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## HUMAN CAPITAL AS A SOURCE OF GROWTH - MYTH OR REALITY?

*Autor istražuje da li se ekonomski rast zemlje odnosi na promjene zaliha ljudskog kapitala osnovane ne teoriji modela endogenoga rasta. Rezultati dobiveni autorovom analizom dostignute stope rasta u Hrvatskoj za razdoblje 1952.-1990. ukazuju da ulaganja u obrazovanje imaju jak pozitivan utjecaj na ekonomski rast zemlje.*

### Introduction

Traditional production factors (land, work and capital) have distinguished and historically proved role in the countries social and economic development. Along with the 21st century approaching they remain important but not primary economic growth sources. We shall not underestimate as well overestimate their importance. International trade evolution along with formation of the world capital market gives countries with poor natural resources and capital (but with substantial human capital) opportunity to achieve high growth rates. Scientist through their research tried to measure and analyse influence of the education on the growth rate. Studies on this subject come across significant obstacles in attempt to state overall conclusion. There is the gap among them, between educational output perception (due to its nature) and the beginning of the schooling process - (*LAG*). *LAG* is a time gap between the period spent by a student in educational institutions and the acquired knowledge availability. In the vast research works on economic growth models, problem of measuring human capital stock and its influence on growth economic emerge. In the 1960s Schultz (1961) and Denison (1962) showed that education contributes directly to the growth of national income by improving

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the skills and productive capacities of the labour force. The early attempts to measure the contribution of education to economic growth were based either on the growth accounting approach, used by Denison and others, or on the rate of return to human capital, an approach adopted by Schultz and others. Growth accounting is based on the idea of an aggregate production function, which links output ( $Y$ ) to the input of physical capital ( $K$ ) and labour ( $L$ ). Denison calculated that among 1930 and 1960 almost a quarter (23 percent) of the rate of growth of output in the United States was due to the increased education of the labour force.”<sup>1</sup> Further analyses by R.M.Solow confirms relationship existence between economic growth and education where 87,5% output growth rate per 1 labour hour owing to ‘residual’, i.e., advance in knowledge of the employees. Hypothesis that education improves and accelerates economic growth has been fully explored by Bowman and Anderson (1963), Kaser (1966), Bennet (1967), Harbison and Myers (1964), Adelman and Morris (1967), Horowitz, Zymelman and Herrstadt (1966), Layard and Saigal (1966), etc.

The aim of this paper is to explore interdependence between education and growth to prove that country could and should rely on human capital as important economic growth source.

## Data

Data used in this paper were derived from annual reports of Croatian Central Bureau of Statistics for the 1952-1990 period. Time series of variables used in the endogenous growth model creation process show the values for: human capital ( $H$ ), forgone earnings ( $N$ ), social expenditures on education ( $R$ ), private expenditures on education ( $K$ ), gross investments ( $I$ ) and fixed assets ( $A$ ) all expressed in constant domestic price 1972 level (Croatian currency = Kuna (Kn) except for employment variable ( $E$ ) expressed in employed working persons.

A total of four variables with considerable impact on *GDP* was identified. Human capital, fixed assets, number of employed persons and gross investments in 99% cause *GDP* changes while the impact of all other economic phenomena in Croatian economy is less than 1%. The average *GDP* growth change in Croatia could and should be attributed to the level change of mentioned variables. With the implementation of best subset regression model method we reached the conclusion that the endogenous variable changes (in our case Croatian *GDP* changes) are in the large degree influenced by changes in human capital

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<sup>1</sup> The literature in Psahchopoulos, G., Woodhall, M., 1985., p. 16.

(significantly), gross investments, employment, fixed assets and that minimum residual (difference between regression and empirical GDP values) is achieved when all four above variables are included in the model.

## Methodology

In order to test the null hypothesis that human capital has no or insignificant impact on *GDP*, we utilised least square estimation model.

