# FUNCTIONAL DEPENDENCIES OF THE HUMAN CAPITAL FACTORS

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## Abstract

*The research under consideration covers the issue of determining the factors influencing the development resource for the human capital on the basis of time series data. There are presented the regression functions for the fundamental factors; these regressions are employed for the further forecast of the human development index.*

*The obtained averaged functions and dependencies for every of the considered factors allow the procedure of forecasting and scientific prognostication; the applied time span makes possible the verification of the functions.*

*The functions typologization has been produced on the basis of regression types and on the determination coefficients. The most of the obtained regressions belong to the polynomial type of the second power or to the exponential type. The factors have been considered for the whole groups of countries. The process of grouping countries has taken place on the basis of social policy adopted within the countries. The fact of possibility of grouping the countries in accordance with the adopted social policy supports the idea of identity of factors of social policy and human capital development.*

***The type of the article:*** *Research paper.*

***Keywords:*** *human capital, factors, regression, functional dependencies, forecast.*

***JEL Classification****: O15.*

## 1. Introduction

***Research problem.*** Research problem has been stated due to the fact that the new economy – knowledge or innovative economy – supposes the Human Capital to be the most valuable resource in the modern economic world. As a result human capital becomes the focus of numerous researches. The peculiarity of the research under consideration is discovering the functional dependencies between the factors of social models and human capital development. Measuring the human capital is the difficult complex and ambiguous process. In the early 90s the group of experts of UNO Development Programme worked out the new concept of human potential development (HDI Reports). It appeared to be the counterpoise to the traditional view on development as a quantitative growth of material goods and services. The cornerstone of this concept is not capability of productive labour (i.e. economic value of person), but development of human as a personality via increase of options due to the growth of life expectancy, education and income (Haque & Knellar, 2007; Gupta & Verhoeven, 2006).

The development of the world has demonstrated that the economic growth is not always followed by positive social consequences, and vice versa (Rogers, 2008; Filmer & Pritchett, 2001). It is impossible to evaluate the level of human capital development according to the level of economic growth. The classics of the human capital theory have determined the whole range of the factors, which have the paramount importance for the human capital development (Becker, 1964; Kendrick, 1974; Schumpeter, 1982; Shultz, 1968; Shultz, 1971). All these factors are directly connected with the social model, supporting the certain living standard and stimulating population for development. The population has to have the certain level of disposable income, the social

protection in case of this income decline, as well as the possibilities for social and professional development (Anand, Sudhir & Martin Ravallion, 1993; Stiglitz, 2009). At the same time, the human capital advance supposes the creation of conditions within the country, and these conditions are to promote the increment in life expectancy, including healthy years of life increase. Then there should be the material protection of the society members. Another condition is arrangement of possibilities for intellectual development of all members of (Zinovkina, Andreev, Gareev, 2004). One more demand is enhancement of economic and democratic freedom allowing all members of society to show the best skills, knowledge and characteristics (Weder, 2002). Then the last but not least there is a demand to support the ecologic protection as a factor having a huge impact on the human health. The society functioning within the state can be described with a special social model, showing the way how this process happens. Any social model has certain elements which can be mentioned in a flexible order: taxation, social insurance, public services, etc. (Kuusi, 1985; Burkhanoff, 2006; Laffer, 2009; Stiglitz, 2009).

Nowadays social models in Europe are classified in the following way:

- Scandinavian Model (or Nordic Model, or Social-Democratic Model, or Institutional Model), distributing the social benefits among all citizens of the country;
- Anglo-Saxon Model (or Liberal Model, or Beveridge Model) distributes the social benefits among people who need this social support. There are rigid limitations for the benefits accessibility;
- Continental European Model (or Bismarck Model, or Conservative Model) states that the social support can be given to the people who have been presented on the Labour Market and who have some social funds;
- Mediterranean Model (or Subsidiary Model, or Catholic Model) is similar to the Continental model, but focuses welfare on generous state-pensions (Holostova, 2009; Gritsenko, 2002).

***The research goal*** is to discover the functional dependencies between the adopted social model and the level of human capital development, allowing predicting the HDI in the certain region.

***The research aims*** comprise the idea that the social models are primarily oriented on the development and advance of the human capital in the region. The particular task of the paper is to determine the exact social model, adoption of which facilitates comprehensively the human capital development.

