# Human Development Index and Economic Indicators

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# HUMAN DEVELOPMENT INDEX AND ECONOMIC INDICATORS

## INDEKS LJUDSKOG RAZVOJA I EKONOMSKI INDIKATORI

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*Abstract:* *Using Human development index (HDI) to present human development has shown how economic indicators have extremely strong influence on its value, although HDI is composed of indicators the life expectancy and the educational attainment as well. Therefore, this paper objective is to examine the connection between HDI value and GNI per capita in Croatia in a period 1990-2015.The connection in between HDI value and GDP per capita, the indicator has also been examined, due to the fact how GDP is most commonly used in the presentation of economic results on the macro level. Both analyses have shown a very strong positive correlation in between income indexes and HDI.*

*Key words:* *HDI, GNI percapita, GDP percapita, CorrelationAnalysis*

*Sažetak:* *Predstavljanje ljudskog razvoja Indeksom ljudskog razvoja (HDI) pokazalo je da gospodarski pokazatelji razvoja imaju izuzetno jak utjecaj na njegovu vrijednost, iako u sebi sadrži i pokazatelje očekivanog trajanja života te postignutog obrazovanja. Zbog toga cilj rada ispitati povezanost vrijednosti HDI i BNP per capita Hrvatske u razdoblju 1990-2015. Ispitana je i povezanost HDI vrijednosti s BDP per capita, pokazateljem koji se u Hrvatskoj češće koristi u prezentiranju ostvarenih gospodarskih rezultata na makro razini. Obje analize su pokazale da postoji jaka pozitivna korelacija između pokazatelja prihoda i vrijednosti HDI.*

*Ključne riječi*: *HDI, GNI per capita, GDP per capita, korelacijska analiza*

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## 1. Introduction

Human Development Index (HDI) is composed of three dimensions: long and healthy life, knowledge and a decent standard of living. These dimensions are quantified through the following indicators: life expectancy at birth through life expectancy index, expected years of schooling and mean years of schooling calculated as an education index as well as Gross national income (GNI) per capita (PPP $) presenting the last HDI component through GNI index. These three indexes (life expectancy index– LE, education attainment index – EA and GNI index) compose the full HDI [7]. Firstly composed in 1990 until 2010 HDI used the Gross domestic product (GDP) instead of GNI as a measure of decent standard of living, when it was transformed primarily due to the heavy critic [9]. Following this change, this paper aims to explore the correlation in between these three indicators on the example of Croatia's case in a period from 1990-2015.

In the context of correlation of economic indicators to HDI Weimann et al.[18] claimed how GDP bears a significant advantage over other indicators of development in the sense that it only uses data that are generated by the market processes. Several studies have indicated a high correlation between an economic indicator of *per capita* GDP and other aggregate social indicators of development suggesting that GDP can be used as a proxy measure of development [5]. The values of development index like the HDI have been shown to exhibit positive and statistically significant correlation with the GDP or GNI *per capita* [11], [1]. Some researchers have therefore suggested that since the HDI is so closely correlated with GDP or GNI *per capita*, it is a redundant index [11]. According to [10] the significance of Ogwang's [12] finding is that the simplified index of HDI is not the GDP index but one based on Life expectancy. Ivanova et al. [9] found that the education attainment (EA) measured by the mean years of schooling (used as an indicator from 1991 to 1994) and the GDP explain a large portion of the variation in LE, and concluded that either the LE or the combination of EA and GDP can explain approximately the same proportion of the variation of the HDI and the overall ranking by the HDI would not change significantly if the GDP and EA are excluded from the index and the countries are ranked only by the LE. Although different authors stated comparative benefits of GDP towards HDI it is important to underline while GDP is a measure of the economic performance of a country, HDI remains the measure of human and social progress as stated by Deb [4].

