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Transformation of the Resource Scarcity Principle in Increasing Return Economics

I.A. Kirshin

Kazan (Volga Region) Federal University, Kazan, Russia

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Abstract: This article deals with the peculiarities of functioning of increasing return economics and reasons the necessity to modify the resource scarcity principle as applied to the research of the subject matter of economic processes with increasing return. Modelling the results of reallocation of a common resource among alternative productions in the increasing return economics, the author determines constraints of the law of increasing relative costs.

Key words: Resource scarcity · Increasing return · Efficiency

INTRODUCTION

The foundation for the modern increasing returns theory was laid by using the increasing return principle. The economic mechanism of the latter can be demonstrated by a model with positive feedback. The total of production factors comes to the input of an economic system, where the scope of these factors is determined by the existing total social demand. At the output of the system, a strong social demand and large cost are generated, including the production factors, which again come to the system input.

The significant result of the application of the increasing return principle in the economic theory is the positive criticism of the classic methodology of overall equilibrium. For example, A. Young in his article "Increasing Returns and Economic Progress"[1] disputed the applicability of the Marshallian partial equilibrium method and the methodologies of the theory of overall equilibrium in theoretical constructs, which explained the concept of the incipient increasing return economy. He pointed at the fact that the logics of an ideal static equilibrium based on the constraints of the decreasing return are at variance with the empirical data. Statistics evidenced the fast change of the economics, the growth of labor efficiency in production, services and investments sector, which was not in line with the theory of static equilibrium. Young treated the economic progress as a dynamic one, which showed symptoms and signs of unbalanced forces, as a motion away from equilibrium and from the previous path of economic dynamics.

Later on, K. Arrow reasoned the provision, according to which, the production becomes more efficient along with the general growth of products output, because the return increases as employees acquire experience in the course of production activity. The mechanism of maximization of efficiency and productivity of production follows the "learning-by-doing" principle [2]. This principle was later reproduced by P. Romer [3]. The innovation was in the fact that while companies kept on working in the mode of permanent return depending on the scope, the increasing return on the scope influenced the whole economy.

The significant difference in the approaches to the research of the increasing return economics resides in the necessity to modify the resource scarcity principle. The mechanism of positive feedback multiplies the signal supplied to the input of the system (the resource) and consequently generates the increasing dynamics of the system operation. Therefore, in this feedback system, scarcity cannot act as the general parameter of all used resources.

RESULTS

Let us consider the changes of the *labor* factor as an example. Indeed, labor resources are limited by the economically active population and they are scarce in this

Corresponding Author: Kirshin, Kazan (Volga Region) Federal University, Kremlevskaya, 18, Kazan 420008, Russia.

meaning. However, first of all, the constraints on the *labor* factor are removed as the scientific and technical progress develops and the level of education, qualification and education of employees grows. This process is determined by endogenous factors of the economic growth. As the labor efficiency improves, employees are displaced from the conventional economic activities and moved to new types of activities. Secondly, the formed economics of knowledge changes the structure of the labor, the share of knowledge-based labor increases. Accumulation and consumption of knowledge produce stronger knowledge; the effect of positive feedback occurs with respect to knowledge and consequently, to the *labor* resource as a whole. In this case, not only the effect of the production scope takes place, but even more the effect of the consumption scope, which is implemented by means of the spillover effect, the matches of skills effect and the network effect.

The specificity of the mechanism of increasing return causes significant changes in the law of increasing relative costs, which is based on condition of resource scarcity and decreasing profitability on the production possibility frontier.

For the analysis, we use the modelling instruments suggested by W. J. Ethier [4]. Let us assume that:

Two types of commodities are produced in the economics: intellectual technology (R) applied in car manufacturing industry and cars (T).

And the only production factor is used - labor (L):

$$L_R + L_T = L,$$

where L_R and L_T are the quantity of labor used in the intellectual sector and car manufacturing industry, accordingly and L is the general labor resource limit.