***The research results*** are expected to support or to reject an idea of grouping the countries for forecasting the HDI according to the adopted social model.

***The practical implementation*** of the research results is possible via forecasting the HDI of the region basing on the social model adopted within the country.

## 2. Methods

### Factors responsible for social model and human capital development

For achieving the goal and the aims of the research the range of methods has been implemented.

***Comparative analysis and Content Analysis*** For supporting the idea that the social models oriented on the development of human capital the factors responsible for the human capital development and the factors of social systems have been compared. The results are presented in Table 1.

***Clustering*** For determining the exact ways of influence of the social systems on the human capital, the European countries have been grouped in accordance with the type of the social models adopted in the certain society. The Scandinavian model is represented by such countries as Denmark, Iceland, Finland, Sweden, and Norway. Germany, France, Austria, Estonia, Lithuania, Czech Republic, Hungary, Poland and Latvia present the Continental model. The Liberal model is implemented in the United Kingdom and Ireland, and Catholic model functions in Spain, Italy and

Portugal. Since this investigation is oriented on the indicators responsible for the human capital formation, development and growth, the research under consideration operates with these indicators only (European Statistical Bureau*).*

## 3. Comparison of social models

***Mathematical methods.*** Further investigation deals with the countries, presenting this model and compares them with the countries, representing the Baltic region. For achieving this goal the complex HDI index (Human Development Index), computed on the basis of several indicators, has been employed. Then the average value of indicator was computed for every model. The results of these calculations are presented in Tables 2, 3, 4, 5.

Indices such as Human Development index, Gender empowerment measure, Index of Democratic development, Life expectancy index, Index of quality of life, Education index, Index of economic freedom are not used in calculation of HDI but still determine the level of the human capital development. The indicators average for the corresponding model has been demonstrated in Table 6.

The procedure of investigation has included processing the time series data, provided by the European Statistic Agency Eurostat. All government expenditures have been taken per capita. There have been employed the data for 10 years (2000-2009).

### Construction of correlation matrices

***Statistical methods.*** Next stage has comprised construction of the correlation matrices for all countries, chosen for representing their models. The data have been processed with employment the software **Statistics_6.** For all countries within the models the factors with high degree of correlation (from 0.8 till 1) have been found out; then the factors with weak correlations (from 0.3 till 0.79) and showing practically no correlation (from 0 till 0.29) have been discovered.

In the process of determining the correlation dependences, common for the countries operating within the same social model, there have been mentioned the certain difficulties: not all countries, presenting the social model, have the same level of economic development, and this fact must have impact on the statistic analysis. Due to this reason the countries within the Continental model have been divided into two groups – well-developed countries and less-developed countries (it is an important note – the division took place according to economic, not human capital development). The more developed countries are presented by France, Germany, Austria, Czech Republic, Poland, while the less-developed countries are Hungary, Estonia, Latvia, and Lithuania. Since the economic development of the Scandinavian countries is homogeneous, the indices are very close for these countries and correlations are possible for comparison, the countries have not been divided.

Table 7 shows the factors, correlating with value of 0.8 and higher.

### Determination of the factors with stable basis

***Statistical and Mathematical methods.*** After determining the factors with practically linear dependence, the Student's criterion has been applied to them. It has allowed determining the factors with more stable basis. Since there has been comparison of factors expressed in different numbers, and numbers differ by several digits it has been necessary to reduce them to the unified system. It has been decided to use the numbers from 0 to 1. The indices have been left unchanged (GDP index, Life expectancy index, Index of level of education)

The level of taxes, demonstrating the redistribution of GDP via taxation system, has been presented as a share of the GDP of the country.

The level of expenditures, shown in millions of Euros, has demanded significant transformations. On this purpose the countries with the highest Human Development Index in the models have been chosen. Consequently, the Netherlands is supposed to be 1 for the Continental model (HDI=0.890, the highest position in Continental model and the $7^{th}$ in the world rating) and

Norway is supposed to be 1 for Scandinavian model (HDI=0.938, the 1st position in Scandinavian model and in the world rating) since the expenditures of these countries have been taken as 1, the corresponding expenditures of other countries have been converted in this scale.

The data converted into values from 0 to 1 have been implemented for calculating Student's criterion. After calculating the values, there have been sorted out the criteria, demonstrating the higher stability.

