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INSTITUTES OF SOCIAL DEVELOPMENT AND THEIR EFFICIENCY ESTIMATION

Summary. Estimation problems of social development institutes' efficiency, such as educational system and human capital are considered in the article. A number of social efficiency criteria is introduced together with the known approaches, models which expand interpretation of social efficiency and help consider institutional features and the effects of separate social systems organization, and, in particular, education, etc. are offered. The problems of social development are considered in terms of academic aspects, the author mentioning the stands which are considered poorly within the limits of certain criteria.

Keywords: institutes, development, social system, efficiency, education,
JEL   D02 E02 I15 I 25 O12

1. Social Efficiency Estimation.

Concepts of economic and social efficiency are different ones in economic science, "social efficiency" being much more poorly explained in the theory. From the point of view of orthodox science, efficiency means how well the limited resources are used and what return they make. Measuring the return per unit of the spent resource, we get the indicator characterizing system's effectiveness. Social efficiency can't be defined so easily. It is possible to consider it as the parametre describing the degree of solvability of "social question" on the agenda. However, in this case "social efficiency" as an indicator will be not only dynamic, but will also have constantly changing content, because the content of "social question" changes with the historical economy development. Therefore, it is better to measure social efficiency according to the criterion reflecting the change in the real social parametre or several parametres. "Index of human development" acts as such indicator representing integrated indicator estimating gross domestic product per capita, the expected lifetime and society's educational level. It is considered, that this indicator gives much more accurate idea about economy's development in comparison with the gross national product as the expanded set of the most essential social functions providing life quality and social stability is estimated. The income per capita defines the level of economic well-being; life expectancy is an indicator of public health services development, environment protection and besides reflects the general living standard. Educational level reflects how the processes of knowledge reproduction and transfer are organized in the economy, how generations replace each other and what quality

human capital finally is. The index of human development is defined as the arithmetic mean of three specified indicators-indexes: average lifetime, per capita income and educational level. Each of the three specified indexes is calculated on the basis of the available statistical data according to the corresponding formulas. Here is the relation for each index separately and for human development index:

In my opinion, the amount of people living below the poverty line, defined by the relation of agents' number conducting a beggarly way of life to the general population of a given economic system is an important indicator of social development level. Besides, it is possible to use the indicator of poverty defined by the rupture between agents' income living below the poverty line and the income, defining the poverty line to the general income created in the country. Certainly, the first and the second indicators are in essence institutional settings as the poverty line is established legislatively. At the same time, this indicator has also an objective basis which is connected with the possibility of consumption of a certain number of welfare (foodstuff) a day for a certain amount of income. When income does not allow consuming elementary amount of welfare necessary for normal working capacity, but only supporting agent's viability, then we speak about a life below the poverty line.

Social development quality is estimated according to the qualitative parametres of condition in education and public health services sectors and other indicators taking into account the dynamic changes in the development of human capital.

Within the limits of the United Nations Development Programme activity) reports on human development under conditions of economy globalization are developed. It is generally accepted, that if the value of human development index makes 0,8, the country is considered to be economically developed. If the index fluctuates between 0,5 and 0,8, it is the country with the average level of human development. For underdeveloped countries the index value makes less than 0,5.

However, this system of efficiency estimation indicators of social development has the following shortcomings.

First, the integrated indicator includes three heterogeneous indexes describing different economic subsystems and processes, that is, it is based on the principle of mathematical aggregation and adapted for the estimation of social system as a whole. Internal distributive effects and motivational efficiency in the explicit form are not considered within the limits of the given index, to say nothing about the qualitative estimation of education, public health services and social protection system.

Secondly, human development index is based on the indicator of gross product/income with its serious inherent shortcomings. In particular, ecological consequences of social development, dynamics of non-material assets and the value added created with their help are not reflected in this indicator. Besides, there are statistical errors of gross national product registration and national income when part of incomes is not considered, and the other part is considered twice. The tax system can seriously distort gross national product calculation.

Thirdly, there is a certain limitation in calculation of the components of human development index, indicators of life expectancy and educational level. It is in the fact that it is impossible to ascertain confidently the correlation between social development quality and life expectancy and educational level. The matter is that high value of "educational level" index does not mean high quality of education at all the stages of educational ladder. Experts in the sphere of education confirm, and it is necessary to agree with it, that the continuity and omnitude of education act as the major conditions of its efficiency. Erudition level can be rather high due to the general education, but higher educational system cannot provide training of the highly-skilled personnel in the necessary volume, making the most essential contribution to the development of information economy, based on knowledge and "high technologies". The same concerns the "life expectancy level" index which can be rather high, for example, with considerable children's death rate or with very low indicators of birth rate. Similar regularities also create the problem of ageing of many economically advanced states, which die out in essence. Then how we can speak about effective social development if the created welfare and living standard refer to reduced national-cultural population.

Fourthly, the largest shortcoming of the indicators is that they do not consider, in what degree the functions of social structures are accessible to various segment of the people, and what share of personal income these functions demand to be executed.

Fifthly, the condition of social sphere and corresponding structures is defined by the general development of social infrastructure, crediting peculiarities of its objects, and by the level of state and private expenses necessary for the development of the social sphere. There is a natural decrease in the qualitative parametres of concrete social system with the reduction of monetary support level. That is why, politician establish standards on the level of expenses of "social spheres" and the branches creating public goods having no special theoretical knowledge about the arising dysfunction of operated system due to absolute or relative decrease in its monetary support. This refers to defence, public health services, science, education and culture. Relative share growth of these expenses becomes a symbol not only of public sector expansion, but also of successful innovative-technological development of the country, its dominating role in the market of hi-tech production and guarantee of competitiveness in the world market.

Thus, human development index represents corrective indicator of gross national product allowing, in a manner, considering the contribution of non-material factors in the creation of national wealth. This criterion of social efficiency is an original "gross national product of social development", that is, a very rough and general estimation of social productivity.

'The main defect" of gross national product indicator and human development index is in the fact that high accident rate of the economy, control of mass diseases, deforestation, repair of the failed funds, lawyers' rivalry, indemnity for any loss, for example, for flood, earthquakes - all these will work towards gross national product

increase and, consequently, the human development index through the income parametre per capita as the lifetime index and erudition level will not essentially change.

If according to gross national product there is an economy growth, the index of sustained economic welfare shows the growth of disappointment by social conditions of life in spite of the fact that on a long historical trend success in social development, especially in the developed countries, are simply stunning. This paradox arises because of the fact that development speed has increased which makes time and access to welfare important limiting parametres of a concrete individual existence, defining his requirements and preference.