The statistical significance of the educational return's impact was tested using the test of significance approach (t-test) and F-test. In the F-test the null hypothesis is that there are no correlation (dependence) between *GDP* and model variables (especially human capital) while the null hypothesis in the t-test states that the true  $\beta_2$  parameter (that is the influence of human capital upon *GDP* growth) is zero.

From table 2 we can see that *t* values are obviously significant at the 99% significance level. Thus we can with no doubt claim that human capital (H) in the first place but also other model variables (A), (I) and (E) significantly affect *GDP*(*Y*). The *F* value presented in table 2 as a measure for the overall significance of the estimated regression is highly significant so we can reject the null hypothesis that *GDP*(*Y*) is not linearly dependent (related) to human capital, fixed assets, employment and gross investments.

## Interdependence between Economic Growth and Education

Modern economic researchers concentrate their scientific work on educational return's measurement problem (see G.S.Becker, J.Sheehan, M.Blaug). Four main economic streams dealing with this problem are (F. Harbison, C. A. Mayer, 1964.):<sup>2</sup> (1) Relation between educational costs and wages growth or physical capital formation, (2) Residual approach in measuring the contribution of education to economic growth, (3) Educational returns rate measurement, (4) Correlation estimation between school enrolment and GNP.

T. W. Schultz conducted researches on (1) for the 1900 - 1956 period in USA. He reached the conclusion that in the observed period resource allocated in education grew by 3,5 times in relation to wages and gross physical capital.

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<sup>2</sup> See Harbison, F., C. A. Mayers., 1964, p. 5.

Educational demand elasticity reaches 3,5 level meaning that educational investments were 3,5 times more attractive than those in physical capital.

Many scientific works tried to establish educational contribution to *GNP*. Among them R.M.Solow calculates that 87,5% of output increase per work hour can be attributed to 'residual', that is to working force quality improvement as the result of education process and the rest 22,5% to physical capital and labour. Educational contribution to *GDP* growth was substantially investigated by E. F. Denison and his results are reported in table 1.

### Human Capital Model

To analyse impacts of education on *GDP* we must first define human capital category as exogenous variable in which these impacts are incorporated. We may write this model as

$$H = f(K, R, N) \quad (1)$$

where

- N is forgone earnings, i.e. average incomes multiplied with the number of secondary and tertiary students;
- R is social expenditures on education, i.e. total public sector expenditures on education together with realised investments in education;
- K is private expenditures on education, i.e. average household expenditures on education;
- H is human capital.

By mean of the OLS method we obtained following human capital model for the Republic of Croatia (1952-1990):

$$H = a + b_1(K) + b_2(N) + b_3(R) \quad (2)$$

$$H = 0,021184 + 0,9998 \times K + 1,0135 \times N + 0,9989 \times R + u_1 \quad (3)$$

Table 2 displays the regression coefficients (slopes) associated with the independent variables, their standard errors, P-values and t-statistics and Durbin-Watson test for autocorrelation.

Obtained regression function describes how the average or expected value of H varies with K, N, R. Each element ( $b_2$  for example) estimates the effect on H for

a unit change in  $N$  with all other ( $K$ ,  $R$ ) held constant. From (3) we can see that raise in average income ( $N$ ) by 1000 Kuna<sup>3</sup> results with the raise in human capital ( $H$ ) for  $(1,0135 \times 1000)$  1013,5 Kuna. Increase in social expenditure ( $R$ ) on education by 1000 Kuna causes human capital ( $H$ ) to raise for 998,9 Kuna. The same is for the change in ( $K$ ). Correlation between  $H$  and endogenous variables  $K$ ,  $N$ ,  $R$  is present while  $H$  mostly depends on changes in  $R$  (correlation coefficients  $R=0,9870$ ,  $K=0,9462$ ,  $N=0,9663$ ). This implies that the greater is  $R$ , the greater human capital growth rate will be. The 1952-1980 average growth rate of  $H$  in Croatia was (11,46%) while the 1980-1985 rate was (-6,16%). From 1985-1990 average growth rate of  $H$  starts to rise (8,36%) breaking off negative trend entirely due to the raise in  $R$  (9,93%).