## Development and typologisation of regression functions

***Statistical methods (Regression analysis).*** Next step is investigation of the time series data, allowing forecasting the resource of the human capital development. There has been established a regression equation for every basic factor of the human capital development. There has been done typologisation of regression functions on the basis of regression dependencies and coefficients of determination. Almost all of obtained regressions belong to the polynomial type of the second power or to the exponential type.

The factors have been considered from the point of view of social models. There have been investigated the countries employing Continental Model and Scandinavian Model. There have been used the statistic data from year 1993 to year 2007 for conducting this experiment. Unfortunately, the data for years 1996 and 2006 have not been considered, since there are gaps in data for many countries for these years in Eurostat. The data on all countries, considered within the models have been implemented. First of all there have been investigated the factors manifesting the high level of correlation with HDI (Human Development Index), and then the factors with insignificant correlation. The procedure of analysis has comprised all the possible regression dependencies of every factor trend; nevertheless, the coefficient of determination has been specified as a criterion for selecting the regression type.

## Forecasting the Human Development Index

***Prognostication on the basis of regression model*** Since the goal of this paper is analysis of the HDI factors, the forecast of this index is presented in this work.

The certain difficulties appeared in the process of working out this forecast. The Reports on this index were always published with time lag of 2 years. So, in 2009 there was published the Report on HDI for year 2007, however, in year 2010 there was published not the Report for 2008, but the Report for year 2010, with simultaneous change of method of calculation of this index. Consequently, the indices for 2008 and 2009 were not published, and starting from 2010 this index is a brand new index. The old method assumed that HDI consists of 3 equal ranking components (HDI Reports (UNDP)):

- *income*, determined by GDP at PPS in US$;
- *education*, determined by adult literacy indicator (with weight of 2/3) and gross enrolment index (with weight of 1/3);
- *length of life*, determined by Life expectancy.

For every of these indices the fixed minimal and maximum values have been determined:

- life expectancy — 25 and 85 years;
- adult literacy — 0% and 100%;
- gross enrolment — 0% and 100%;
- real GDP per capita at PPS in US$ — 100 and 40 thousand.

The indices are calculated according to:

$$Index = \frac{x_i - x_{min}}{x_{max} - x_{min}}$$

Income index is calculated differently in accordance with the diminishing marginal utility principle:

$$W(Y)=\frac{\log y_i - \log y_{\min}}{\log y_{\max} - \log y_{\min}}$$

The final index is calculated as arithmetical mean of three indices.

According to new method the calculation is complicated by new components (HDI Reports (UNDP)).

The following indices are used:

1. Life expectancy index $LEI=\frac{LE-20}{83.4-20}$

2. Education index $EI=\frac{\sqrt{MYSI * EYSI}}{0.951}$

2.1. Mean Years of Schooling Index $MYSI=\frac{MYS}{13.2}$

2.2. Expected Years of Schooling Index $EYSI=\frac{EYS}{20.6}$

3. Income Index (II) $II=\frac{\ln(GNIpc)-\ln(100)}{\ln(107.721)-\ln(100)}$

Finally, the HDI is a geometric mean of the previous three normalized indices:

$$HDI=\sqrt[3]{LEI * EI * II}$$

The content of indices has also changed: LE: life expectancy at birth; MYS: Mean years of schooling (Years that a 25-year-old person or older has spent in schools); EYS: Expected years of schooling (Years that a 5-year-old child will spend with his education in his whole life); GNIpc: Gross national income at PPS per capita.

As a result of changed method, it is impossible to apply directly the received regression dependencies. Nevertheless, there should be certain dependence between the indices calculated according to different methods. For determining this ratio the HDI for year 2010 was calculated according to the previous method. Index was calculated for every country considered in the paper and presenting the social model. On the basis of produced calculations there has been determined the ratio between the indices, calculated according to the old method (calculated values) and new method (presented in UNO Report). As a result the ratio of indices is determined as 1.14.

Next stage comprises comparison of forecasted calculated values of HDI with coefficient 1.14 and values, presented in UNO Reports for years 2010 and 2011.