It is possible to present social efficiency through the efficiency of concrete social sectors: education, public health services, and infrastructural sectors - informational, social security and labour relations. By the way, the level of bureaucratism and "shadow" economy will also influence the general value of social efficiency. Here we will present the estimation method of public health services effectiveness. A separate paragraph will be devoted to educational system. To estimate the efficiency of such system as public health services, it is necessary to wonder, what this system is necessary for, that is, what function it carries out. System's effectiveness change is the change of this function, from the positions of its qualitative and quantitative execution. In other words, the dynamics of efficiency is an expansion or contraction of system's dysfunction.

Public health services efficiency is estimated within the limits of the model "expenses - processes – results". And the result is rescue of human lives, prolongation of this life and its activity, decrease of the level of physical inability and disease of social system's agents. Such result is attained by both preventive actions, and especially by medical way. However, the result depends on the initial nation's health, ecological situation, the demand for medical services, supply of medical technologies, social insurance mechanisms, and even education, etc. From the point of view of the agent, health is the welfare whose value increases with age and the total cost decreases, and in a point of death of the agent health as the welfare is equal to zero (Figure 1). Expenses for health support are investments into creation of the future income as with health loss labour productivity decreases, there appear losses of working hours connected with invalidity or "slack" work that lowers the income taken by the agent. Health decrease with age is compensated partially by the growth of expenses for healthcaring actions. We will show the curves of health reserve changes of two agents who were born with different initial reserves of health (for example, this divergence can be genetically predetermined, or was caused by a mode of bearing and birth).
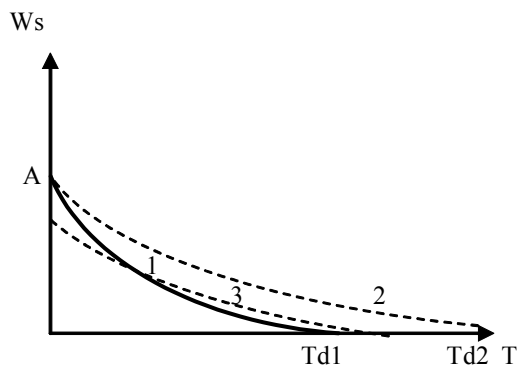
Figure 1 Dynamics of the Function of Agent's Health Reserve

As we can see in Figure 1, function of health reserve for agents 1-2 originates in one point A, in case 3 the initial health reserve of agents differs. If the reserve is identical, the agents can all the same live for different periods - Td1 and Td2 accordingly. The situation with curve 3 shows, that agent 3 having lower health reserve in relation to agent 1, will live a little bit longer, but less than agent 2. Such function dynamics of health reserve says that the agents have different ways of socialization, various incomes which allow them to liquidate the dysfunctions of their organisms and, finally, affect life expectancy. Here the function of health reserve which can become equal to zero owing to accident is not considered. For example, agent 1 studied perfectly well, that demanded considerable efforts, room work, eyes and nervous system load. Agent 3 studied in the open air, quickly got the job which is useful for organism. Intersection of curves 1 and 3 gives the point in which their health potentials are equal, and then there is different dissipation of health reserves. So, the first agent defends the thesis for a doctor's degree at young age. If there is no stimulus for such trajectory of development in the economy, he will pay off for such desire with his health. Besides, connecting his work with science, agent 1 gets low income, and agent 3 controls construction of objects in a forest zone that promotes health strengthening and guarantees, at least, in the Russian economic system, higher income. Agents invest a part of the income in their health, and every year they do it in larger amounts, but generally the investment share of income in such welfare as health is not usually identical and is defined by agents' preferences to make such expenses.

When it moves to the right on the time axes, the value of health for each agent will increase in any case, as well as the function of expenses – investments, if initially psychologically healthy agents are considered. Otherwise, the function of value and health reserve can have absolutely different appearance. The number of diseases (dysfunctions), and death rate will increase with the age of agents, the specified investments (expenses) resisting this growth that it could be.

John Richard Hick is remembered to mention, that capital heterogeneity is its major property. It is this very property that economic science cannot disclose and explain. As for the human capital, to estimate its efficiency is even more difficult, because it is extremely heterogeneous. One of the factors and one of the reasons of

this heterogeneity is unequal function of health reserve which predetermines agent's possibilities on the trajectory of his movement on the phases of development and ageing (life cycle). It is possible to add the function of initial and obtained abilities and knowledge and the function of needs and motivation to include the model of a person completely into the economic analysis by means of these functions. Now, it is quite appropriate to note the following: obviously these functions are very similar in the social groups (strata), as they depend on the amount of average income per capita, that is, living standard. Using decil or quintil distribution of agents on the level of income per capita and, having shown empirically established functions for every decil (quintil), having found the difference between neighbour groups for each group of agents of the given age on these functions, it is possible to roughly establish quantitatively the rate of heterogeneity of human capital for economic system. Certainly, it will differ from the usual heterogeneity on income - inequality. As we see, heterogeneity is defined by many factors, including per capita income which is in essence heterogeneity derivative. The size of this per capita income defines agent's possibilities in the sphere of public health services, training, legal safety, etc. Economic democracy, if to be strict, becomes literally economic, it is attached to the income function. Both the agents' rights and their possibilities and needs are defined by cash income. From these positions there is a monetary democracy in today's world, that is, democracy which is determined by the size of per capita income.

If to be strict, the curve of health reserve should have a little bit other appearance, than it is presented in the previous figure. The function of health reserve will have an increasing part, which is connected with accumulation of health reserve and formation of p health potential at children's age (Figure 2) on the part [0; T*]. The period from the beginning of T* is a junior age of the agent. Up to the contact of x-axis from moment T* the function of health reserve behaves in the same way as it is shown in the Figure above. Hence, while calculating it is possible to consider function W_s permanently decreasing on which the ledges connected with waste of health reserve can be observed, or with the restoration of health reserve depending on the situation, condition of public health services and corresponding state policy in this sphere in the country.
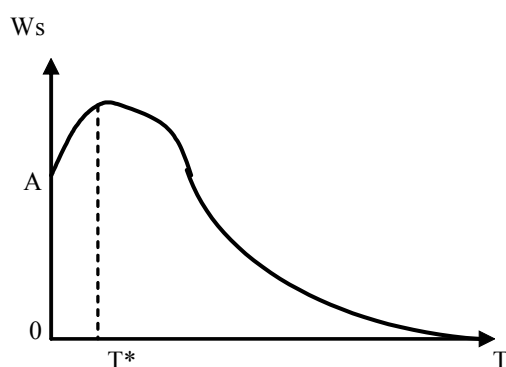

Figure 2 Shape of the Function of Agent's Health Reserve

The main criterion for efficiency estimation of medical actions is expenses level (both social and private), connected with implementation of these actions taking into account their probable consequences. It is possible to present it in such a way: $S = Pm + S_e - S_{pe}$, where S - cost of medical action, Pm - the price of the suggested medical action equal to its cost price, S_e - cost of side effects, S_{pe} - cost of the prevented adverse medical consequences.