As is known, GDP variation also influence and determinate the human capital amount but this time indirectly in distinction from direct influence of upon mentioned variables. When GDP is growing briskly, social and private expenditure on education is likely to rise too due to the rise in disposable income and total public sector expenditures that would cause the rise in human capital. Croatian human capital rapid improvement for the 1952-1990 period is the result of the strong increase in the educational social expenditures over relatively small increase in the real disposable income.

### **Croatian Endogenous Growth Model with Human Capital**

In order to define educational impact on Croatian *GDP* growth endogenous growth model must be set. How education influence growth can be viewed and measured through human capital variable, is defined above. Croatian endogenous growth model can be obtained as follows:

$$Y = f(\text{Human capital}(H), \text{Employment}(E), \text{Investment}(I), \text{Fixed assets}(A)) \quad (4)$$

By the means of the multivariable *OLS* regression the following results were obtained:

The regression form of the equation (4) is:

$$Y = - 598 + 1,3004(H) + 0,11835(A) + 0,0032184(Z) + 0,87149(I) + u_i \quad (5)$$

From the regression form (5) returns to education, investment, fixed assets and employment expressed in the terms of Croatian real *GDP* growth (in domestic currency) can be marked. Educational returns are reported for secondary and higher

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<sup>3</sup> Kuna- domestic currency.

education. Returns on education through human capital variable are substantially larger than that on investment, fixed assets and employment (see coefficients in table 3). Variables in the regression (5) are expressed in real domestic currency (Kuna=Kn). Increase in the human capital level around 1000 Kn would result in the increase of *GDP* around 1300 Kn. Multiplying returns coefficients of investment, fixed assets and employment we shall see how the increase in these variables would affect *GDP*. Returns coefficients from (5) however strongly indicate that higher *GDP* growth rates can be achieved by investing in human capital. There should be pointed out the difference between returns on education through human capital and *GDP* growth decomposition. Why?

### Potential and Achieved Impact of Education upon *GDP* Growth

Strongest endogenous growth models critics suggest that in many economies, scarcity of estimated human capital stock compared to physical capital is the main obstacle for human resources to claim a role of the steem of growth. Decomposition and analyses of growth studies carried out by other researchers<sup>4</sup> indicate that human capital accumulation insignificantly contributes to growth while other studies<sup>5</sup> reveal a consistently significant human capital influence on growth.

Examining the factors contributions in output share for the 1952-1990 period in Croatia we estimated that the share of human capital in *GDP* from 3,06% in 1952 augmented significantly to 11,17% level in 1990. The key assumption of this paper is that achieved educational impact on *GDP* for 1952-1990 was much beyond its potentials. Low disposable incomes and educational expenditures for the mentioned period were the cause of the low human capital output share. In the same period, share of the gross investments in output has significantly fallen from 19,26% in 1952 to 8,65% in 1990 (caused by inefficient and unprofitable investments during the state planned economy). Labour had a very significant share of *GDP* growth during the whole period (around 60%) while fixed assets creation on average capture about 25% of the total output. In Croatia on the contrary to the most economies where high labour coefficients and labour small share of output were registered, low labour coefficients together with the consistent labour share output exist. This is mainly due to the labour intensive production methods implemented in Croatia after 1950. Figure 2 and 3 shows the difference between returns on education through human capital (potential impact on *GDP*) and actual (achieved impact on *GDP*) factors shares in Croatian *GDP* growth rate.

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<sup>4</sup> See Behhabib, J. and Spiegel, M. 1991.

<sup>5</sup> See Judson, R. 1995, p. 8.

If we look at the human capital growth share shown in figure 2 we can with no doubt (yet wrongly) conclude that human capital had and will have only minor role in Croatian economic development.

This statement speaks in favour to the conclusions reached by the human capital critics that its role in the economic development of the country has to be minor compared to the role of physical capital (due to the limited human capital stocks of the country).

