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## **THE EFFECTIVENESS OF EDUCATION – METHODOLOGICAL PROBLEMS ON THE BASIS OF E. F. DENISON’S RESEARCH**

### **Abstract**

Qualifications of employees are an extremely vital issue with respect to the modern economy, both on a micro- as well as macroeconomic scale. Education is one of elements that make up these qualifications. The issue of the effectiveness of education has been raised in a theory of economics many times. It was viewed mainly from macroeconomic perspective, while qualitative approach had been presented for the first time by E. F. Denison in the 60’s of the 20<sup>th</sup> century. The aim of this article is to show, on the basis of Denison’s research, that macroeconomic research has unlimited possibilities of evaluating the effects of education and due to this there is a need for paying greater attention to individual effectiveness of education.

**Key words:** the effectiveness of macroeconomic education, the influence of education on economic growth

### **Introduction**

The issue of the importance of educating the citizens of a particular state in the scope of the functioning and competitiveness of the economy has been raised many times in a theory of economics. Until the first half of the 20<sup>th</sup> century, these references were qualitative in nature. It was only in the 60’s when E. F. Denison made an attempt in his research to evaluate the influence of education on economic growth. Denison made use of assumptions which questioned the possibility of qualitative approach toward this issue. Other economists (T. W. Schultz, G. Psacharopoulos, F. Herbison, Ch. Myers, J. Mincer, G. Becker, and others) cited Denison’s research, but nobody improved them significantly.

The article will present the methodology of E. F. Denison’s research in the scope of education effectiveness along with the criticism and conclusions which will demonstrate that the research on individual approach toward education effectiveness should be more well-grounded.

### **The methodology of E. F. Denison’s research on the macroeconomic effectiveness of education**

In his estimate research, E. F. Denison aimed at distinguishing the factors and their proportions influencing the growth rate of the national income. He put himself three questions, namely: What were the determinants of economic growth in the USA? What economic growth rates may be forecasted on the assumption that there are no unexpected events? What influence particular factors of economic growth have on the rate of this growth? Denison considered the third question superior (Denison 1966, p.203), while paying special attention to the estimation of the influence of education on the economic growth of the United States.

Denison determined growth rates for particular production factors, and then

determined their share in the national income (Table 1). For his calculations, he used a modified function of Cobb-Douglas. The modification consisted in replacing hitherto existing treating L (labor) as the number of working hours, by considering such variables as education level, the increase in women's professional activity, changes in the structures of age and sex, the influence of reduced working hours on labor productivity.

Analyzing the dynamics of economic growth factors in the USA from 1929 to 1957, Denison estimated the influence of labor<sup>1</sup>, capital<sup>2</sup>, and land on this growth. He determined an average growth rate of the national income during the period from 1929 to 1957<sup>3</sup> and an average increase in employment, education level, etc.

On the basis of presented assumptions concerning the influence of particular production factors<sup>4</sup> on economic growth and multiplying these quantities by yearly growth rates of distinguished growth factors, he got a percentage share of these factors in the national income growth<sup>5</sup> (table 1).

It turns out from Denison's calculations (table 1) that GDP growth in the United States from 1929 to 1957 amounted to (on average) 2,93% and resulted from, in 68% the growth in outlays, and in 32% the growth in efficiency.

Capital as a production factor was divided into five components. Calculating them, Denison took an inflation rate into consideration. With regard to the period under examination, there was a rise in employment by (on average) 1,31% yearly, but, at the same time, working hours were reduced (on average) by 0,73% yearly. As an effect, changes in employment and working hours influenced economic growth in 28%. However, Denison, apart from quantitative factors, also paid attention to the influence of qualitative factors of labor on this growth. Denison calculated that the decline in the number of working hours during the period under examination brought about an improvement in the quality of labor by (on average) 0,50% yearly.

With respect to learning people<sup>6</sup>, Denison made an assumption that 3/5 of the difference in pays, that people who were the same age got, resulted from the difference in the period of education<sup>7</sup>. The remaining 2/5 refer to the influence of inborn abilities, motivation for working one has, etc., which are connected with education but are not its direct result<sup>8</sup>. Making this assumption, Denison estimated that the increase in education level improved the quality of human capital by 0,93% yearly. In other words, the fact that the period of education became longer and longer brought about the improvement in the quality of human capital by c.a. 30%.