In the economy of public health services two criteria of efficiency estimation are often used:
- Years of a life with the adjustment for disability;
- Years of a life with the adjustment for life quality.

The first indicator is calculated as the quantity of future years of life without disability and functional infringements (at a dysfunction minimum) which could have been lost as a result of early death or disability in a current year.

The second indicator represents a quantitative estimation of lifetime growth with the account of life quality, this growth being provided by the work of public health services.

In other words, both indicators give intergrated estimation of disease decrease, on the one hand, and on the another hand, they estimate lifetime increases at the quality level not decreasing as a result of medical actions and special medical and social programs application.

Cost estimation of human life is economically important as only then it will be possible to estimate the efficiency of medical actions truthfully enough. The question of economic estimation of human life cost was being solved as far back as by William Petty , and then later by W.Farr. Today approaches of human life cost estimation on the basis of human capital estimation are known. Certainly, discounting methods are convenient for such estimation, but how to estimate current cost, not applying discounting for the time being. Obviously, it is appropriate to consider, that agents do not differ in costs of their lives, that is, this parametre is identical for all the agents. If to accept a different position assuming distinction in life cost, then there will be a differentiation on the fundamental right for life, and this will undermine the democratic foundations resulting from the principle of natural right.

Cost of human life, from the point of view of medicine, will be equal to the difference of expenses for life and benefits provision which this life brings to the general number of the rescued years of life. It is possible to accept one more criterion: to estimate benefits, certainly, discounted, which could be received if a person lived, and then to subtract the expenses connected with the maintenance of agent's viability parametres in the limits admissible for life. But, thus, the criterion becomes negative for pensioners, and it is difficult to count up benefits or expenses for a child as it is still not clear, what social niche he would occupy in future, what trade and what income he would have. The problem of inheritance and income registration brought

by such asset is also important here. Besides these ways, it is possible to estimate human life by the criterion of readiness for the expenses reducing death probability.

It is interesting to notice, that, for example, having established organism dysfunction of the agent, physicians can suggest the treatment which would liquidate this dysfunction or considerably lower its depth, restoring the majority of functioning parametres of an organism to the required norm or acceptable values. However, the fact whether the nature of such dysfunction occurrence will disappear is absolutely unknown. Then, without understanding of the dysfunction nature, for how long time the organism will be safely functioning. It can be a month, a year, three, five years, etc. What does this term depend on? Most likely, on the dysfunction depth in the initial point, on the accuracy of the selected treatment and on how much drugs casually or intentionally influence the nature of chemical processes in a human body, or how much they launch parallel processes worsening conditions of given dysfunction and its further development and deepening. The efficiency of treatment is defined in this case by the given term. The optimum result of practiced medical actions in this case is connected with the fact that at a minimum of the used exposures having medical effect and minimum expenses for the patient, the dysfunction of the given kind does not arise any more (without a repeated course, or correction of errors at the first course of treatment). Certainly, such result depends on the perfection of diagnostic technique and doctors' qualification, that is, on their vocational training and the provision of the branch with necessary technologies and medicinal and auxiliary drugs, that is, on pharmaceutical industry, etc.

Thus, estimation of human life cost is assumed as the basis for all subsequent estimations of public health services performance, and besides provides control, including prosecutor's one and judicial decisions in this branch. In other words, usual comparison techniques of expenses and benefits which are given by medicine are insufficient, that is, the measure of budgetary efficiency is necessary, but insufficient.

2. Efficiency of Education as a Social System

Efficiency of educational system represents a combination of several kinds of efficiency. Organizational, administrative, motivational efficiencies influence heavily the system effectiveness as a whole. Probably, it is possible to describe educational system integrally as an indicator of synergetic efficiency or adaptive efficiency.

But in a generalized way the following criterion can become an efficiency indicator: the system of higher education should provide a high rate of specialists whose professional parametres would be competitive in the modern labour markets and set higher standard for the development of these markets. Thus, educational system should provide access to the suggested functions to as many citizens as it is possible. And it is necessary, that the bottom steps of educational system (comprehensive secondary school, the system of technical schools, vocational schools) should stimulate pupils to continue education.

Besides efficiency criteria while estimating complex systems functioning and comparing their results, it is useful to use criteria or principles which symbolize inefficiency and which are sometimes easier to establish or to calculate. With reference to educational system and to the intellectual capital of firms (organizations) such criteria can be:

- absence of motivation for training and professional development;
- discussion of past results and merits;
- exaggerated self-assessment and conceit of the agents participating in the production of welfare or services.

Finally, the level of experts' training defines skill level and success of various decisions (technical, administrative, organizational, etc.). If to consider the decision giving the greatest return (value) of effect as the optimum decision, effective decision as the one, giving a certain positive effect and inefficient as the one, giving a negative effect, then on the prevalence of each variant of decisions, it is possible to estimate indirectly the system's effectiveness which reproduced the specialists, making such decision. From the methodical (procedural) point of view, to make such estimation is difficult enough. At the same time, the given approach can be applicable to small, in particular, to regional or corporate structure where the types of decisions can be traced and estimated. Usually, different decisions adjoin with each other. It is impossible to make only these or those decisions. However, if it is possible to estimate the effect from each decision, it is not reasonable at all to add the effects, as the decisions are, for certain, interconnected parametres for the given object - system.

Efficiency of educational system is defined by the skill level of pedagogical personnel, efficiency of the learning process organization, and efficiency of the training. These are direct factors setting the general system's efficiency. However, such factors as propensity for training, motivation of training, prestige of separate professions, labour market condition, the amount of scholarship, payment of training at the paid form of training and availability of credit define the demand for education and educational services. With reference to firm, education efficiency depends on the need for training and the desire of workers to study. The named conditions are defined by how the wage of a worker will change before and after training and how much its productivity will increase. That is, how much training will be justified for the firm and contributes to the general results of economic activities, to functioning efficiency.

Let's single out and set forth three base approaches to the estimation of educational system effectiveness here:

- investment (the pure discounted cost of training and a payback period);
- qualitative;
- external.

Let's consider the content of each approach in series.

1. The approach based on the estimation of investments efficiency into human capital, allowing estimating the effectiveness of educational system.