However, figure 3 clearly demonstrates quite opposite. We not only proved that even Croatia as former socialist country with low incomes and educational expenditures reached sufficient level of human capital stocks, but also that economic investment efficiency is much higher for human capital resources than that for physical.

Figure 2 shows achieved impact of each factor on GDP growth expressed as a share of the total growth rate while figure 3 shows potential factor impact on GDP through input-output factor returns. Potential educational returns are largely above other growth factors returns. If all growth factors were to rise by 10% the amount of output increase would vary upon factors individual returns and efficiency. Figure 3 shows that between all available growth factors only one of them records increasing returns and that is the human capital factor. Rise in the human capital stock through educational expenditures by 1% will raise output (in this paper measured by the change in Croatian total GDP) by 1,3%. Such increases in scale bring enormous benefits through better labour productivity, increased efficiency and resource allocation along with the overall growth of the Croatian economy. Considering this fact we can explain the Croatian slow growth among other European countries for the period 1952-1990.

Diminishing returns to labour capital caused by obsolete technology and decreasing labour productivity (because the lack of investments in human resources) along with the existence of diminishing returns to fixed capital are to be blamed for achieved slowdown growth in Croatia. Results from (3) prove the existence of diminishing returns to fixed capital and the human capital importance particularly pointed by Lucas supporting his hypothesis that there are no diminishing returns to human capital.

## Results

Evidences and facts presented in this paper pointed out the fatality of attitudes which consider the educational needs and expenditures only as unproductive (consumption) economic category. Increased educational expenditures through augmented teaching school staff wages and investments in school's buildings and

equipment along with the free admissions and text-books about 30% will result in *GDP* growth by 18% disproving above mentioned attitudes. Notice that stated educational effects resulting from increased state budget expenditures on education were examined in interdependence with *GDP* changes only, while total educational effects (through indirect means as job satisfaction, health prevention, criminal activity slowdown, parental involvement in community work etc.) in the long run are far more higher and larger. Obtained results bring to the conclusion of educational high influence on *GDP* in Croatia (but in our opinion in other countries too). Mentioned results along with model testing results speak in favour of the hypothesis stated in this paper that human capital in the future (in the past not recognised) would determine growth path of each country.

Negation of the human capital as a part of total capital stock of the country is the main reason for viewing country's economic growth as a function of physical capital and labour only along with technology exogenous growth rate. As a consequence, economic growth of world national economies were based mainly on physical capital factor conditioning the growth rate upon exogenous technology growth rate that we could not control. Period between 1952-1990 in Croatia was characterised by intensive investments activity in fixed assets and capital intensive activities while investments in education were pushed aside. The results of such economic policy Croatian economic development was based on investments in fixed assets (neglecting quality growth factors - human capital) along with inadequate investment allocation, investing mainly in house and apartments buildings, operating and office appointments and barely in research and development, equipment and facilities, licences and patents. We proved human capital propulsive character as economic growth factor by value forecasting method simulating *GDP* changes in Croatia depending upon changes in model variables that is human capital, employment, fixed assets and gross investments.

Forecasting *GDP* future value by simulating (controlling) changes in human capital, fixed assets, employment and gross investments once again confirmed education as basic growth factor in the future.