It can be noticed (table 1) that there were no changes with reference to the production factor, i.e. land, during the period under examination.

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<sup>1</sup> This quantity corresponds to a pay for labor which all working people receive, including the owners (E. F. Denison, *Measuring ...*, op. cit., p. 203)

<sup>2</sup> Along with pure profit added

<sup>3</sup> In his research, he also included the years from 1909 to 1929 as a separate research period

<sup>4</sup> i.e. labor, capital, and land

<sup>5</sup> e.g., as for education, 0,67 result is a consequence of multiplying 73% by 0,93% and dividing this by 100. The results indicates the size of education share in the national income growth, whereas the percentage share in the growth results from dividing 0,67 by 2,93 and amounts to 23%.

<sup>6</sup> Denison calculated that in 1957, a 25-year old man spent 80% more time (on average) at school than a 25-year man in 1929

<sup>7</sup> E. F. Denison, *Measuring ...*, op. cit., p. 207. See also table 2

<sup>8</sup> *ibid.*

Table 1. Determinants of GDP growth in the United States, growth rate globally and per an employed from 1929 to 1957, and the forecast for 1960-1980

Growth factors	GLOBALLY					PER AN EMPLOYED			
	1929-1957			1960-1980		1929-1957		1960-1980	
	An average growth rate	According to GDP growth rate	growth %	According to GDP growth rate	growth %	According to GDP growth rate	growth%	According to GDP growth rate	growth%
<b>National income</b>	<b>2,93</b>	<b>2,93</b>	<b>100</b>	<b>3,33</b>	<b>100</b>	<b>1,60</b>	<b>100</b>	<b>1,62</b>	<b>100</b>
<b>Total growth in outlays</b>	<b>1,99</b>	<b>2,00</b>	<b>68</b>	<b>2,19</b>	<b>66</b>	<b>0,67</b>	<b>42</b>	<b>0,48</b>	<b>30</b>
Correction	-0,11	-	-	-	-	-	-	-	-
Growth after correction	2,10	-	-	-	-	-	-	-	-
<b>Labor corrected according to changes in quality</b>	<b>2,16</b>	<b>1,57</b>	<b>54</b>	<b>1,70</b>	<b>51</b>	<b>0,57</b>	<b>36</b>	<b>0,37</b>	<b>23</b>
<b>Employment and working hours</b>	<b>1,08</b>	<b>0,80</b>	<b>27</b>	<b>0,98</b>	<b>29</b>	---	---	---	---
Employment	1,31	1,00	34	1,33	40	---	---	---	---
The influence of reduced working hours on the quality of labor carried out by an employee during a year	-0,23	-0,20	-7	-0,35	-11	-0,20	-12	-0,35	-22
Working hours during a year	-0,73	-0,53	-18	-0,42	-13	-0,53	-33	-0,42	-26
The influence of reduced working hours on the quality of labor carried out by an employee during an hour	0,50	0,33	11	0,07	2	0,33	21	0,07	4
<b>Education</b>	<b>0,93</b>	<b>0,67</b>	<b>23</b>	<b>0,64</b>	<b>19</b>	<b>0,67</b>	<b>42</b>	<b>0,64</b>	<b>40</b>
The increase in experience and better application of women's work	0,15	0,11	4	0,09	3	0,11	7	0,09	6
Changes in the structure of labor according to age and sex	-0,01	-0,01	0	-0,01	0	-0,01	-1	-0,01	-1
<b>Land</b>	<b>0,00</b>	<b>0,00</b>	<b>0</b>	<b>0,00</b>	<b>0</b>	<b>-0,05</b>	<b>-3</b>	<b>-0,04</b>	<b>-2</b>
<b>Capital</b>	<b>1,88</b>	<b>0,43</b>	<b>15</b>	<b>0,49</b>	<b>15</b>	<b>0,15</b>	<b>9</b>	<b>0,15</b>	<b>9</b>
Flats not included in agriculture exploitation	1,46	0,05	2	---	---	0,01	1	---	---
Other buildings and facilities	1,85	0,28	10	---	---	0,10	6	---	---
Warehouses	1,90	0,08	3	---	---	0,03	2	---	---
American assets abroad	0,7	0,2	1	---	---	0,1	1	---	---
Foreign assets in the USA	0,2	0,0	0	---	---	0,00	0	---	---
<b>The growth in the result per a unit of an outlay</b>	<b>0,92</b>	<b>0,93</b>	<b>32</b>	<b>1,14</b>	<b>34</b>	<b>0,93</b>	<b>58</b>	<b>1,14</b>	<b>70</b>
-The reduction of optimal use of outlays	---	-0,07	-2	0,00	0	-0,07	-4	0,00	0
-The reduction in wasting human labor in agriculture	---	0,02	1	0,02	1	0,02	1	0,02	1
-The transformation of agriculture into industry	---	0,05	2	0,01	0	0,05	3	0,01	1
<b>-Knowledge development</b>	<b>---</b>	<b>0,58</b>	<b>20</b>	<b>0,75</b>	<b>23</b>	<b>0,58</b>	<b>36</b>	<b>0,75</b>	<b>46</b>
-Shortening the time spent on introducing new knowledge	---	0,01	0	0,03	1	0,01	1	0,03	2
Economy (savings) of a scale – independent increase in local markets	---	0,07	2	0,05	2	0,07	4	0,05	3
Economy (savings) of a scale – the increase in domestic market	---	0,27	9	0,28	8	0,27	17	0,28	17