Measuring instrument of the impact on the system of investments into human capital can be presented by the following indicator:

$$K_{Ropt} = \frac{Z_{max}}{D_{max}},$$

where K_{Ropt} - net profit ratio of investment in human capital; Z_{max} - maximum expenses for investment in human capital; D_{max} - maximum received income.

We also suggest expressing averaged estimate of efficiency coefficient of the human capital investments in the formalized way:

$$\overline{K}_{EIH} = \frac{\sum\limits_{i=1}^{n} \overline{z}_i^{\,j}}{\sum\limits_{i=1}^{n} \overline{d}_i^{\,j}},$$

where K_{EIH} - estimate of efficiency coefficient of investments into human capital; $\overline{z}_i^{\,j}$ - average expenses of i- family of j- decil group; n - number of families in the sample; $\overline{d}_i^{\,j}$ - the average income of i-family of j-decil group, i - family number in the sample from n families; j - number of decil group.

If we apply the first formula of general profitability to the definition of efficiency of the human capital investments, having made the sampling from families of various social groups (suppose, that such decil groups will be ten), we can get the following expression:

$$K_{REIH} = \frac{\sum\limits_{j=1}^{10} \sum\limits_{i=1}^{n} \overline{z}_i^{\,j}}{\sum\limits_{j=1}^{10} \sum\limits_{i=1}^{n} \overline{d}_i^{\,j}}$$

It is possible to note, that the period for which means invested in a person are paid off, depends on economy branch where the person will work after training. The remuneration of labour is different in different branches; hence, it is possible to speak about time distinction for which investments will pay off. I believe, this problem should trouble the state as branches with the highest level of remuneration cannot provide everyone with work, so it is necessary to actively pursue adjustment of prices policy concerning different kinds of capital, taking into account the substitution effect, including cost evaluation of labour capital, wage.

Payback period in each separate case should be defined proceeding from the equality of the discounted capital costs in educational system and the value of economic results achieved by t-year. Mathematically it will assume the following form:

$$\sum\limits_{t1}^{t2} (R_t - Z_t) \cdot \alpha_t = K_d^{\,T=t2-t1},$$

where: R_t - economic results achieved in t; Z_t - expenses in t-year, without capital investments; α_t - discounting factor; K_d - the sum of the discounted capital investments for the payback period $T = t2 - t1 \rightarrow$ min.

Efficiency estimation of investments into a person according to the offered coefficients is necessary, but insufficient condition for the provision of estimation completeness from the methodical point of view. The analysis of payback period is necessary as the basic indicator of efficiency estimation of investments into human capital. The reason is that investments into a person have a long-term character, and this effectiveness ratio efficiency reflects the time aspect poorly as at long-term stages both expenses and incomes should be discounted. And discounting should be carried out according to different "analytical schemes" and it always has a high element of inaccuracy. The longer is the time interval, the higher is the discrepancy. Both income and expenses in the presented expressions should be subject to discounting.

By means of the factors suggested above it is possible to estimate investments dynamics into a person depending on the influence of various factors evaluated on the change of expenses and incomes.

Any system develops by certain stages. For a person as a socio-biological system the life cycle is also characteristic, therefore, it is possible to assume, that investments in a person are subject to change depending on these stages, that is, at different stages the size of invested funds is different. Thus it is possible to consider, that investment in a person and the effect from this process are defined by the life cycle of a person. That is, if we accept the quantity of years for t, and invested funds a year i for I, then expression $\sum_{i=1}^{t} I_i$ can define the sum of invested funds at each stage of human life.

The question concerning quality of educational system as a whole, of all its structures, is very important, beginning from the primary level and up to the governmental bodies supervising and regulating educational system in the country. It is interesting to note, that calculation (estimation) of separate quantitative and qualitative indicators can testify that the system functions as though effectively. Actually, general efficiency will be rather low because institutionally the system will be imperfect, it can be based on corruption contracting, having quite different principles and motives. For example, the motive of getting a diploma and the motive of training a highly competent specialist are, in practice, two converse motives. The first motive can be provided by superficial and bureaucratized education, low qualification of teaching staff and corruption, and the second motive can be realized only by a different educational system when its three main elements, qualification of pedagogical personnel, efficiency of learning process and education itself radically differ from the first variant.

2. The "qualitative" approach assumes quantitative estimation of qualitative changes in the system.

For estimation of respective alterations in system's effectiveness parametres, it is important to estimate the change of workers' wages in the general expenses of the system, and also the share of wages costs of those occupied in research and development in the general wages expenses. Labour-intensiveness decrease per unit of production and output and the general growth of labour productivity act as an important indicator of efficiency.

Educational system or the training system of personnel can be estimated by the following quality indicators:

- knowledge increment (on the basis of the use of the agents' tests who were trained).It is a share of excess of the weight average right answers after training over the weight average answers before training among the weight average answers before training (tested group of agents should be the same to keep cleanliness of measurement);

- the quality of education measured by the level of training of those who carries out education and digestion of new knowledge level. For this purpose the following indicators can be used: share of new knowledge digestion in the course of training in the total amount of knowledge in this branch of science, specialty, subject; the volume of methodical support of one subject; number of professors per one trainee; professors' level of proficiency (volume of annual scientific publications); quality estimation of the trainee's work before and after training; demand for graduates of high schools in the labour market, etc.;

- information capacity of active job. How the volume of relevant information has increased and average expenses for getting a unit of such information per unit of produced product (income), or per unit of educational service cost have decreased;

- the quality of production measured by use value rate of products, or by the ratio of actual losses due to rejects of finished goods and intraproductive rejects to valid production, or by number of complaints accordingly.

The educational system promotes professional development, increases standards of economic system controllability, raises labour productivity (reduces labour-intensiveness). Besides, education improves moral and psychological climate, which is expressed in improvement of solidarity indexes, group interaction, integration (the ability to maintain structure due to the low level of proneness to conflict) and so on.

Turnover of staff in educational system, absenteeism norm, intensity of personnel dropout because of age (age structure), the number of free vacancies, and besides professors' employment in different high schools are the characteristics of process of training quality At least, they expressly or by implication influence educational system quality. The same refers to a firm which requires educated specialists.

Turn-out of appropriate specialists can be defined roughly on the average score of the diploma:

$$S = \sum_{i=1}^{N} \frac{b_{ai}\alpha}{100},$$

where: S - average score of the diploma; b_{ai} - average score of the diploma in i-speciality, N - number of specialities, α – unit weight of the given speciality to aggregate number of trainees.

Such approach can be used for the estimation of a system's skill level including educational system. It is only necessary to estimate specialists, teachers, associate professors and professors instead of trainees and, certainly, to calculate the indicator for the system as a whole, for example, for a corporation.