#### *VALUE METHOD FORECASTING:*

##### **Simulation 1**

*PREDICTED VALUE OF Y = 10816 Kn*

*SE = 419,99 Kn*

*LOWER PREDICTED BOUND = 9962,7 Kn*

*UPPER PREDICTED BOUND = 11670 Kn*

*PREDICTOR VALUES: A = 37000 Kn, E = 1568000, I = 996 Kn, H = 862,0 Kn*

*UNUSUALNESS (LEVERAGE) = 1,0*



### **Simulation 2**

*PREDICTED VALUE OF Y = 12568 Kn*

*SE = 410,87 Kn*

*LOWER PREDICTED BOUND = 11733 Kn*

*UPPER PREDICTED BOUND = 13403 Kn*

*PREDICTOR VALUES: A = 30421 Kn, E = 1568000, I = 3900 Kn, H = 862,0 Kn*

*UNUSUALNESS (LEVERAGE) = 0,9917*

### **Simulation 3**

*PREDICTED VALUE OF Y = 10464 Kn*

*SE = 411,22 Kn*

*LOWER PREDICTED BOUND = 9628,4 Kn*

*UPPER PREDICTED BOUND = 11300 Kn*

*PREDICTOR VALUES: A = 30421 kn, E = 1568000, I = 996 Kn, H = 1190 Kn*

*UNUSUALNESS (LEVERAGE) = 0,9952*

### **Simulation 4**

*PREDICTED VALUE OF Y = 11412 Kn*

*SE = 409,70 Kn*

*LOWER PREDICTED BOUND = 10579 Kn*

*UPPER PREDICTED BOUND = 12244 Kn*

*PREDICTOR VALUES: A = 30421 Kn, E = 1995000, I = 996 Kn, H = 862,0 Kn*

*UNUSUALNESS (LEVERAGE) = 0,9804*

Forecasting 1 simulates how fixed assets increase on 37000 Kn should affect *GDP* in Croatia. As results of fixed assets increase by 23% *GDP* would grow by 18%. In order to achieve such economic growth, *GDP* annual growth rate should be 3,52%. Time extent needed to achieve mentioned *GDP* level along with 3,5% annual growth is five years while required fixed assets growth rate is 4% for the same period.

Second simulation (forecasting 2) presents how changes in gross investments should influence output growth. To reach *GDP* level around 12568 Kn (38%) with annual growth rate 3,52% for the period of ten years, required gross investments annual growth rate is 9,53% in the same period. Taking into account that in the period 1980-1990 achieved gross investments annual growth rate was - 8,71%, simulation 2 seems quite optimistic. Forecasting 4 shows Croatian *GDP* growth that could be achieved (25%) if employment rate rises annually around 5% in the next 6 years reaching the level of 1995000 employees. In the period 1980-1990 registered employment growth rate was 0,75% while after 1990 due to the transition

process and war employment rapidly falls. For this reason labour can not be considered propulsive factor for Croatian economy. Croatian *GDP* increase in simulation 3 around 15% requires human capital stock to rise by 38% (to reach 1190 Kn level). In the 1952-1990 period human capital stock in Croatia registers 8,52% average annual growth rate where required annual growth rate of human capital in simulation 3 is 6,66%. Forecasting presented in simulation 3 reflects objective and real economic growth possibilities for Croatian economy in next five years. Comparing simulations 1 to 4 we can notice than if Croatian government decides to base future economic growth mainly on gross investments, fixed assets and labour, higher *GDP* growth rate could be achieved. Taking into account objective possibilities of Croatian economy in assuring required increase for fixed assets, gross investments and labour we can conclude with no doubt that those scenarios could not be implemented due to lack of the resources but (important to notice) more for diminishing returns (decrease in scale - decrease in output resulting from increase in the inputs employed quantities).

This fact brings up human capital factor for two reasons: first is increasing return to scale of education and second sufficient level of human capital stock. Due to negative or stagnant trends in employment, fixed assets and gross investments that represent real constraint of planned *GDP* growth in the future, simulation 3 (*GDP* growth depending mostly upon human capital) presents the only one objectively feasible variant. Republic of Croatia is one among states that in the period 1952-1990 besides law standards, wealth and *GDP* achieved relatively high human capital growth rate through increased education enrolments (education for all). Following this example, Croatia as former socialist and underdeveloped country achieved human capital stock sufficient for the future economic growth based on its propulsive character (proved in simulations 1-4). We can claim that highly developed countries in the world posses required level of human capital and that the only way of obtaining higher *GDP* growth rates is through human capital.

