in the total amount of the physical assets of production is negligible. In the future the proportion of the increase of new works will decrease even more. In the RSFSR the increase of the fixed production capital and the number of employed will take place at an accelerated rate by means

of the eastern regions. Therefore, here the degree of dependence between the factors and the end result of production is slightly different.

The coefficients of elasticity of the growth of the economic indicator from the factors influencing it can be used in short-term forecasting since, having ascertained the perspective changes in the indicator, it is possible to determine the amounts of the end result of production. The coefficients of elasticity, by means of which the economic structures of regions are analyzed, in our opinion, make it possible to ascertain the influence of each factor both separately and in interdependence.

Scientific and technical progress is an important factor of economic growth. A number of articles, which have touched on the problems of the influence of scientific and technical progress on the national economy, have appeared in the press in recent years. Thus, S. Golosovskiy and B. Grinchel' examine factors which in one case directly reflect the influence of technical progress on the national income, while in another--in a mediated, indirect manner. This pertains first of all to the natural factor.[1] It is well known that the natural factor does not affect equally the different sectors of physical production. For example, the volumes of agricultural production and correspondingly the production volumes and labor productivity in the food and light industry depend substantially on climatic conditions, which the authors take as a criterion which influences the national income. At the same time the influence of this factor in practice does not affect machine building, ferrous metallurgy and other sectors of industry. Therefore, the natural factor certainly affects labor productivity and accordingly the national income, but its influence is nonuniform by sectors.

A formula for calculating the influence of the increase of the number of workers in social physical production on the national income is also proposed in the article. This formulation is natural, but, in our opinion, it is impossible to take the absolute increase of the number of workers in pure form for the factor of technical progress, since as a result of technical progress a relative decrease of the number of workers should occur. In fact the proposed formula reflects the product of the labor productivity of the preceding year times the increase of the available working time during the reference year. This would be legitimate if the labor productivity remained unchanged.

The question arises: is it possible by the means of modern economic analysis to determine the influence of scientific and technical progress on the process of social production? The concept "scientific and technical progress" is a very broad one, it covers basic theoretical and applied research, designing, the development of new technical and technological means and so on. The direct influence of the basic sciences on production and economic processes is manifested through the introduction of certain technical innovations or others in production. In turn, the increase of the technical level of production creates the need to increase the skill of production personnel.

1. See VOPROSY EKONOMIKI, No 10, 1976, pp 24-37.

The statistical data on the union republics make it possible to determine the laws and dynamics of the introduction in production of new equipment and technology, the degree of increase of the skills of workers and so on. Relying on the available economic data, we attempted to ascertain the influence of some components of scientific and technical progress on the growth of labor productivity. Here it was presumed that a certain proportion in the increase of labor productivity should correspond to each component of scientific and technical progress, while a direct link exists between the growth of the individual components of scientific and technical progress and the labor productivity. The following components (with allowance made for the available data) were used for the calculations: the number of specialists with a higher and secondary specialized education, the power-worker and electric power-worker ratios, the availability of mechanized flow and automated lines, the number of introduced inventions and rationalization proposals. The goal of the calculation is to find the total influence of the above-indicated components of scientific and technical progress on the growth of labor productivity.

The increase of the number of specialists with a higher and secondary specialized education has taken place at an accelerated rate in industrial production of the republic, which stems from the overall increase of the electric power-worker and power-worker ratios, as well as the introduction of new automated and mechanized flow lines of production and so on. The data of the table reflect the dynamics of the absolute increase of each component individually.

Table 5

Dynamics of the Increase of the Components of Scientific and Technical Progress in Industry of the Georgian SSR (1960 = 100)

Components	1965	1970	1971	1972	1973	1974	1975
Scientific and technical progress							
Including:							
Number of specialists with a higher and secondary specialized education	151.2	230.7	243.4	262.0	283.2	297.2	318.2
Power-worker ratio	142.9	185.7	199.5	207.1	214.3	222.3	231.0
Electric power-worker ratio	137.5	175.0	183.3	196.0	204.2	213.4	223.7
Availability of mechanized flow lines	148.6	193.8	208.4	219.7	233.7	250.1	268.5
Availability of automated lines	102.6	137.1	182.5	200.7	225.0	249.7	269.8
Introduction of inventions and rationalization proposals	112.0	134.6	137.1	140.4	147.7	157.2	163.9

The degree of dependence of the growth of labor productivity on the growth of the separate components can be ascertain by using the methods of regression analysis. The labor productivity ($y_л$) acts as the function, each one of the above-indicated components of technical progress ($x_{1л}$, $x_{2л}$..., $x_{nл}$) acts as an independent variable. Then the multiple regression equation will assume the form:

$$y_л = a_0 + a_1x_{1л} + a_2x_{2л} + a_3x_{3л} + a_4x_{4л} + a_5x_{5л} + a_6x_{6л}.$$

The coefficients of elasticity of the growth of labor productivity from the growth of the individual components of scientific and technical progress are determined during the solution of the equation. These coefficients show the proportion of each component of scientific and technical progress in the increase of labor productivity. The sum of the proportions of the components (in this case there are six of them in connection with the limitedness of the necessary data) reflects the proportion of scientific and technical progress in the growth of labor productivity (see Table 6).