Source: E.F. Denison, *The sources of Economic Growth in the United States and the Alternatives Before Us*, Committee for Economic Development, New York 1962, particularly p.37, pp. 140-152. E.F. Denison, *Education, Economic Growth, and Gaps in Information*, *The Journal of Political Economy*, no 5/1962, supplement, pp. 124-125, E.F. Denison, *Measuring the Contribution of Education*, in: *The Economics of Education*, E. Robinson, J. Vaizey (ed.), Macmillan, New York 1966, pp. 204-205

Table 1 shows, apart from the dynamics of changes, calculations concerning the dynamics of a structure as well. What deserves a special attention are percentage shares, total and per an employed, concerning outlays, employment, and working hours, education, capital, labor efficiency, and knowledge development. During the examined period, GDP growth resulted mainly from a total rise in outlays, and, to a smaller extent, from labor efficiency. These relations change proportions per an employed and amount to, respectively 42% and 58% (previously – analogically – 68% and 32%). During this period, employment and working hours had an influence on the national income growth in 27%, whereas education in 23% altogether, and in 42% per an employed. Knowledge development also had an impact, as altogether it has a 20% share in the national income growth, and a 36% one on an employed. As a “residual” quality, and – what is connected with it - burdened with some inaccuracies, it includes both a progress in the scope of technique, as well as organization and management<sup>9</sup>.

Therefore, what is the most significant in Denison’s research – economic growth from 1929 to 1957 in the USA – should be ascribed in 27% to the rise in outlays on labor (employment and working hours)<sup>10</sup>, in 23% to the increase in education level, in 20% to knowledge increase, and in 15% to capital growth. What is also interesting is the fact that there is a 32% increase in labor efficiency to as much as a 20% one in knowledge development.

Table 1 also includes Denison’s calculations concerning the forecast of the national income growth during the years 1960-1980. It can be noticed that Denison’s yearly estimates as to this growth are similar to the estimates of this growth during the years 1929-1957. The difference is that, with respect to the former period (1960-1980), the proportions of the influence of factors under analysis on this growth will change to a great extent. The share of outlays will be reduced to 66%, and the share of labor efficiency will increase to 34%, the importance of education will be reduced to 19%, and the importance of knowledge will increase to 23%.

### **The influence of education on labor efficiency**

As Denison has pointed out, the level of education of the population of a state, working people in particular, is a significant determinant of economic growth. At the same time, the increase in the level of education influences the growth in human capital of a particular person and his or her productivity. Yet, there is a problem of viewing this influence from quantitative perspective. Facing this, Denison presented the methodology on the basis of which he made an attempt to estimate the influence of extra learning<sup>11</sup> on economic growth<sup>12</sup>.