As opposed to Ethier who admitted the usage of constant return on one of the commodities, we will analyze the increasing returns to scale (IRS) for both commodities. Let us assume that the labor unit in the car manufacturing industry produces h cars; then:

$$T = h \cdot L_T$$

The h parameter depends on the production scale:

$$h = L_T^{\alpha-1},$$

where $\alpha > 1$ for the increasing return. The result will be:

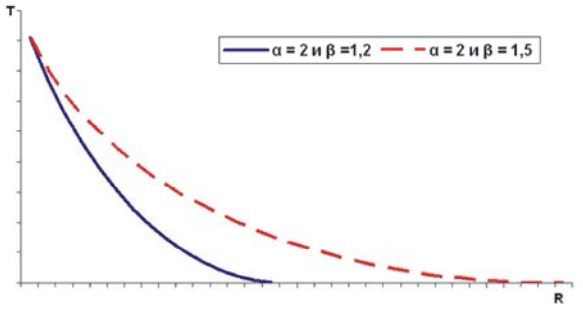

Fig. 1: PPF and IRS diagrams in both production sectors.

$$T = L_T^{\alpha-1} L_T = L_T^{\alpha}, \text{ or}$$

$$L_T = T^{\frac{1}{\alpha}}$$

Then, average costs will be decreasing along with the increasing production scale (usage of more labor quantity).

If we apply the consumption scale and similar analytic constructions for the intellectual sphere, we will receive:

$$L_R = R^{\frac{1}{\beta}},$$

where $\beta > 1$ for IRS. Let us assume that $\alpha < \beta$, then the total labor resource limit will be expressed as:

$$L = R^{\frac{1}{\beta}} + T^{\frac{1}{\alpha}}$$

Graphically, the law of increasing relative costs is expressed in the form of a curve of production possibilities frontier (PPF). In our case, the PPF equation will be formulated as:

$$T = (L - R^{1}/\beta)^{\alpha}$$

The PPF diagram is provided in Figure 1.

As opposed to the conventional PPF configuration, the slope of this curve decreases as the output of one of the commodities increases and the ratio of the decrease reduces. The convex down shape of the curve of production capacity means that the marginal rate of transformation (MRT) decreases as the output of the alternative commodity grows. And at that, the larger the increasing return, the lower MRT is. Graphically, it is expressed through the different PPF slopes with $\beta = 1.2$ and $\beta = 1.5$. Refusal from production of each subsequent

unit of one commodity is followed by the larger growth of the alternative commodity production. The explanation is that the expansion of production is accompanied by the increasing returns to scale – every additional unit of the factor, which is reallocated from production of one commodity, causes even larger growth of another commodity production. Similar result can be achieved if we assume constant return in one sector and increasing return in the other.

Thus, the effect of the law of increasing relative costs in an increasing return economics is drastically changed even when the resources are scarce: it is replaced by the law of decreasing alternative costs.

Let us assume that price formation is carried out using average costs. When the labor unit payment equal to w and production of T cars, the car price will be:

$$P_T = \frac{wL_T}{T}$$

Similarly, the price of an intellectual labor unit P_R will be equal to:

$$P_R = \frac{wL_R}{R}$$

Then, the relative price of production will be:

$$\rho = \frac{P_R}{P_T} = \frac{L_R}{L_T}.\frac{T}{R} = \frac{R^{\frac{1}{\beta}}}{T^{\frac{1}{\alpha}}}.\frac{T}{R} = \frac{T^{1-\frac{1}{\alpha}}}{R^{1-\frac{1}{\beta}}}$$

If we differentiate the resource limitation by labor, it will be:

$$\frac{1}{\beta}R(\frac{1}{\beta}-1)dR + \frac{1}{\alpha}T(\frac{1}{\alpha}-1)dT = 0$$

$$MRT_{RT} = -\frac{\Delta T}{\Delta R}; l = const$$

The marginal alternative cost of production of a car, if expressed in the units of intellectual commodity, is of a decreasing nature.