3. "External" approach is in the estimation of additional positive effects which are provided by educational system and personnel training.

It is possible to present educational system effectiveness as the relation of cumulative positive external effect to the general expenses for maintenance of its functioning during the training period (five years for high school, eleven for school, 3-4 years for technical school, 2-3 years for vocational school):

$$E_o = \frac{\sum_{i=1}^{T} E_{+i}}{Z_{i+n}}$$

where: E_O - educational system effectiveness; Z - expenses of educational system during studies; E_{+i} - positive external effect in i-year on time interval T until it is exhausted, as in due course without interior and professional development the given effect for the agents who were trained on interval i+n, where n - training period, by the time T it can become equal to zero.

However, in my opinion, external effect should be estimated from the moment of studies start till the moment of the retirement of the trainees as economically active agents. But even being on pension, not working, educated people provide positive external effect in their households. Thereby, this circumstance should be considered at calculations.

If training reduces production rejects, then the effect is measured by costs economy connected with the decrease in reject level as a result of training. At decrease in labour-intensiveness resulting from training, when the equipment is not changed, it becomes clear that only training could produce such effect. Hence, to take efficiency increase into account in this case is not difficult. Similarly, it is possible to measure the effect of increase of such economic system's social indicators, as its accident rate, institutional infringements (opportunism), as a result of training and rise of education level and qualification of economic agents.

Proceeding from the model of Romer-Mankiw it is possible to define the point of global stability of the system where physical and human capital values per unit of effective labour are equal (see the Figure). It corresponds to point A in Figure 3.
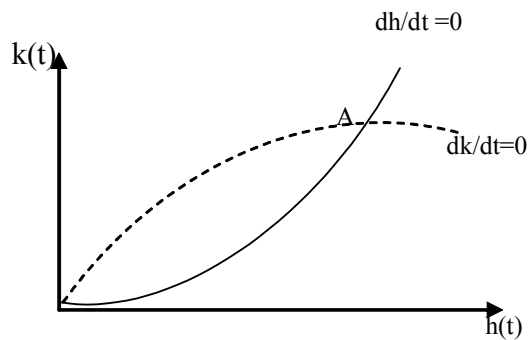
Figure 3 Global Stability Condition of Economic System according to the Growth
Model of Physical and Human Capital per Unit of Labour

Production function for human capital, according to T. W. Schultz, can assume the following air:

$$Y_{Ht} = A(Z_t \cdot K_t)^{\beta 1} C^{\beta 2},$$

where Y_{Ht} - volume of the produced human capital; t - time period; A - factor describing the ability to increase human capital; Z_t - share of human capital which is used to produce this capital; K_t - general value of the available human capital; C - repaid investments; β1, β2 - positive elasticity coefficients of the resources, showing by how many percent the volume of the produced human capital will change when the resource increases by 1 %; β1 + β2 <1.

This approach to the production of human capital allows considering the condition of educational system and its possibility. The parametre describing the ability of the agent/system to increase human capital, and the amount of capital which is spent for reproduction of the next portions of capital, actually describe the contribution of educational system in the human capital increment.

The important trend of the analysis with reference to educational system is the relationship of the state and private education, and comparison of efficiency of these two educational models and their contribution to public product. Here two circumstances are important: whether educational system and higher education give the possibility to get higher future income, that is, how private and social benefits-costs vary with education after it is finished and the agent begins his labour activity. It is a particular question when education is provided in the course of agent's labour activity. It is possible to judge about the condition of educational system and its influence on the development of economic system (contribution to economic growth) by the rupture value between private benefits-costs and social benefits-costs. For the efficiency characteristic it is possible to introduce social and private rate of educational system return. Then it will be logical to consider the relation of private costs to private benefits as private rate, and the relation of social benefits to social costs as social rate of return. Social benefits are a value of positive externality plus

direct social benefit, deep down. For example, from specialist training for public sector, defensive complex, etc. And it is possible to consider state expenses for educational system as social costs. We will present a possible change of key parametres of educational system's effectiveness depending on the years of training (time parametre).
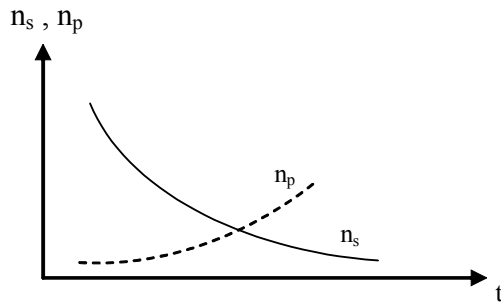

Figure 4. Social (n_s) and Private (n_p) Return Norm of Educational System

If to proceed from the fact that social institutions are arranged in such a way, that they provide higher income for higher education (more years of training) during the life cycle of the agent, then the recoupment of the higher and post-graduate education for the society will demand more time. For an individual agent the number of years of recoupment of his investments in the equivalent kinds of education will be lower as its income will be considerably higher at once, as well as the extended possibilities in getting well-paid job. And far as the society is concerned, positive external effect of such training of one agent will be relatively lower and will affect economy appreciably in a considerable time interval. In this connection, all other things being equal, the social rate of return will decrease with time increase, and the private rate of return will increase. The graph will preserve its shape (Figure 4) if the state market share is shown on x-axis. With its increase which corresponds to higher education demanding larger, ever-growing state investments, the norm of social return usually decreases a little, and the rate of social return owing to quicker recoupment of private investments increases. However, it is fair, only if base institutions provide higher income to higher educational level during all the life cycle of the agent. Otherwise, if higher income does not correspond to higher education, dynamics character of both private and social return will be a little bit different.

As more capable agents provide larger contribution to production of human capital and output aggregate production, it is necessary to adjust the process of these agents' selection for educational system, science and high- tech production effectively. Moreover, it is necessary to provide them with the best conditions of training, that is, on budgetary basis with the further employment or in free form, or to suggest them working for the state (defence, fundamental science).

If private costs surpass private benefits from education in all its forms, it means that incomes level of such country does not allow providing proper education privately. Such countries are the poorest. Generally, the level of private benefits surpasses the level of private expenses, and the rupture between these values is reduced with the increase of educational level. The situation when private costs are more than private benefits at elementary school level is possible, but then private benefits from getting higher education and postgraduate studies sharply increase. It corresponds to the situation when school education should be provided by the state, and getting it privately with the termination of further study does not pay off because of great difference in earnings between the agents, having higher, post-graduate and elementary education. Such state of affairs is characteristic for economy in which the wages differentiation between simple and complex (skilled) labour is high. Basically, both developing and developed countries can be referred to this group if labour there is highly automated, mechanized and requires long training and high qualification. Then it is not profitable to stop education process and stay at the bottom level. Social benefits can essentially exceed social costs during the studies beginning at school and up to the postgraduate education. A variant, when social costs of educational system are larger than its social benefits during the whole period of training, demonstrates high system's inefficiency, its dysfunction. In this case, education is conditionally-unprofitable for the society and economy. But it can be profitable for private agents. However, in any case if such situation arises or educational system is coming nearer to such condition, it is an indicator of dysfunction increase, sharp system's degradation, high costs, low qualification of trained specialists. Besides the system of elite private education can function rather successfully in the economy which will provide sharp excess of private benefits over private costs.