<sup>9</sup> *ibid.* p. 211. It should be added that the value of knowledge development may not seem to be great, but it involves a progress in other already mentioned factors (apart from employment, working hours per year, land, and capital) that influence the national income growth. Besides, Denison notices that the national income first of all, does not distinguish better products from worse ones (from a statistical perspective), and secondly, the structure does not change

<sup>10</sup> This result is the difference between a rise in employment by 34%, and reducing the obligatory working hours by 7%

<sup>11</sup> Understood as another years devoted to education and not as additional training

<sup>12</sup> This methodology and estimates have been presented in: E. F. Denison, *The sources ...*, *op. cit.* particularly pp.

According to Denison, extra education can influence economic growth in two ways. Firstly, it may improve the quality of human capital of employees, which may be treated as productivity increase. Secondly – it raises the level of education of population, due to which the knowledge of the entire society increases somehow by itself. Referring to this, Denison believes that one ought to distinguish between the improvement in the quality of human capital of working people, which is a result of education, and productivity increase that stems from knowledge acquired within society. As far as Denison is concerned, this knowledge is still increasing in society and should be treated as a variable affecting economic growth. That is why he differentiates between raising the education level and knowledge acquisition. Needless to say, there is also an opposite relation, i.e. raising the education level may have an impact on the increase in accessible knowledge.

According to Denison, one should expect great economic growth when education level raises considerably<sup>13</sup>. At the same time he highlights that the influence of higher education on economic growth<sup>14</sup> is usually examined when these qualities may be viewed quantitatively.

In order to evaluate the influence of changes in education level on economic growth, information concerning the changes in education level itself are necessary. Furthermore, there should be a possibility of making comparisons with respect to acquired knowledge at a certain level currently and during the period in which working people (examined subjects) were learning. However, Denison believes that simultaneous comparison between the quality of formal education in different periods, and the results of this education is not plausible. For, he is of the opinion that in his or her research one should restrict oneself to the number of days or years of education, and not to its quality<sup>15</sup>.

From the research carried out by Denison, it appears that first of all, for a particular level of education along with the age, up to 50, pays rise (which may result from greater experience), and then are gradually cut, secondly – along with the increase in education level, pays rise. The second relation has been presented in table 2.

It could be observed in the above table that in comparison with people who finished primary school (Denison adopted 100 as a point of reference for this education level), people who did not finished primary school had lower incomes, whereas the level of incomes grew along with a growth in the number of years devoted to education (table 2).

Yet, Denison emphasizes that other factors, apart from education and professional experience, also have an influence on the diversity in pays, these are non-measurable factors such as inborn abilities, intelligence, motivation, energy to work, etc. For, a correction is needed that would aim at isolating the influence of education itself and other factors affecting the diversity in pays (talents, motivation for working, etc.). As it has already been mentioned, Denison assumed that 3/5 of the difference in pays result from the differences in education. Thus, if only the influence of education itself is taken into account, then differences in pays are slightly smaller than if the aforementioned factors were taken into consideration, and amounted to from 70 to 180% of pays that people who finished primary school were given (table 2). This implies that e.g., a person without any education would have earned only 70% of the pay that a person who completed an 8-year period education got, only if education had been the only factor influencing the pay.

It should also be added that there is a correlation between education level and motivation for working, intelligence, etc.

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67-80

<sup>13</sup> E. F. Denison, *Measuring ...*, op. cit. p. 216

<sup>14</sup> *ibid.* p. 217

<sup>15</sup> E. F. Denison, *Measuring ...*, op. cit. p. 217. Currently, on an international scale, there is a possibility of making comparisons between the quality of the education of students aged 15. Such research are conducted by OECD within PISA programme

Table 2. The influence of education on the level of incomes

<b>COMPLETED YEARS OF STUDY</b>	<b>Income in % of the income of people who completed an 8-year period of education</b>	<b>Income in % of incomes of people who completed an 8-year period of education, depending on the effect produced by education</b>
Without any education	50	70
Primary school		
1-4 years	65	79
5-7 years	80	88
8 years	100	100
Secondary school		
1-3 years	115	109
4 years	140	124
Higher education institution		
1-3 years	165	139
4 years or more	235	181