## 4. Results

### Factors responsible for social model and human capital development

Apparently, the tasks, put forward for the social systems, are very close and practically coincide with the tasks of the government, oriented on the development of the human capital in the region (Becker, 1964; Holostova, 2009;Schumpeter, 1982; Social Security Programs). The principal factors, having influence on the human capital, and the fundamental factors, describing the social systems, are listed in Table 1.

As it is seen from the below presented table, the social systems factors and the factors of the human capital development are practically coinciding.

**Table 1**. Factors of social models and factors of human capital

| Factors of the Social Models | Factors, Having Impact on Human Capital |
|---|---|
| Employment level | GDP per capita (in PPS) |
| Redistribution of income via the taxation system | Level of poverty and stratification of the society |
| Governmental investments in education and science | Governmental investments in education |
| Total investments in education and science | Private investments in education |
| Governmental investments in healthcare | Governmental investments in healthcare |
| Total investments in healthcare | Private investments in healthcare |
| Governmental funds for poverty diminishing | Social transfers |
| Social contributions | Democratic Freedom |
| Mandatory social insurance | Level of economic freedom |
| Regulation of the relationships between the Labour and the Employers | Level of investment in R&D and innovation technologies |
| Existence of R&D and manufacturing clusters | Investments in ecological projects |
| Implementation of the innovations in the production process | Implementation of the innovations in the production process |
| Labour productivity increment | Labour productivity increment |

## Comparison of social models

The computed average values of Human Development Index are presented for every model and demonstrated in Tables 2, 3, 4, 5.

**Table 2.** Scandinavian Model

| | Norway | Sweden | Iceland | Finland | Denmark | average |
|---|---|---|---|---|---|---|
| HDI: | 0.971 | 0.963 | 0.969 | 0.959 | 0.955 | 0.963 |

**Table 3.** Continental Model

| | France | Austria | Germany | Czech Republic | Hungary | Poland | Estonia | Lithuania | Latvia | average |
|---|---|---|---|---|---|---|---|---|---|---|
| HDI: | 0.961 | 0.955 | 0.947 | 0.903 | 0.879 | 0.88 | 0.883 | 0.87 | 0.866 | 0.911 |

**Table 4.** Anglo-Saxon Model

| | Ireland | UK | average |
|---|---|---|---|
| HDI: | 0.965 | 0.9 47 | 0.956 |

**Table 5.** Catholic Model

| | Spain | Italy | Portugal | average |
|---|---|---|---|---|
| HDI: | 0.955 | 0.951 | 0.909 | 0.938 |

According to this indicator Scandinavian Model is the Model mostly facilitating the Human Capital development. Undoubtedly, this criterion is not sufficient enough basis for choosing this Model as a reference model for comparison of the regions. Nevertheless, all other indices (see Table 6), determining the level of development of different components of human capital, also demonstrate the advantage of Scandinavian Model. The table shows indicators average for the corresponding model.

**Table 6.** Values of indices of human capital

| Index / Model | Gender empowerment measure | Index of Democratic development | Life expectancy index | Index of quality of life | Education index | Index of economic freedom |
|---|---|---|---|---|---|---|
| **Scandinavian Model** | 0,899 | 9, 4 | 79,7 | 7,767 | 0,987 | 73,9 |
| **Continental Model** | 0,707 | 7,67 | 76,1 | 6,522 | 0,963 | 69,2 |
| **Liberal Model** | 0,75 | 8, 48 | 79,2 | 7,625 | 0,971 | 76,6 |
| **Catholic Model** | 0,776 | 8,00 | 79,8 | 7,615 | 0,956 | 64,8 |

## Construction of correlation matrices

The obtained correlations are shown in Table 7

**Table 7.** Factors correlations

| | | LE | GDP/cap | ED/cap | Tax/lab | Pov | R&D | Soc | Emp |
|---|---|---|---|---|---|---|---|---|---|
| **HDI** | I[9] | + | + | + | - | - | + | + | - |
| | II[10] | - | + | + | - | - | + | + | + |
| | III[1] | + | + | + | + | + | - | + | - |
| **LE** | I | | + | + | - | + | + | + | - |
| | II | | + | + | - | - | + | - | + |
| | III | | + | + | + | + | + | + | - |
| **GDP/cap** | I | | | + | + | - | + | + | - |
| | II | | | + | - | - | + | + | + |
| | III | | | + | + | + | + | + | - |
| **ED/cap** | I | | | | + | - | + | + | - |
| | II | | | | - | - | + | + | + |
| | III | | | | + | + | + | + | - |
| **R&D** | I | | | | - | - | | + | - |
| | II | | | | - | - | | + | + |
| | III | | | | + | - | | - | - |
| **SOC** | I | | | | | - | - | | - |
| | II | | | | | - | - | | + |
| | III | | | | | + | + | | - |