The relation of private costs-benefits and social costs-benefits will define the sectors of the state and private education relation. At the same time, qualifying requirements can be defined only by the government proceeding from the estimation of positive external effect and the forecast of necessary experts' qualification for the future. Though the private system can be guided by its own standard which will exceed the government standard.

During training, the skill level in effective educational system should increase. However, if we compare any training disregarding its quality, the increment of knowledge will be available comparing with the initial level of the agent before training. Therefore, the estimation of the degree of growth of the skill level in the course of training is important. In connection with everything told above, it is possible to introduce specialist's qualification function (competence level) and to compare the dynamics of this function in the period of training and during all the agent's life with the functions of health reserve W_s. Before the training period T_{NO} qualification function can increase depending on the character of preschool education and knowledge of the world around, time spent for the child in the family, initial level of income, parents' abilities, including the abilities of children's upbringing. On the

sector of training $[T_{NO}, T_{KO}]$, health reserve is reduced, and qualification function grows. Then, after the basic training the following scenarios are possible: 1) qualification increases inertially at the expense of experience accumulation by the specialist and with years is stabilized at one level (line 3), or by the life's end is reduced (line 4); 2) qualification grows inertially at the expense of experience perfection, retraining and skill conversion (professional development, study courses, etc.) in the following years, reaching peak by the life's end and being stabilized (line 1), or reducing a little (line 2). The health reserve steadily decreases, though the function can reflect a more sharp (quick) decrease right after or even during studies (line 5), Figure 5. Because of health loss qualifying skills can be lost as well (Figure 6, lines ABO, ACO, and AO). The character of change is defined by the speed of health reserve reduction with the following reduction of qualifying skills and knowledge level. Qualification function of the agent then will depend on the health reserve function. Besides, qualification will depend on the abilities of the agent, including its genetics, and also from the initial income level, or the available or inherited asset which is bringing in return.
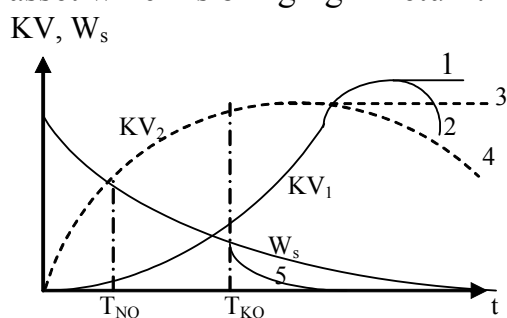
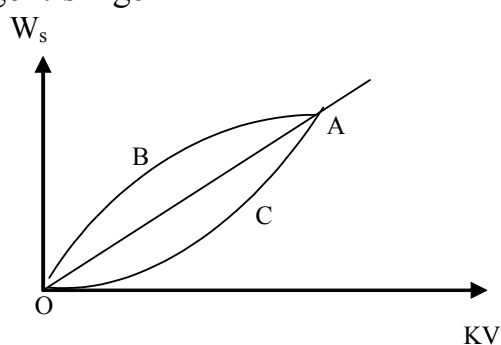Figure 5. Dynamics of Skill Level and Health Reserve Depending on the Agent's Age

Figure 6. The Function of Qualification Reserve Depending on the Agent's Health Reserve

Depending on the income level of the agent, it is possible to present the function of health reserve and skill level function (Figure 7).
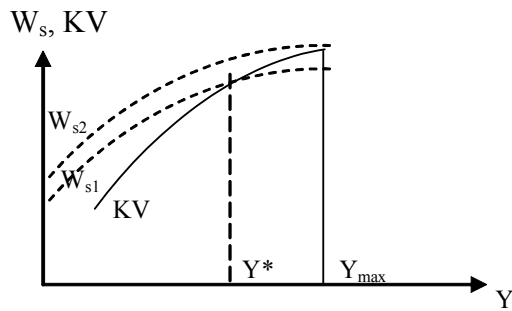
Figure 7. The Function of Health and Qualification Reserve Depending on the Income

Let's admit that health reserve is higher than qualification reserve for the same income level. Both functions grow at decelerating speed, but beginning from some value of national/per capita income Y* qualification reserve grows more greatly than health reserve, and then this growth at Y_{max} stops at all. From moment Y* qualification becomes more significant. Its further growth, which can be connected with technological breakthrough, can provide the movement of curve W_{s1} to position W_{s2}, thereby, health reserve for the given income level will increase. Affixment of health reserve function and qualification affixment to income level allows to formulate the problem of rupture finding between two functions and optimum distribution of investments between preservation, restoration or increase of health reserve, or advanced training and capital supplies augmentation. In short, human capital augmentation by means of training and advanced training is accompanied by its obsolescence, real physical deterioration expressed in deterioration of health reserve and working capacity and productivity decrease.
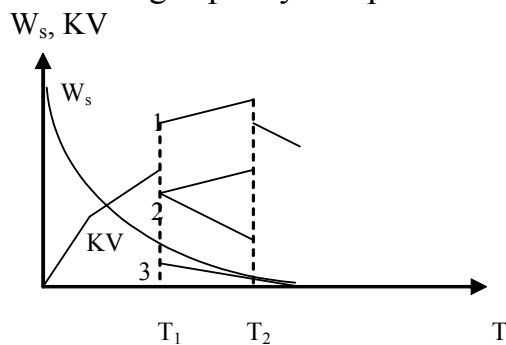

Figure 8 Change of the Qualification Function

It is possible to present the change of qualification function according to the development periods of the agent. Then at moment T_1 due to study courses and advanced training this function is shifted to position 1 (Figure 8), but the disqualification situation is possible, for example owing to illness (curve 3 - a part of function W_s) which can be described by curve 2 going downwards (degradation), or

upwards (partial restoration of qualification). Age reduction of qualification will be observed since age moment T_2.