Source: E. F. Denison, *The Sources...*, op. cit., p. 68

Conducting relevant, macroeconomic research, Denison paid attention to microeconomic issues at the same time, namely to the fact that there is a relation between education level and income level of an employee, between the level of education of fathers and sons, as well as between income level of a family and education level of sons. With reference to last two mentioned regularities, Denison pointed out that the higher the father's level of education, the higher the son's level of education<sup>16</sup>, and along with the growth in family incomes, education level of sons raises as well. These relations are obviously interrelated as people with higher education have higher incomes.

## Conclusion

What is particularly significant in E. F. Denison's research is understanding why the improvement in the quality of human capital has so great influence on economic growth. The thing is that two factors co-exist. Firstly, education influences, through the improvement in the quality of human capital, in 73% the initial value (creation) of GDP. This quality corresponds, according to Denison's assumptions, to a pay for work that was done. Secondly, during the period examined by Denison, employees' education increases (in days) by 2% yearly. According to his research, this corresponds to the increase in the quantity of work by 1%. A great difference between capital and labor, with regard to the influence on GDP, results from this. That is why "education" factor is of greater importance for the growth than "capital".

Estimation method used by Denison is an interesting tool for determining the share of particular factors in economic growth. Yet, it does raise a few doubts. For, the results of the research may be partly distorted by the assumption made by Denison, that results from a theory of ultimate productivity of labor, which states that a pay is a reflection of the input in

<sup>16</sup> In Poland, extensive research in this scope was conducted by Białecki (I. Białecki, *Wykształcenie i rynek, Tępis, Warszawa 1998*)

production. Another problem is a need for considering, which Denison fails to do, the changes pay rates due to the growing percentage of learning people<sup>17</sup>. Denison believed<sup>18</sup> that if there was no growth in the number of learning people, there would be a great rise in unemployment<sup>19</sup>.

Denison, apart from quantitative benefits from education that have already been pointed out, indicates qualitative benefits as well. He includes the following into these<sup>20</sup>:

- In every profession, better educated people are, on average, more efficient than less educated. The former carry their work out in a better way, faster, and more independently, but also carry out a greater scope of tasks.
- The increase in education level influences a greater awareness of performed tasks, and thus makes one look for better solutions. Besides, better educated people are more prone to further development.
- The increase in education level favors greater flexibility in making decisions since better educated people know a greater number of solutions. Employees can also evaluate alternative solutions in a better way than they know economic reality in a better way, can change professions easier and adjust to new professional requirements, as well as acquire new abilities.
- Changes in environment, especially economic, technical, and technological, bring about the fact that professional structure changes which requires retraining or training for particular professions. Better educated people can adjust to such a situation, especially with regard to technical progress that requires intensive learning.

A kind of inadequacy of Denison's research is also the fact that he restricts himself to the evaluation of formal education (primary, secondary school, higher education institution), and does not consider learning in the workplace, additional training, dual system of education, etc. What is significant in Denison's research is a possibility of looking at the role of intensive and extensive factors of economic growth.

The results of Denison's research have limited possibilities that can be used to evaluate the influence of the increase in education level on economic development. This particularly results from changes that occurred in the economy during last 40 years, and especially at the turn of the 20<sup>th</sup> and 21<sup>st</sup> centuries when there began an era of informatization and globalization that may be characterized by the fact that new markets on which labor costs are low are sought, and knowledge have become the fourth factor of production.

Considering the above reservations with respect to the attitude toward examining the efficiency of education, particularly with reference to the lack of possibilities of isolating the influence of education itself on economic growth, it seems advisable to direct the research to microeconomic perspective so undertaking more extensive research on individual efficiency of education that would take mainly motives, costs, and results of increasing the level of education into account.

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<sup>17</sup> i.e. what influence a greater and greater number of learning people has on pay rates

<sup>18</sup> E. F. Denison, *Measuring ...*, op. cit., p. 234

<sup>19</sup> Nowadays, one could analyze whether a situation is not the opposite

<sup>20</sup> *ibid.* pp. 235-238

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