LE – Life expectancy;
GDP/cap – GDP per capita (in PPS);
ED/cap – Governmental expenditures on education;
Tax/lab – Taxes on Labour;
Pov – Expenditures on fighting poverty;
R&D – Research and Development expenditures;
Soc – Social expenditures;
I – countries within the Continental model with well-developed economies;
II – countries within the Continental model with less-developed economies;
III – countries within the Scandinavian model.

As it is seen from the table above, the GDP per capita and governmental expenditures on education (per capita), as well as the expenditures for science development and social expenditures manifest the correlation dependencies in all groups of countries, without any connection with the adopted social system.

Nevertheless, the most interesting fact is existence of correlations between the factors and taxes on Labour in Scandinavian countries, while the taxes are insignificant for the countries with Continental social model. At the same time, the less-developed countries of Continental model (the Baltic countries are in this group) demonstrate the great significance of employment level. On the contrary, the well-developed countries of both, Scandinavian and Continental model have no correlations with employment level. These facts permit to assume that the low level of economic development and simultaneous refusal of the government to give the complete social support to the population under the condition of absence of accumulated social funds, employment becomes the most influential factor in the country (Stiglitz, 2009). It is the situation the Baltic countries have found themselves in. The government has chosen to follow the Continental model, but population has rather low level of accumulated social funds (it is the consequence of being the post-soviet country – the part of population, reached the pension age, have no accumulated social funds since they lived in the Soviet Union, moreover, there is no tradition in these countries to get prepared for

the pension from the very first year of working activity), low level of governmental support (because of the chosen social model) and low level of personal savings (consequences of low standard of living) become the prerequisites for great impact of employment. In these countries work is the only way to survive.

The expenditures on overcoming the poverty show significant correlation only for Scandinavian countries. This fact evidences that only Scandinavian social model supposes the governmental support to improve the situation with standards of living for the poorest categories of population. Probably, the maxim "the rich pay more not to see the poverty around them" works in these countries and these expenditures are significant for all indicators describing the human capital. The level of poverty several digits low in Scandinavian countries in comparison with the countries of Baltic region. For instance, level of poverty in Scandinavian countries fluctuates from 1.6% till 3.1%, while in the Baltic countries from 6.2% till 21.9%. Gini coefficient shows the differentiation of monetary income of population as a degree of deviation of actual income stratification from perfectly equal distribution of income among the population of the country. This index is practically ideal way of cross-country comparison, since it does not depend on the selected aggregate and neutral to the scales of economies of different countries. It does not take into account the source of income; that is why it is usually employed together with decile or quintile coefficient, demonstrating the relation of 10% or 20% of population with the highest income within country to 10% or 20% of the population with the lowest income within country. Gini coefficient fluctuates from 24.7 to 25.8 within the Scandinavian Model and is significantly higher in the countries of Continental Model – from 28.3 in Germany to 37.9 in Latvia. The quintile coefficient in the Scandinavian countries fluctuates from от 3.5 to 3.8, while in the countries of Continental Model from 3.8 (Austria) to 7.3 (Latvia).

## Determination of the factors with stable basis

Life expectancy index is more stable indicator than other factors. The only exceptions are the expenditures on education for well-developed countries of continental model and taxes on labour for Scandinavian countries. Probably the stability of the Life expectancy index can be explained by the fact that the countries under consideration, grouped according to the social model adopted and economic development level, have these indices very close, while the other factors change greatly from country to country. It is rather difficult to explain the stability of government expenditures on education for the Continental model (countries with high economic development). Speaking about the taxes on labour in Scandinavian model, it is quite natural to assume that this indicator is the most significant for this model and naturally presents the higher stability.

The less developed countries of continental model demonstrate that the GDP index is less stable than other factors. It means that GDP is less important for these countries than for the developed countries. As it has been mentioned above, the quintile coefficients in these countries are very high, consequently, the redistribution of GDP is very uneven and it is important to be very cautious basing on this indicator in the process of the human capital investigation.