### **Conclusion and Summary**

Adopting Marshallian capital conception, human capital component was pushed aside. Recognition of human capital significance as augmenting productivity factor is incontestable since Adam Smith. Importance of human capital as economic growth source was not scientifically investigated until T.W.Schultz, E.F.Denison, M.Blaug, K.J.Arrow, P.M.Romer, R.E.Lucas. Observing total costs and benefits (returns) of investing in human resources, educational investment true character becomes reality. We have to regard education not only as productive investment (such equipment, facilities) and nothing else since educational multiplicative effects are far more higher (reducing unemployment, social security transfer reduction, standard of living increase, labour supply restructuring, etc.).

Proving education investment (not consumption) character we set two hypothesis in this paper. First was that only human capital originates increasing returns to scale among traditional growth factors. The second was that a country with sufficient human capital stock should and could rely upon human resources in order to achieve higher growth rates. Either of two hypotheses has been proved on the model of Croatia. Figure 3 shows human capital increasing return to scale paragonated with fixed assets and gross investments while simulations 1-4 demonstrate that potential but also objective high growth possibilities of Croatian economy depend mainly upon human capital stock.

This paper provides two additional insights that should be useful in future research on interdependence between education and economic growth. First, prior researches on human capital (educational) impacts on economic growth Lucas (1989), Romer (1980), Arow (1962), find little evidence for this variable power significance. As shown in paper's analysis this was due to absence of human capital stock valuation methods. Taking into account T.W.Schultz's concept of human capital we derived and investigate human capital level for the Republic of Croatia. Second, the paper analyse whether systematic disregarding of educational investments character (that is low *GDP* share allocated in education) is responsible for achieving low growth rates in the past but also in the future. For this example of Croatian economy for the period 1952-1990, results suggest that low level of educational investments along with former socialist economic policy caused low economic growth in the Republic of Croatia. This paper proves on the example of Croatia (but in our opinion the same is for other countries) that growth results from human capital accumulation (government investment in education capital).

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Table 1

## THE CONTRIBUTION OF EDUCATION TO GDP GROWTH RATE IN USA

	Period		
	1900.- -1929.	1929.- -1956.	1960.- -1980*
Real national income growth rate	2,82	2,93	3,33
Growth rate share attributed to education	0,33	0,67	0,64
% of growth rate attributed to education	12	23	19
Real national income growth rate per employees	1,22	1,66	1,62
Growth rate share attributed to education	0,35	0,67	0,64
% of growth rate attributed to education	29	42	40

Source: Ivan Vuković: "Financing Higher Education in Europe", 1995., p. 24.

Table 2

REGRESSION RESULTS				
Predictor variables	Coefficient	Student's <i>t</i>	R Squared	Adjusted R Squared
Constant	0,021184			
K	0,9998	249,54 > 2,724	1,0000	1,0000
N	1,0135	43,66 > 2,724		
R	0,9989	1110,77 > 2,724		
F test	Standard deviation	Residual mean square (MSE)	Correlation (Pearson)	Durbin-Watson test
6208640 > 3,91	0,4005	0,1604	0,9462 0,9663 0,9870	dl < 1,4161 < du

Source: Author's Estimation Based on Data from Croatian Central Bureau of Statistics.