Thus, economic agent's dysfunction (DF_A) is, in essence, a set of health (D_{Ws}) and qualifications (D_{KV}) dysfunctions. Qualification dysfunction is a disqualification which is expressed in the loss of necessary knowledge, or inability to apply this knowledge at the agent's disposal. It is possible to present the dysfunction itself according to each component through the functions of health and qualification reserve. Certain parts of these functions will correspond to dysfunction. Then we will write down:

$$DF_A = D_{Ws} + D_{KV}$$

Then macroeconomic policy should proceed from the necessity of this function minimization, or it is required to set the task in other way, to present well-being function (SFW) in the form of the sum of functions of health reserve (W_s) and skill level (KV). And the problem of global maximum search for the whole system will be formulated. However, nobody prevents to preserve this formulation for microeconomic level:

$$DF_A \rightarrow \min, \quad SFW(t) = W_S(t) + KV(t) \rightarrow \max$$

Function of dysfunction symbolizes a minimum of losses while achieving concrete maximum, as there can be several movement trajectories as well as maxima (a maximum for each trajectory). Probably, it would be necessary to build empirically each function, taking into account agents' age structure of economic system, as this structure will influence the type of corresponding functions greatly. As it has been shown on the theoretical graphs, functions can have a broken appearance because they have their own elasticity for the given time periods.

Different qualifications and specialists number of each qualification have its importance in economy regarding their contribution to the rate of economic growth and to the increment in the national income. The problem of definition and forecast of economy's qualifying matrix according to the contribution of each professional group in the development, therefore, makes sense. In such statement of a question the given problem, having been solved, will allow to operate educational system as well as labour markets and the development in general.

Prosperity of the agent is made up of health reserve and accumulated qualification. Actually, it is possible to present it as the sum of two functions: $B_i(t)$ = $W_{si}(t)$ + $KV_i(t)$. The available resources, projected institutions, accumulated physical reserve of capital (dwelling, infrastructure, working areas/capacities, etc.) serve these base functions and provide, or do not provide, their increment.

The so-called qualifying approach can be applied to educational system estimation. In this case mathematical model describes the skill level dynamics:

$$\frac{\partial k}{\partial t} = f(k) + Z(t), k(t = 0) = k_0$$

where: k (t) – specialist's qualification or educational capital (competence) accumulated as a result of training;

k_0 - qualification before training, at a certain initial time period;

Z (t) - function of educational system expenses.

The solution of this differential equation depends on function selection f (k), and on the assumptions defining a material's digestion in the course of training, use of the given qualification in the economy, etc. It is important to take into account how accumulated experience defines the dynamics of qualification when training has been finished for a long time. The same refers to labour market condition and economy as a whole which can or cannot claim specialists of this or that level. In other words, competences cannot find practical application and approbation.

With accumulation of operational experience the qualification of trained specialists should grow, instead of decrease or being stable. With modern competition it actually means qualification decrease. It is an optimum variant. In other words, educational system should provide further development of specialists with the qualification increment if it is effective.

Reduction of health reserve or as we sometimes say, "nation's health" decrease, as a macroeconomic indicator affects the possibility of knowledge production and skill level which goes down. As a result, productivity, technological level of production is reduced. The quality of life also decreases.

On the assumption of the facts stated, we will present the functions of health and qualification reserve in the analytical form in conformity with the graphic dependences given above. Then, it is possible to write down:

$$W_s = a_1 - a_2 e^{-\beta 1 y}, \quad KV = b_1 - b_2 e^{-\beta 2 y}$$

Having differentiated it according to the level of per capita income, we will receive:

$$\frac{\partial W_s}{\partial y} = c_1 e^{-\beta 1 y}, \quad \frac{\partial (KV)}{\partial y} = c_2 e^{-\beta 2 y}$$

It is possible to present the dependence of the function of health reserve and skill level in the following two ways:

$$W_s = a - b e^{-\alpha KV}, \quad \frac{\partial KV}{\partial t} = A KV_0 e^{\mu W_{sw}}$$

Then: $\frac{\partial W_s}{\partial t} = c_3 e^{-\alpha KV}; \frac{\partial W_s}{\partial t} = \frac{\partial W_s}{\partial t}\frac{\partial y}{\partial y} = \frac{\partial W_s}{\partial y}\frac{\partial y}{\partial t} = c_1 e^{-\beta 1 y}\frac{\partial y}{\partial t}$, from which it follows, that

$$\frac{\partial y}{\partial t} = c_4 e^{\beta 1 y - \alpha KV}$$

Having expressed qualification function, we will receive:

$$KV = \frac{\beta_1}{\alpha} y - \frac{1}{\alpha}\ln[\frac{1}{c_4}\frac{\partial y}{\partial t}]$$

Having substituted this expression in the function of health reserve, we will receive:

$$W_s = a - \frac{b}{c_4} \frac{\partial y}{\partial t} e^{-(1+\beta 1 y)}$$

Thus, the solution, as well as the type of functions of qualification and health reserve will depend on dynamics representation of y-gross product (per capita). A different way is to set the function of qualification and the intensity of educational system expenses, that is, to use the equation type as: $\frac{\partial KV}{\partial t} = f(KV) + Z(t), KV(t=0) = RV_0$. Having accepted f (KV) = φ KV (φ <0 - indicator characterizing knowledge perception, that is, efficiency of digestion (speed) of knowledge) and Z (t) = Z_0, we will receive: $\frac{\partial KV}{\partial t} = \phi KV + Z_0$.

The solution of the given equation in a general form is the expression:

$$KV(t) = -\frac{Z_0}{\phi} + (KV_0 + \frac{Z_0}{\phi}) e^{\phi t}$$

Having accepted KV_0=0,5, Z_0=1, φ =-0,5 we will receive: KV (t) = 2 - 1,5 e $^{-0.5\,t}$. The graph will reflect qualification increase depending on time (Figure 9).
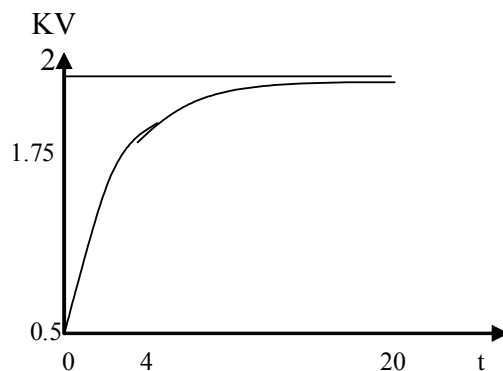
KV