At the same time the taxes on labour are more stable factor than GDP index for Scandinavian model countries. It is another support for the idea of special significance of the income redistribution via taxation for these countries.

The government expenditures on education are relatively constant in all countries, and it is possible to assume if to consider them as the factors of the human capital development, they will demonstrate the same level of stability for all countries. Unexpectedly this indicator becomes more stable factor for the well developed countries of the continental system. The level of employment is more stable for less developed countries. The taxes on labour and government expenditures on poverty overcoming become more stable factors for the human capital development for Scandinavian countries.

The low stability of the factor "expenditures on R&D" is rather unexpected for Scandinavian countries positioning themselves as the countries paying special attention to the science development. Probably, the taxes on labour demonstrate the level of redistribution via the taxation

system and it is more important for the human capital development than investing the scientific research. The situation when the investments in R&D are not so stable for the Continental model is reasonable since the level of these investments is lower than in Scandinavian countries, and then the countries of Continental model do not emphasise these investments relatively to the human capital development.

The social expenditures are very stable factor for all models and all countries. Support of population in case of decrease of income is significant for the human capital development.

## Development and typologisation of regression functions

The developed regression functions are demonstrated in Tables 8, 9 and 10.

It should be mentioned that in several cases the determination coefficient in the mentioned type of regression was a bit lower than in other types of regression. However, it has been decided to mention the types, corresponding to other factors regression types, since the difference in the coefficient of determination is minor (thousandths) and the investigation has been taken from the position of factors community within the social model. The following factors regressions have been exchanged: Estonia – expenditures on R&D, exponential regression has been changed with polynomial, $R^{2} = 0{,}9572$ in exponential regression and $R^{2} = 0{,}9565$ in polynomial type; Latvia – expenditures on poverty overcoming , exponential regression has been exchanged with polynomial, $R^{2} = 0{,}873$ in exponential regression and $R^{2} = 0{,}8657$ in polynomial type. There has been a necessity to change the type of regression for the expenditures on the social sphere and on science for the group of well-developed countries, representing the Continental Model. The exponential types of regressions on the expenditures on R&D in Germany and Austria a have been exchanged with the polynomial types, and the coefficients of determination are, correspondingly, $R^2 = 0{,}9647$ for Germany in polynomial type and $R^2 = 0{,}9959$ for Austria in polynomial type, while in exponential type the coefficients of determination are $R^2 = 0{,}9708$ for Germany and $R^2 = 0{,}9968$ for Austria. The type of regression for social expenditures for these countries has also been changed from polynomial to exponential. For Germany the new coefficient of determination is $R^2 = 0{,}9317$ and in polynomial it is $R^2 = 0{,}9384$. For Austria the new coefficient of determination is $R^2 = 0{,}9795$ and in polynomial it is $R^2 = 0{,}9867$.

The most significant changes have been done for Norway (see Table 8). For obtaining the coincidence between the indicators of Norway and indicators of other countries within the Scandinavian model it is necessary to change regressions for four factors. The difference between the coefficients of determination is minor, it the changes of regressions types have been done. Nevertheless, it is not excepted to distinguish Norway as a separate group within this model. The regression types have been considered without binding them to the HDI, and this fact means that the general situation with factors grouping. Norway, employing the Scandinavian Social Model, at the same time has the intermediate type of economy – the massive employment of innovations allows speaking about the innovative economy, or knowledge economy, and simultaneously the economy significantly dependent on primary raw resources.

