THE INVESTMENT IN HUMAN CAPITAL, AN INTRISIC FACTOR OF THE SUSTAINABLE ECONOMIC GROWTH

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Abstract
The educational system will need to direct its actions and programs towards the identification of the current and future values of the labour market, starting from the existing and potential labour resources, anticipating first and foremost the adjusting of the economy to fast-developing fields and domains, put forward by the State via the Fast-developing Field Strategies or even via the Fast-developing National Strategy. It will accordingly generate a binder between the demands of the labour market as a response to the developing necessities of the economy, and the training/specialization of the labour force as offered by the national syllabus. By these means the educational system would create a labour force compatible with the labour market, which is both a premiss for the increasing level of employment and for the sustainable economic growth. Our task is therefore to provide a concept of education related to technological progress, based on the model of Nelson and Phelps, and a suggestion for investments and education policies.

Keywords: *education, human capital, labour market, technological progress, investment policies*

Introduction

Education and training converge, ultimately, to find a job whose usefulness is maximal in terms of restrictions which refers mostly to the absorbtion of the labour market, labour productivity and economic competitiveness of goods produced.

Currently, education and labour market are two different sets that interact only at the declaratory; action is necessary for interaction through cooperation and coordination, competition in the domestic labour market providing the binder between higher levels of efficiency and competitiveness of the workforce. Education market provides input for the labour market, which would require a training strategy linked to labour market trends and changes at work, on the one hand, and the needs for development of a region / economic zone (economically -entrepreneurial and social-investment), on the other side.

The development of contemporary society, the educational system that will serve the workforce needs of employers and future economy is based on smart growth[1] which requires intensive growth of labour and capital inputs with bonding technology innovation which, combined, increases total factor productivity.

We will exemplify with a model based on Cobb-Douglas production function with returns to scale assumption, $\boldsymbol{Q = A\,K^{\alpha}\,L^{\beta}}$, where K is the capital employed, and L is the volume of labour.

This shows that if the quantities used of the two factors of production, labour and capital, increases in the same proportion, the report of the marginal productivity does not change[2]. However, if L and K show a proportional increase then income growth (Q) is greater or less than proportional,

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[1] William J. Baumol, Robert E. Litan, Carl J. Schramm, *Capitalism bun, capitalism rău şi economia dezvoltării şi a prosperităţii* [Bucureşti: Polirom, 2009], p. 13.
[2] Gilbert Abraham Frois, *Economia politică*, [Bucureşti: Humanitas, 1998], p. 115.

as $\alpha + \beta > 1$ or $\alpha + \beta < 1$. In the theory of production, α and β express the elasticity of production in relation to production factors.

Considering a state of technological capital, what can increase production / productivity is the investment in human capital / education. Therefore, if the volume of capital and labour remains constant, it may get a boost production by increasing the sum of the elasticity of production factors, α and β. If α, the elasticity of production related to capital is considered constant, it is sufficient to increase β, the elasticity of production related to work, to get an $\alpha + \beta > 1$, and hence increased production and increasing returns to scale.

Our task is therefore to provide a concept of education related to technological progress, based on the model of Nelson and Phelps, and a suggestion for investments and education policies. The need of a new concept of education integrated in a model that emphasizes the development of technology is irrepressible.

Education and technological progress: a new perspective on a concept of education

For a concept of education[3], we shall go on studying the formalization of a way explaining the technological progress. The model introduces a specification in the technological factor *A* that separates *practical technology* (used technology) from *the theoretical technology* (the new technology under study to be implemented), which is going to be introduced according to the progress related to education/ skills, considering the gap between technologies[4]. The model aims mainly at explaining the irreducible relation between education/ skills and technologies in the technological progress. The model is a double one, but I shall resume only to the first variant. For simplicity we renounce to the specifications α and β.