Figure 9 Change of Qualification Function

If we accept KV = a - b e $^{-\alpha\,W_s}$ and W_s = b_1 + b_2 e $^{-\beta\,t}$ and having accepted a=1, b=0,2, α =0,3, β =0,5, b1=1,5, b2=0,5, we will receive W_s=1,5+0,5 e $^{-0,5\,t}$. And then graphs for function of health reserve and qualification will have the form they are shown in Figure 10.
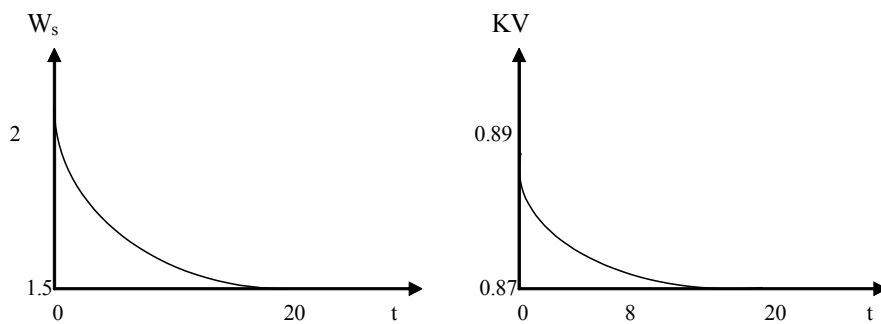
Figure 10 Change of the Function of Health and Qualification Reserve

As it is seen from Figure 10, decrease of health reserve can, though slightly, lower the possibilities of advanced training at the used values. Qualification function decreases the same way as the function of health reserve. Such change differs from the model presented above where a certain constant intensity of expenses for education Z_0 was set.

Thus, at macroeconomic models formation it is necessary to consider the action of various factors and interconnection of various systems. Otherwise the result will actually be set by the type of mathematical function, or limited by the conditions of functioning of a considered subsystem, educational system in this case. However, with reference to systems where the health of population is extremely low, or the population in general starves, no import of education can cardinally change the situation till function of health reserve will allow doing it. Naturally, it is necessary to consider the function of advanced training. In other words, it is necessary to invest in economy so that final products and consumption refer to two sectors, providing health and education, the output in which would have application within the limits of concrete national system. Only thus it will be possible to break off a vicious circle of poverty or backwardness of any stability. To lift upwards the decreasing curve of health reserve and to extend it to the right so, that its crossing with x- axis would occur as late as possible is an absolutely rational aim. Agents wish to live as long as possible and to retain labour activity or vital activity. Such purpose is righteous from the point of view of "the social state" and corresponds to economic policy, and together with the necessity of education and qualification extension, it can be reached. Thus, qualifying level increase will act as one of the tools of its achievement and health improvement will simultaneously provide motivation for training.

Introducing the share of investments directed to health and education d1 and d2 accordingly, and the share of savings from wages and profit s1 and s2 accordingly, having accepted, that investments into economic system can be reduced to two components, to investments into education (knowledge, technology) and to public health services (it is possible to consider investments into capital funds as new technological possibility and as a kind of knowledge), it is possible to receive the following simple macroeconomic model of system. For this purpose we will write down:

I (t) = α (t) S (t) - investments in general case are not equal to savings;

Y = S+C, Y = w+p - income will be presented as the sum of savings (S) and consumption (C), because revenue earned is used for consumption or it is saved. It can also be presented as the wages sum (w) and profits (p);

I = d1 w + d2 p = d1 w + d2 (Y-w) = w (d1-d2) + d2 Y.

α (t) S (t) = w (d1-d2) + d2 Y,

α (s1 w+s2 p) = w (d1-d2) + d2 Y,

Having substituted p = Y - w and having expressed Y, we will receive:

$$Y(t) = \frac{w(t)\dfrac{(d1-d2)-\alpha(t)(s1-s2)}{\alpha(t)s2-d2}}{}$$

On the assumption of received above expressions, we have:

$$y = c_4 \int_{t1}^{t2} e^{\beta 1 y - \alpha KV}\, dt$$

Having expressed y (t) through wage and parametres of investment and savings processes, it is possible to solve the reduced equation in relation to qualification function, having the dependence on wages and given institutional parametres of "investment-savings" process in macroeconomic.

In a generalized form the training effectiveness can be estimated by means of knowledge comparison – competences before and after training. Then it is possible to judge how effective/ineffective the methods and ways of training were. Efficiency presupposes the criterion for estimation, taking into account the purposes of system's development, set of alternatives (trajectories) of development and decision-making within the limits of the system, restrictions and stability range and system's viability. Training effectiveness can be estimated by the relation of the sum of grades after and before training $R = \Sigma R_P / \Sigma R_D$. Or, proceeding from the competences calculation method, it is possible to present indicators of the general effectiveness of educational system as follows:

$$R = \frac{r_{ip}}{r_{id}}, \qquad R_\Sigma = \frac{\sum_{j=1}^{n} a_j r_{jp}}{\sum_{j=1}^{n} a_j r_{jd}},$$

where:

R, R_Σ - indicators of general efficiency from separate competence training and the whole set of competences training accordingly;

r_{jp} - estimation after training, or "ideal" competence level according to each j-competence;

r_{jd} - estimation before training, or competence level after training (if there is the "ideal" value in the numerator);

a_j - specific weight of j-competence in the model according to the number of competences - n.

The skill level is defined by the agent's competence in this or that professional questions, in the solution of this or that problems. Therefore, qualification is defined through competences. Advanced training and competence reproduction are a product (task) of educational system. In turn, advanced training leads to agent's competitiveness growth in the labour market. Hence, proceeding from the experience and empirical data, it is possible to introduce flexible standards of skill level according to the requirements of the labour market and competences and to use the suggested instrument for estimation of education quality change. The need of personnel for required qualification is formed by the economic system, and educational system should satisfy this need taking into account the state component, because the government can order educational system specialists of other qualification, than it is required on the labour market.

If there is a situation of markets failure in the economy, including the labour market, reacting to the situation correspondingly, the educational system is capable to train personnel "failure" in the period ahead, with a certain lag equal to the period of specialist's study and training. The Russian example is a vivid proof of this fact. In 1990s the system of vocational schools did not train specialists of working trades as the markets were contracted; the workers lost their jobs and left the enterprises for trade and small-scale business. As a result they were disqualified. Years later the workers absence is the factor limiting growth in many sectors of Russian economy. Hence, educational system is a special sector of economy which should not react to market fluctuations, and should be guided by the prospect solving the problems of personnel reproduction for the economy. That is, it should be guided by the economy's future and its need in a certain skill level. Another danger is that the estimation of this future can be overestimated and the personnel so well prepared will simply be not absorbed by the economy. For example, the level of competence and knowledge will not correspond to the available fund or laboratory base. And then the best workers, scientists, engineers will search for jobs in corresponding conditions. Thus, educational system can work for specialist training for other economic systems.

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