**Table 8.** Scandinavian model – regression types

| | HDI | | LE | | GDP/cap | | ED/cap | | TAX/lab | | POV/exp | | SOC/exp | | EMPL | | R&D/exp | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type |
| **Norway** | 0.8705 | poly | 0.9736 | polyn | 0.9522 | poly | 0.9413 | poly | 0.5465 | polyn | 0.9612 | polyn | 0.9896 | polyn | 0.6307 | polyn | 0.9045 | polyn |
| **Sweden** | 0.8735 | poly | 0.952 | polyn | 0.9804 | poly | 0.9855 | poly | 0.918 | polyn | 0.7866 | polyn | 0.9792 | polyn | 0.4122 | polyn | 0.975 | polyn |
| **Iceland** | 0.8443 | poly | 0.9319 | polyn | 0.9722 | poly | 0.9836 | poly | 0.3306 | polyn | 0.8484 | polyn | 0.9085 | polyn | 0.3699 | polyn | 0.9608 | polyn |
| **Finland** | 0.7529 | poly | 0.9892 | polyn | 0.9883 | poly | 0.9797 | poly | 0.8425 | polyn | 0.8994 | polyn | 0.9922 | polyn | 0.7214 | polyn | 0.9859 | polyn |
| **Denmark** | 0.8236 | poly | 0.9883 | polyn | 0.9916 | poly | 0.9869 | poly | 0.8597 | polyn | 0.3783 | polyn | 0.9924 | polyn | 0.7559 | polyn | 0.9793 | polyn |
| **SCANDINIAVIAN** | 0.9383 | poly | 0.9929 | polyn | 0.9886 | poly | 0.9947 | poly | 0.89 | polyn | 0.9023 | polyn | 0.9915 | polyn | 0.4719 | polyn | 0.9875 | polyn |

**Table 9.** Continental model (group I) – regression types

| | HDI | | LE | | GDP/cap | | ED/cap | | TAX/lab | | POV/exp | | SOC/exp | | EMPL | | R&D/exp | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type |
| **Netherlands** | 0.828 | poly | 0.969 | polyn | 0.9863 | expon | 0.9924 | polyn | 0. 494 | polyn | 0.6271 | polyn | 0.9705 | exponen | 0.7064 | polyn | 0.973 | poly |
| **Germany** | 0.7659 | poly | 0.982 | polyn | 0.976 | expon | 0.9651 | polyn | 0.9638 | polynm | 0.7913 | polynm | 0.9317 | exponen | 0.6995 | polyn | 0.9647 | poly |
| **Austria** | 0.7394 | poly | 0.9874 | polyn | 0.9905 | expon | 0.9834 | polyn | 0.7991 | polyn | 0.2625 | polyn | 0.9795 | exponen | 0.5002 | polyn | 0.9959 | poly |
| **Czech Republic** | 0.7169 | poly | 0.9746 | polyn | 0.9869 | expon | 0.9933 | polyn | 0.9057 | polyn | 0.8 | polyn | 0.9829 | exponen | 0.6777 | polyn | 0.9573 | poly |
| **France** | 0.7443 | poly | 0.822 | polyn | 0.958 | expon | 0.9671 | polyn | 0.2965 | polyn | 0.9784 | polyn | 0.9858 | exponen | 0.9762 | polyn | 0.9529 | poly |
| **Poland** | 0.7 43 | poly | 0.9642 | polyn | 0.9735 | expon | 0.9939 | polyn | 0.9647 | polyn | 0.6189 | polyn | 0.9827 | exponen | 0.9251 | polyn | 0.9122 | poly |
| **CONTINENTAL I** | 0.7573 | poly | 0.985 | polyn | 0.9903 | expon | 0.993 | polyn | 0.9188 | polyn | 0.871 | polyn | 0.7371 | exponen | 0.2386 | polyn | 0.9561 | poly |

**Table 10.** Continental model (group II) – regression types

| | HDI | | GDP/cap | | ED/cap | | TAX/lab | | POV/exp | | SOC/exp | | EMPL | | R&D/exp | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type | $R^2$ | Type |
| **Estonia** | 0.9514 | polyn | 0.975 | polyn | 0.9373 | polyn | 0.906 | polyn | 0.9205 | polyn | 0.9774 | polyn | 0.9284 | polyn | 0.9565 | polyn |
| **Lithuania** | 0.7077 | polyn | 0.9906 | polyn | 0.9764 | polyn | 0.7785 | polyn | 0.5216 | polyn | 0.9001 | polyn | 0.8526 | polyn | 0.9903 | polyn |
| **Latvia** | 0.6779 | polyn | 0.9802 | polyn | 0.9996 | polyn | 0.9115 | polyn | 0.8657 | polyn | 0.9 488 | polyn | 0.9416 | polyn | 0.9443 | polyn |
| **Hungary** | 0.6 418 | polyn | 0.9773 | polyn | 0.9606 | polyn | 0.1804 | polyn | 0.4068 | polyn | 0.9889 | polyn | 0.9051 | polyn | 0.9661 | polyn |
| **CONTINENTAL II** | 0.933 | polyn | 0.998 | polyn | 0.979 | polyn | 0.8837 | polyn | 0.7677 | polyn | 0.9776 | polyn | 0.9448 | polyn | 0.9864 | polyn |

### Forecasting the Human Development Index

Due to the calculations presented in chapter "Methods" the ratio of indices has been determined as 1.14. This ratio has been used for comparison of forecasted calculated values of HDI and values, presented in UNO Reports for years 2010 and 2011.