Table 6

Coefficients of Elasticity of the the Growth of Labor Productivity From the Growth of the Individual Components of Scientific and Technical Progress in Industry of the Georgian SSR

Factors	Coefficients of elasticity $э_1$, $э_2$..., $э_6$	Proportion of individual components of scientific and technical progress in the increase of labor productivity (percent) $y_л = \frac{1}{9}(э_1 \cdot 100)$
Overall influence of the factors of economic growth on labor productivity.	2.920	100
Scientific and technical progress.	2.013	70
Including:		
Number of specialists with a higher and secondary specialized education ($x_{1л}$).	0.760	25
Power-worker ratio ($x_{2л}$).	0.500	17
Electric power-worker ratio ($x_{3л}$).	0.103	4
Availability of mechanized flow lines ($x_{4л}$).	0.023	1
Availability of automated lines ($x_{5л}$).	0.077	3
Introduction of inventions and rationalization proposals ($x_{6л}$). .	0.550	19
Other factors (x).	0.907	30

From the table it follows: first, the individual components of scientific and technical progress influence the magnitude of labor productivity differently; second, the sum of the coefficients of the individual components of scientific and technical progress on the whole shows that with an increase of the components of scientific and technical progress by 1 percent labor productivity increases by 2.013 percent ($Э = 2.013$). Now let us calculate the proportion of scientific and technical progress in the increase of labor productivity, which can be calculated by the formula:

$$X_{П} = \frac{1}{Э}(Э_1 + Э_2 \ldots Э_n) \cdot 100, \quad (1)$$

where $X_{П}$ is the proportion of scientific and technical progress in the increase of labor productivity; $Э_1$, $Э_2 \ldots Э_n$ are the coefficients of elasticity of the growth of labor productivity from the growth of the individual components of scientific and technical progress; $Э$ is the coefficient of elasticity of the growth of labor productivity from the growth of the factors acting on it together.

The growth of labor productivity in the republic during the period of time in question was 75 percent. It is possible to determine the proportion of scientific and technical progress as a whole in the increase by substituting the actual data from Table 6 in the formula. The calculations show that the number of specialists with a higher and secondary specialized education accounts for 25 percent of the total increase of labor production, the implementation of inventions and rationalization proposals--19 percent and so on. Thus, of all the components the greatest proportion of the growth of labor productivity was obtained by means of the increase of the level of skills of workers and engineering and technical personnel.

In connection with the updating and renovation of the fixed production capital the influence of the power-worker ratio on the increase of labor productivity is also significant. Mechanized flow and automated lines account for the smallest increase of labor productivity for the republic as a whole. This is the result of the still inadequate proportion of mechanized and automated lines in the total amount of fixed production capital. On the basis of the experience of individual enterprises, which are notable for the greater mechanization and automation of production processes, it is possible to assert that in the future the influence of the indicated component on the growth of labor productivity will increase.

In connection with the fact that scientific and technical progress, which has a decisive influence on the increase of the ultimate impact of physical production--the produced national income, is the main source of the increase of labor productivity, it is necessary to find the dependence of the increase of the national income on the increase of labor productivity, that is, the proportion of labor productivity in the growth of the national income.

During the period in question by means of the increase of labor productivity the national income increases for the union republics by 75-85 percent,

while for the country it increases on the average by approximately 80 percent a year. Consequently, by knowing the proportion of scientific and technical progress in the growth of labor productivity, it is also possible to calculate its proportion in the production of the national income (the net production). If, for example, the growth of the national income of some republic in 16 years was 2 billion rubles, by means of the increase of labor productivity it increased by 80 percent, or 1.6 billion rubles. Taking into account the fact that the growth of labor productivity during this period amounted to 75 percent, each percent of increase of the labor productivity accounts for 21.4 million rubles. Thus, if scientific and technical progress constituted 70 percent of the total increase of labor productivity, it accounts for 1,498,000,000 rubles (70 X 21.4 million rubles) of the national income.

The most important indicator, which reflects the economic growth of the republics and the country as a whole, is the produced national income. One of the methods of predicting the national income is the so-called production method, in which the dynamics of the change in the ratios of the gross social product with material expenditures is taken into account. In recent years the method of calculation according to the dynamic intersectorial balances has become widespread. However, in the former and the latter cases the calculation of the standards of material costs has a strong influence on scientific and technical progress, the elements of which are difficult to take into account for the future. By knowing the amount of the national income for the required period, it is possible to calculate the main production factors (the number of employed, the fixed captial, the output-capital ratio) from the formula:

$$T_{it} = \frac{T_{i0} \cdot H_t}{100 \cdot \vartheta_i} + T_{i0},$$

where T_{it} is the amount of factor i in the year being planned; T_{i0} is the amount of factor i in the base year; H_t is the increase of the national income (the net production; percent in the year being planned); ϑ_i is the coefficient of elasticity of the growth of production factor i.

The dependence of the increase of the employed on the growth of the national income (the net production) is determined initially according to this formula. Here the magnitude of the increase of labor productivity, which reflects the saving of living labor, is used. By substituting in the formula the values of the coefficient of elasticity of the growth of the national income from the growth of labor productivity and the magnitude of the labor productivity during the base year, we obtain its amount for the year being planned.

The calculation of the amounts of fixed production capital for the future is made in a similar manner, but the labor productivity, and not the national income, functions as the initial indicator. The coefficient of elasticity of the growth of labor productivity from the growth of the

capital-labor ratio is used for this. By substituting the values of the coefficient of elasticity of the growth of labor productivity during the base year, we will obtain its magnitude for the year being planned. The product of the number of employed times the value of their capital-labor ratio reveals the amounts of fixed capital.

The proposed methods of calculation made it possible: to ascertain the efficiency of the functioning of physical production of the republics, to determine the existing dependence of the value of the impact on labor productivity, technical progress and other factors, which affect it, to substantiate the most rational ratios between the number of employed and the capital-labor ratio, which can serve as an important economic tool for forecasting the structure of the physical production of the republic, to use the identified trends for forecasting the development and improving the structure of the sectors and subsectors of physical production.

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