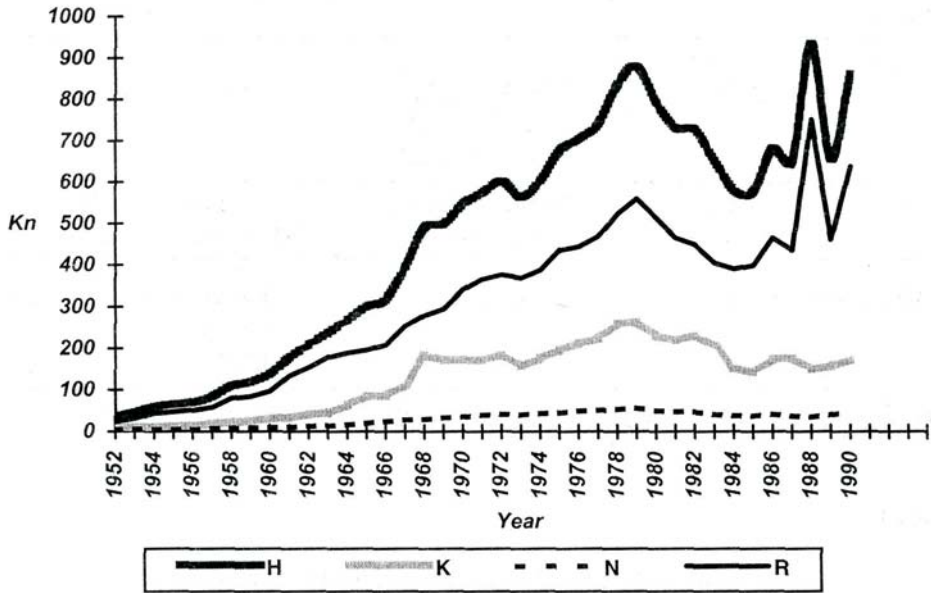
Table 3

GROWTH MODEL REGRESSION RESULTS					
Variables	Coefficient	Student's <i>t</i>	R Squared	Adjusted R Squared	F test
H	1,3004	2,64 > 2,43			
A	0,11835	4,28 > 2,43	0,9918	0,9909	1032 > 3,91
E	0,00322	4,41 > 2,43			
I	0,87149	6,96 > 2,43			

Source: Author's estimation based on data from Croatian Central Bureau of Statistics.

Figure 1

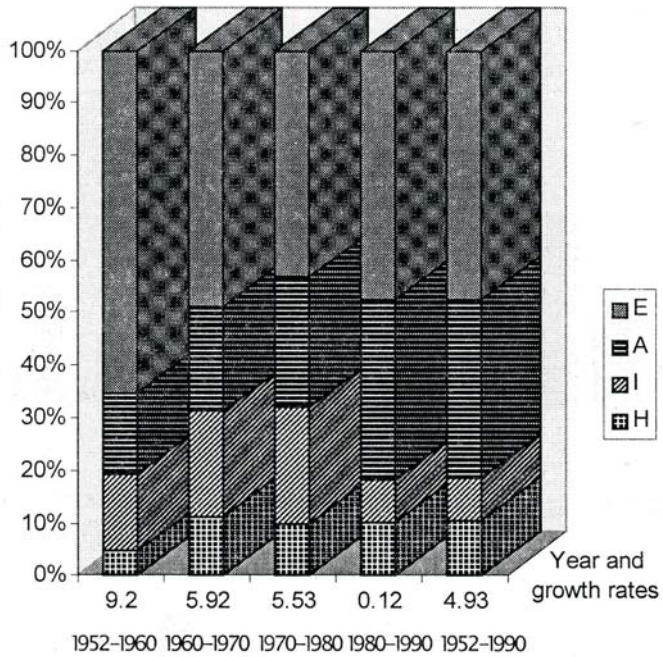
REAL HUMAN CAPITAL, FORGONE EARNING, PRIVATE AND SOCIAL  
EXPENDITURES ON EDUCATION 1952-1990 IN CROATIA



Source: Author's Estimation Based on Data from Croatian Central Bureau of Statistics.