The marginal rate of transformation will be equal to:

$$MRR_{RT} = -\frac{dT}{dR} = \frac{\alpha}{\beta}.\frac{R^{\frac{1}{\beta}}}{T^{\frac{1}{\alpha}}}.\frac{T}{R} = \frac{\alpha}{\beta}.\rho$$

As $\alpha < \beta$, the relative price exceeds MRT. Thus, the optimal quantity of the intellectual commodities from the perspective of the optimal state of social prosperity will not be produced. At that, the larger the difference between the α and β values, the lower MRT is, which means the increasing rate of the R commodity production growth if the labor is engaged in its production.

The peculiar feature of the science-based business, as it was already noticed, is the specificity of the influence of the economic mechanism effect on a scale. The influence of the increasing return effect in this sector is determined mainly by the scale of consumption, rather than the scale of production. Increase of personnel number and capital size in the intellectual sphere is not directly correlated with the faster growth of the result. On the contrary, the decreasing returns to scale (DRS) can take place sooner with respect to the production scale.

Let us analyze the situation, when the sector of intellectual technology operates in the DRS mode. The increasing average costs are expressed with the following equation:

$R = L_R^{\lambda}$, where $0 < \lambda < 1$.

$$L_R = R^{\frac{1}{\lambda}}$$

Then, the PPF equation will be stated as:

$$T = (L - R^{1/\lambda})^{\alpha}$$

With the purpose of further analysis, we will treat the decrease of the λ parameter as the DRS strengthening. Let us consider several possible combinations of IRS and DRS effects in sectors R and T at $L = const$.

The PPF curves, on the assumption of $\alpha = 2$, $\lambda = 0.8$ and $\lambda = 0.7$ are shown in Figure 2. The PPF configuration has changed; it has a point of inflexion. With increased production of intellectual commodities, MRT initially goes up; and, having passed the point of inflexion, it starts decreasing. I.e. the point of inflexion of the PPF curve is a frontier of effect of the laws of increasing and decreasing relative costs. Such path of the process encourages increasing the intellectual products manufacturing scale to exceed the value determined by the horizontal point of inflexion, when the IRS effect will start working in the sector of intellectual commodities production, too. This can be explained with the fact that at low scale of car production, the potential of the IRS effect is insignificant.

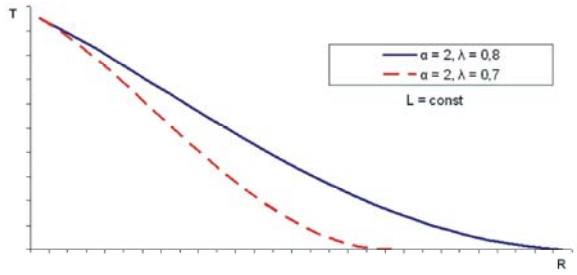

Fig. 2: PPF diagram with IRS in the *T* sector and DRS in the *R* sector.

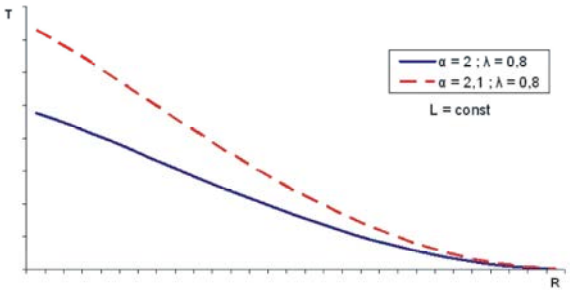

Fig. 3: PPF diagram with increasing IRS in the *T* sector and constant DRS in the *R* sector.

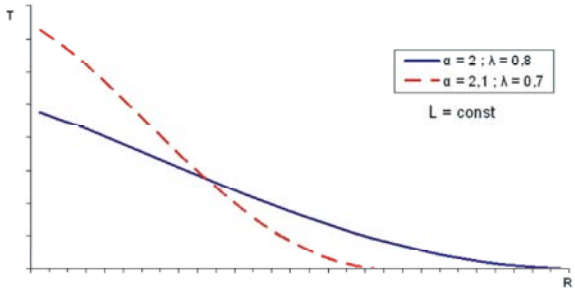

Fig. 4: PPF diagram with increasing IRS in the *T* sector and increasing DRS in the *R* sector.