Nelson and Phelps consider that human factor is crucial in increasing rate/ level of technological progress. It does not mean that payoff in education (or even modifications at the level of education) is independent to the technological developments- it is trying to correct this situation. They suggest a double model that correlate the diphase time between the moment in which a technology is produced and the time when education is implemented. Thus, output *Q* is a function of *K(t)*, *L(t)* and *A(t)*:

$$Q(t) = F[K(t), A(t)L(t)]. \quad (1)$$

Where *K* stands for capital, and *L* for the labour that use it. *A* indicates the best way of practical use of the given technology. If we name *T(t)* the theoretical level of technology, which is new technology that is studied and is to be implemented, *T(t)* becomes:

$$T(t) = T_o e^{\lambda t}, \lambda > 0 \quad (2)$$

where λ represents the rate with which the theoretical level of technology advances. To find the role that education plays, *A(t)* becomes:

$$A(t) = T(t - w(h)), w'(h) < 0 \quad (3)$$

where *h* indicates the average level of education or intensity of human capital, and *w* – the lag. Tightly reformulated, the above equations 2 and 3 become:

[3] See Diana Apostol, "Knowledge, Education and Technological Progress in the New Economy", Metalurgia International, Issue No.5, Vol. XIV.

[4] Nelson, Richard R. Edmund S. Phelps: "Investment in Humans, Technology Diffusion, and Economic Growth", Cowles Foundation Paper 236, Reprinted from *American Economic Review*, 56(2), 1966.

$$A(t) = T_o e^{\lambda[t - w(h)]} \qquad (4)$$

If *h* is constant, it results that: a) the index of practical technology increases with the same ratio λ, technology theoretical index; and b) the level of technology in practice is a increasing function of *h*, because an increase of *h* shortens the gap between *T(t)* and *A(t)*[5]. Simultaneously, the investment return in education is even higher, faster the theoretical level of technology advanced. Thus, the effect on *A(t)* of a marginal increase of *h* is an increasing function of λ, when we have *A(t)*, and it is positive whether $\lambda > 0$, which means that rate or theoretical level advances or is higher than zero. It means that:

$$\frac{\partial A(t)}{\partial h} = -\lambda w'(h) T_0 e^{\lambda[t - w(h)]} = -\lambda w'(h) A(t) \qquad (5)$$

The level of the marginal product of education is visible in the base equation and can be formed as it follows considering the relations (1) and (4):

$$Q(t) = F[K(t),\ T_o e^{\lambda[t - w(h)]} L(t)] \qquad (6)$$

from where:

$$\frac{\partial Q(t)}{\partial h} = \lambda T_0 e^{\lambda[t - w(h)]} L(t)\left[-w'(h)\right] F_2 = -\lambda w'(h) \times Wage \quad Bill \qquad (7)$$

Thus, marginal productivity of education is a increasing function of λ, considering *the wage bill*, and it is positive only if $\lambda > 0$. Nelson and Phelps states that, correctly, this approach is not found in the conventional treatment of education[6].

The second model introduces a correction in the first model, starting with two problems: "It is unreasonable to suppose that the lag of the best-practice level behind the theoretical level of technology is independent of the profitability of the new techniques not yet introduced. Further, it is somewhat unrealistic to suppose that an increase of educational attainments instantaneously reduces the lag"[7]. Thus, the correction implies that the increasing ratio of the technology theoretical level reflected in practical technology depends on the educational level and the gap between the theoretical level of technology and the practical level of technology. In the first model, the inherent difficulties of any lag are not well stressed. But as long as we are interested only in the way in which education and technological progress can be formalized to indicate how the combination between education and technology results in the progress of the technological factor A, we shall not insist on the development that the second model introduces in the first one. The basic equation to say only this can be made up as it follows:

$$A(t) = \Phi(h)[T(t) - A(t)] \qquad (8)$$

Thus, the ratio of technology increase in practice is a function of education and proportional to the lag: *(T(t) – A(t)) / A(t)*[8]

[5] idem, p. 72.
[6] ibid, p. 72.
[7] ibid, p.72-73.
[8] ibid, p. 73.

Generally, the lesson about the model of Nelson and Phelps is like *theoretical technology* or the rate with which the gap between *the theoretical technology and the practical technology,* which is $\lambda > 0$, is reduced, it is a function of the rate with which the education gap *w(h)* is over passed, according to the equation number 4. What is significantly is that *w(h)* is not isolated from the *theoretical technology,* considering the equation number 3. The conventional treatment of labour excludes a differentiated approach on education (ordinary jobs versus jobs with high level of adaptability at other levels) and implies that marginal values of education may stay positive if technology is stationary[9]. Nelson and Phelps make clear that the payoff of education is an increasing function of the *theoretical technology,* which means $\lambda > 0$. Thus, the lesson is that if education high adaptability to change results in more rapid rates of technological progress, the gap *w(h)* or the level of education intensity is also an increasing function of the *theoretical technology*.