Figure 2

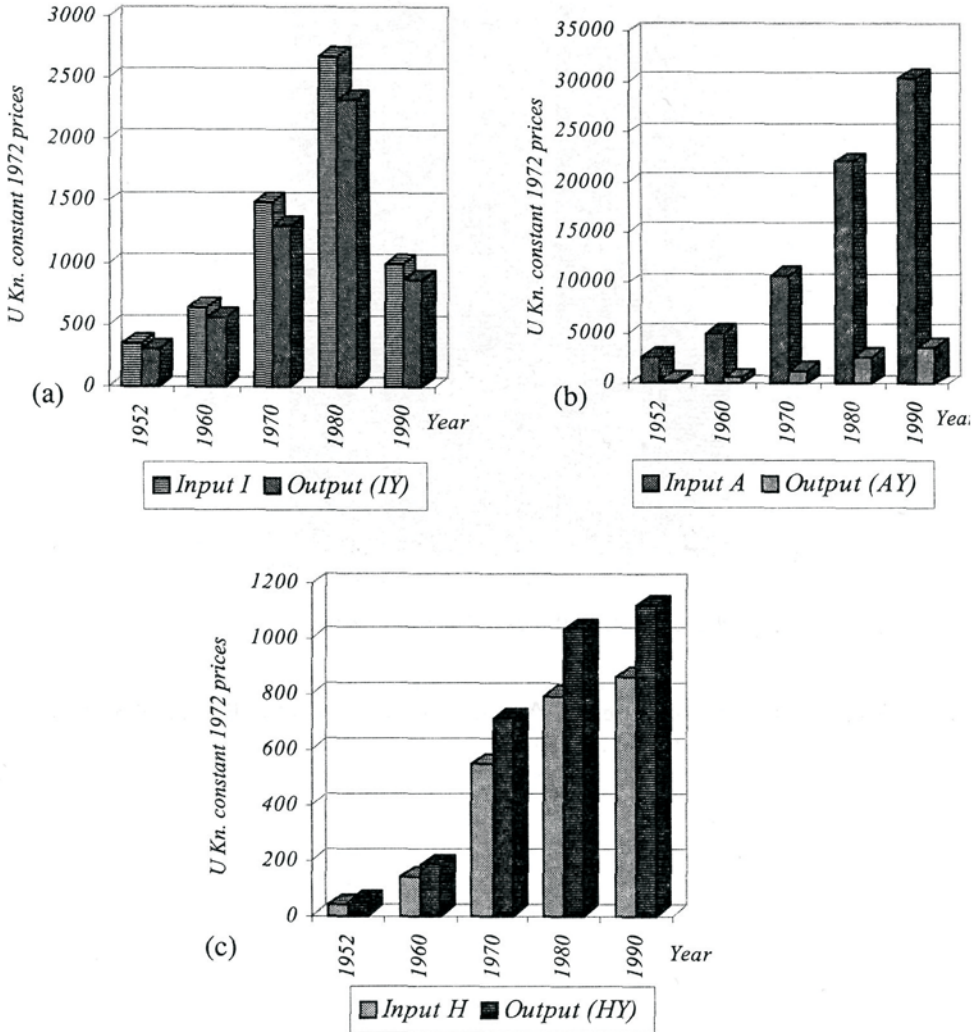
FACTORS SHARE IN CROATIAN GDP GROWTH RATE 1952-1990



Source: Author's Estimation Based on Data from Croatian Central Bureau of Statistics.

Figure 3

INPUT-OUTPUT RATIO FOR HUMAN CAPITAL (c), FIXED ASSET (b)  
 AND GROSS INVESTMENTS (a) IN CROATIA 1952-1990



Source: Author's Estimation Based on Data from Croatian Central Bureau of Statistics.



## LJUDSKI KAPITAL KAO IZVOR RASTA - MIT ILI STVARNOST

### Sažetak

Članak istražuje da li se ekonomski rast zemlje odnosi na promjene zaliha ljudskog kapitala osnovane na teoriji modela endogenoga rasta. Rezultati dobiveni analizom dostignute stope rasta u Hrvatskoj za razdoblje 1952.-1990. bazirani na podacima Državnog zavoda za statistiku ukazuju da ulaganja u obrazovanje imaju jak pozitivan utjecaj na ekonomski rast zemlje. Što je još važnije, ulaganja u osnovna sredstva (ljudski kapital) i rad, u negativnom su odnosu prema povratu proizvodnje. Kroz ekonometrijski model endogenog rasta dokazali smo da ljudski kapital jako utječe na ekonomski rast zemlje. Članak daje dva dodatna uvida koja bi trebala biti korisna u budućem istraživanju ekonomskog rasta, dokazujući da ljudski kapital pozitivno i jako utječe (najveći utjecaj) na ekonomski rast u usporedbi s tradicionalnim faktorima rasta.