The following results have been obtained: in group of countries with relatively high economic development implementing the Continental model the forecasted index differs with real by 2.14% in 2010 and by 2.2% in 2011.

In the group of countries with relatively low economic development, implementing the Continental model, the difference in 2010 is 2.39% and in 2011 is 3.74%. The sharp difference exists due to HDI in Hungary, the real indicator is significantly lower than the calculated one.

The group of Scandinavian countries presents the following difference in indices: 2.24% in 2010 and 3.24% in 2011. In 2011 HDI in Norway is significantly higher than the calculated one.

## 5. Conclusion

The research under consideration has determined the factors which are important components of social structure of any country and simultaneously have great impact on human capital. The way of arranging these factors determine the level of HDI. These factors are organised in accordance with the social model adopted by the country. There four social models functioning in the European Union, and the paper operates with two of them – Continental model as a model, adopted by the countries of special interest of the author and Scandinavian model as a referent model since all the indicators of human capital development are higher in this model compared to other ones. Employment of correlation matrix and then Student's criterion allows finding the factors which are cardinal ones for the human capital development in countries with different social models. The developed regression functions support the idea of dividing countries by adopted social model. They allow also forecasting the HDI, though the method of calculating this index changed in 2010, while the regressions are based on data of previous years. The coefficient permitting forecasting HDI has been computed. The time span allows verification.

The paper has achieved its goal and has determined the functional dependencies between the social model adopted by the society and the level of human capital development.

## 6. Discussion

The presented research seems to be rather important for investigating the human capital.

To begin with, it again the idea of interconnection of the level of human capital development and the social model adopted within the country. The novelty of the research lies in the direct investigation of these factors as ***determinants*** of the human capital development, but not only as ***influencers*** of the economic component of HDI.

The paper demonstrates that it is possible to apply the alternative way of regional development of European countries – according to the adopted social model.

Then, the countries are usually grouped according to the value of HDI. The research connects the value of HDI with the social model adopted within the country, and this idea has been supported by investigating the regression equations.

Then, the research under consideration suggests the way of forecasting the HDI. It is quite possible to assume that this way of forecasting might allow assessing the possible consequences of government activities in social sphere and their influence on such important factor as HDI.

The research reveals the types of models. Since the Baltic region presents the primary interest for the author, and the countries of it employ the Continental social model, the papers concerns mostly the influence of this model on the human capital development. The Scandinavian model has been implemented as a reference model. The paper also concerns the criteria for choosing this model specifically as an object of comparison.

The special interest is presented by the investigation of HDI (Human Development Index) correlations with other factors important for the human capital development, as well as factors

interdependence. Since the correlation dependencies of factors are clearly observed within the frameworks of the chosen models, it gives opportunity to conclude that the existing correlation dependencies reflect the level of the human capital development.

Further the considered correlation dependencies have been checked for sustainability with employment of Student's criterion. The Student's Criterion supported the correctness of methods applied to the human capital development and revealed the community of factors within the frameworks of the social models.

There have been revealed the regression dependencies of the factors.

Aggregating the regressions in the frameworks of the considered social models manifests their conformity. Accordingly, the fact of correctly chosen criterion for human capital factors grouping has been supported.

The obtained regression dependencies allow forecasting HDI, but the procedure is complicated by the fact of changing the method of calculating HDI in 2010, while the regressions have been obtained basing on the data of 2007. Nevertheless, the research has provided the coefficient allowing forecasting on the basis of regression equations even after changing the method of indicator calculation.

These regression functions can also be employed for forecasting the indices having great influence on determining and describing the development of the human capital.

***Practical implications*** The obtained averaged functions and dependencies for every of the considered factors allow the procedure of forecasting and scientific prognostication; the applied time span makes possible the verification of the functions.

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