In addition, some implications from our analysis, e.g. macroeconomic policies, the future of technology[10] etc. Essential to the implementation of the sustainable economic growth in the society are:

-Macroeconomic stability ensured by a set of macroeconomic policies aimed at implementing prudent fiscal and monetary policies to keep inflation relatively low and stable and to prevent the decrease in economic activity to affect the long-term economic growth;

- technological progress that requires continuous innovation and not reproduction;

- emphasizing the role of human capital to propel the implementation of conditions for sustainable growth;

- identify specific framework of each nation which establish an optimal relationship of proportionality between natural factors, social, political, educational converging towards a system based on a sustainable economic growth, in line with present and future needs of the population;

- identify those occupations and professions which converge to a new level of sustainability of the labour market, result of changing perceptions of entrepreneurship on expectations of workforce training and ability to contribute to increasing productivity and increasing returns of the production function.

Thus, universities can play an important role in shaping the future business. These are centers where there are huge accumulations of specialized knowledge, and students are a valuable resource to explore areas of science and technology already known or even novel, whose impact on the labour market is analyzed differently, depending on societal resources, the degree absorption of labour market and its level of liberalization. University education system has not always come to anticipate the requirements of employers, which makes supply-demand relationship in the labour market to converge to a price not desirable, namely to a coverage of labour market needs as high. Thus, according to societal needs, we can distinguish several types of university programs focused on:

- technologies of the future in the fields of nanotechnology, nanoenergy, biotechnology, neurotehnology, infotehnology;

-incorporation of the knowledge and innovation economy in the behavior of organizations and economic entities in general, considered a convergent force of the economy, democracy, trade and technology leadership that determines the future of nations, business productivity and wealth of individuals, global poverty reduction, promote trade without borders, or democratic reforms[11];

- improving the performance of human capital, effect of investment in convergence areas as nano-bio-IT-neurotehnology which will play a vital role in safeguarding the future evolution of the global economy, creating new jobs, companies or fields[12];

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[9] ibid, pp.69-70.

[10] See Cristina Bălăceanu, *Abordări secvențiale ale economiei României înainte şi după aderare*, [Bucureşti: Universitară, 2010], pp. 99-112.

[11] James Canton, *Promovarea viitorului*, [Bucureşti: Polirom, 2010], p. 62.

[12] idem, p. 94.

- stimulate creativity in the technical areas and entrepreneurship by developing the capacity of young people to innovate, stimulation of free enterprise and create a reward system for motivation;
- innovation is the essential connection between knowledge characterized in an invention and the successful implementation of that invention to market.

Conclusions

Probably, the trump of the model of Nelson and Phelps consists of stressing the irreducible nature of the established report between education and technological progress. Thus, if progress in education results in technological progress, then, in its turn, education exhibits a positive payoff if technology develops permanently. The changes generated by ICT/new technologies at the level of production function results in technological progress and economic growth. Nelson and Phelps clearly state how important the techno-human gaps are in the process of technological change; they cannot be identified but in a strict reciprocal relation. It must go without saying that there is not any better possibility of discussing about increasing the performances of the inputs related to the process of production. At another level this model has implications for public policy. So education and schooling need to be complementary to technological change and productivity in advanced manufacturing and services sectors[13], because of the labour market conditions - are selected workers with high potential productivity largely reflected by the nature and specificity of the education incorporated in the educational system.

References

- Diana Apostol, "Knowledge, Education and Technological Progress in the New Economy", *Metalurgia International*, Issue No.5, Vol. XIV
- Cristina Bălăceanu, *Abordări secvențiale ale economiei României înainte şi după aderare*, [Bucureşti: Universitară, 2010]
- Gary S. Becker, *Capitalul uman*, [Bucureşti: All, 1997]
- Gilbert Abraham Frois, *Economia politică*, [Bucureşti: Humanitas, 1998]
- James Canton, Promovarea viitorului, [Bucureşti: Polirom, 2010]
- Nelson, Richard R. and Edmund S. Phelps: *"Investment in Humans, Technology Diffusion, and Economic Growth"*, Cowles Foundation Paper 236, Reprinted from *American Economic Review*, 56(2), 1966
- William J. Baumol, Robert E. Litan, Carl J. Schramm, *Capitalism bun, capitalism rău şi economia dezvoltării şi a prosperității*, [Bucureşti: Polirom, 2009]

[13] Gary S. Becker, *Capitalul uman*, [Bucureşti: All, 1997].