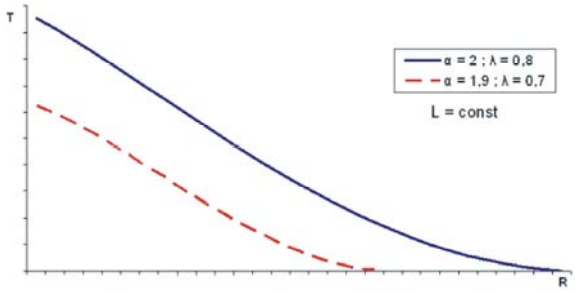

Fig. 5: PPF diagram with decreasing IRS in the *T* sector and increasing DRS in the *R* sector.

In case of increase of the intellectual production DRS (decrease of the λ parameter with constant $\alpha = 2$ value), MRT increases and the IRS effect decreases (the lower distance between the horizontal co-ordinate of the point of inflexion and the maximum value of the output of the *R* sector) and, therefore, the effect of the *T* product transformation to *R* product decreases along with the respective resource release from the *T* sector.

Let us assume the IRS increase in the *T* sector: $\alpha = 2$, $\alpha = 2.1$ and constant DRS in the *R* sector: $\lambda = 0.8$. The PPF curves with these parameters are shown in Figure 3.

In case of increasing DRS in car manufacturing industry (α parameter increases), MRT increases, too, but, as opposed the previous case, the transition from DRS to IRS happens earlier (the horizontal co-ordinate of the point of inflexion is shifted to the left, i.e. at lower production scale), which compensates to a certain degree the effect of transformation of the *T* product to the *R* product (Figure 3, $\alpha = 2$.) along with respective release of the resource from car manufacturing industry. If the α parameter value was changed, the number of the points of inflexion of the PPF curve could be more than one, which would make the analysis of the scale effect results more difficult.

In case of simultaneous increase of DRS of the intellectual commodity production and IRS of the car manufacturing industry (with other parameters the same), MRT increases and the IRS effect becomes lower (smaller distance between the *R* co-ordinate of the point of inflexion and the maximum value of output in the *R* sector, Figure 4). Consequently, the alternative cost of the intellectual commodity production increase will rise considerably accompanied by the respective release of the resource from the car manufacturing industry.

In case of combining the increase of DRS of intellectual commodity production and the decrease of IRS in car manufacturing industry (with other parameters the same), PPF shifts to the left and the economic growth rate slows down (Figure 5).

Thus, the combination of IRS and DRS effects in alternative sectors with *L = const* limits the effect of the law of increasing relative costs.

The scarcity of the knowledge resource is a debated issue because of its contradictory nature. The knowledge combines the attributes of social and competitive commodity in itself. The internal noncompetitiveness and inexhaustibility of knowledge are combined with the market forms of its implementation. According to the realia of the market in the model, the provision on the limited nature of knowledge and, subsequently, the *labor* resource provided with knowledge was used. Indeed, the scarce resource, which determines the scope of the *labor* factor, is the time, mainly the free time. "A person has got only 24 hours a day to distribute his attention between millions of innovative phenomena and opportunities that economics throw at him" [5].

CONCLUSION

The limited nature of knowledge, useful information and the number of the intellectual creators of them can be determined by various factors, e.g. by absence of demand, absence of incentives, non-readiness of the institutional environment, mentality of the society, etc. The understanding of the non-scarce and non-exhaustive nature of an informational product does not mean its common accessibility in the manner of a Communists' motto "To each according to his needs!" Indeed, potential information (knowledge) can be endlessly consumed, but only by virtue of title. For others, its consumption is limited and controlled. Virtually, an information product has a social nature, but the dominance of the economic demand determines its contemporary existence as a competitive commodity. Information and knowledge are not free of charge; on the contrary, the prices can be much higher than the prime cost of their mass replicating, even if compensation of the initial R&D expenditures is included.

The forms and the modes, in which an information product is provided, imply access limitations by introducing economic, institutional and legal barriers. And the number of intellectuals who can generate a useful information product is also not too large. Thus, from the perspective of reproduction, we can define the information product as a scarce and exhaustible resource. Production, distribution, exchange and, partially, consumption of an information product are limited.

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