## 2. Comparing HDI and GNI *per capita* ranks

According to Human Development Report [6] measured by HDI, the Republic of Croatia is 45th world ranked country in 2015, improving its ranking for two positions compared to 2014. Even though average annual HDI growth in a period 1990-2000 amounted 1,13% it slowed down to 0,85% from 1990-2015, which resulted that HDI rank increased only for one position in 2015 compared to 2009. With HDI value 0,827 in 2015, Croatia is in the group with very high human development (51

counties) in which world first ranked is Norway with HDI value 0,949. If comparing Croatia's HDI to Norway's, in a given period a smoothed annualized growth of the HDI is considerably higher as a result of a conspicuous expanse of growth in regard to developed countries. The same 2015 year Norway achieved GNI *per capita* 67,614 $, ranked 6th on the world scale. Accordingly, the difference in ranking by GNI *per capita* and by HDI value is 5. Some countries have an outstanding difference in GNI and HDI ranking value. For example, Qatar is 33rd (with Andorra and Cyprus) HDI ranked (HDI value 0,754), but 1st GNI *per capita* ranked (129,916 $) making the difference in between these two ranks -32. The greatest rank difference in between GNI *per capita* and by HDI value is registered in Kuwait placed 51st in a group of countries with very high human development (HDI value 0,800) and scored 76,075 $ GNI *per capita* (3rd world rank) whose difference in ranking by GNI *per capita* and by HDI value is -48. During 2015 Croatia achieved 20,291 $ GNI *per capita* ranking 59th in the world, so the difference in ranking by GNI *per capita* and by HDI value in Croatia is 14. The difference between a country's human development ranking and its per capita income ranking shows how successful it is in translating the benefits of economic growth into the quality of life for its population. A positive difference means that a country is doing relatively better in terms of human development than in terms of *per capita* income. This outcome is often seen informer socialist countries and in the developed countries of Europe [13].

## 3. Data and methods

HDI value, GN *per capita* and GDP *per capita* in Croatia in the period from 1995 to 2015 are taken from Human Resource Report (HDR) [6].Data for the calculation of HDI were published in [8], [14],[15],[16] and [19]. For the HDR, GNI *per capita* values are taken from the [8], [16] and [19]. GDP *per capita* is taken from the Croatian Bureau of Statistics [2] and [3].

According to HDR [6], GNI is aggregate income of an economy generated by its production and its ownership of factors of production, less the incomes paid for the use of factors of production owned by the rest of the world, converted to international $ using PPP rates. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products [2] and [3], expressed in EUR. Both of these indicators are divided by midyear population to get relative numbers *per capita*.

Although the HDI indicator emerged with respect to various indicators (life expectancy at birth through life expectancy index, expected years of schooling and mean years of schooling calculated as an education index as well as Gross national income), the relationship between HDI and GNI *per capita* and HDI and GDP *per capita* was examined in this paper. For this purpose, the Parson correlation coefficient was calculated, the i.e. covariance of standardized values of variables *x* and *y*, according to [14, p. 414]:

$$r = \frac{\mu_{11}}{\sigma_x \sigma_y}, -1 \leq r \leq 1$$

$$\mu_{11} = \frac{1}{N} \sum_{i=1}^{n} (x_i - \bar{x})(y_i - \bar{y}) = cov(X, Y)$$

$$\sigma_x = \sqrt{\frac{1}{N} \sum_{i=1}^{2} (x_i - \bar{x})^2} \qquad \sigma_y = \sqrt{\frac{1}{N} \sum_{i=1}^{2} (y_i - \bar{y})^2}$$

Representativeness was tested by the coefficient of determination, r2, using sums of squares

$$r^2 = \frac{\sum_{i=1}^{n} (\hat{y}_i - \bar{y})^2}{\sum_{i=1}^{n} (y_i - \bar{y})^2}$$

the variability by calculating the standard deviation of the regression

$$\sigma_{\hat{Y}} = \sqrt{\frac{\sum_{i=1}^{n} y_i^2 - a \sum_{i=1}^{n} y_i - b \sum_{i01}^{n} x_i y_i}{n}}$$

and by the coefficient of variation of the regression models.

$$CV_{\hat{y}} = \frac{\sigma_{\hat{y}}}{\bar{y}} 100$$

## 4. Results and Discussion

Scatter diagram (Figure 1) in Ti (xi, yi), i = 1,2,3, ... n, (Table 1) refers to the form of regression function in which the common tendency of increasing GNI *per capita* and HDI is existing. Results of the relationship analysis GDP *per capita and* HDI point to the same conclusion. The trend of the HDI movement (Figure 2), GNI (Figure 3) and GDP *per capita* (Figure 4) is largely an upward trend in the period from 1995 to 2015.
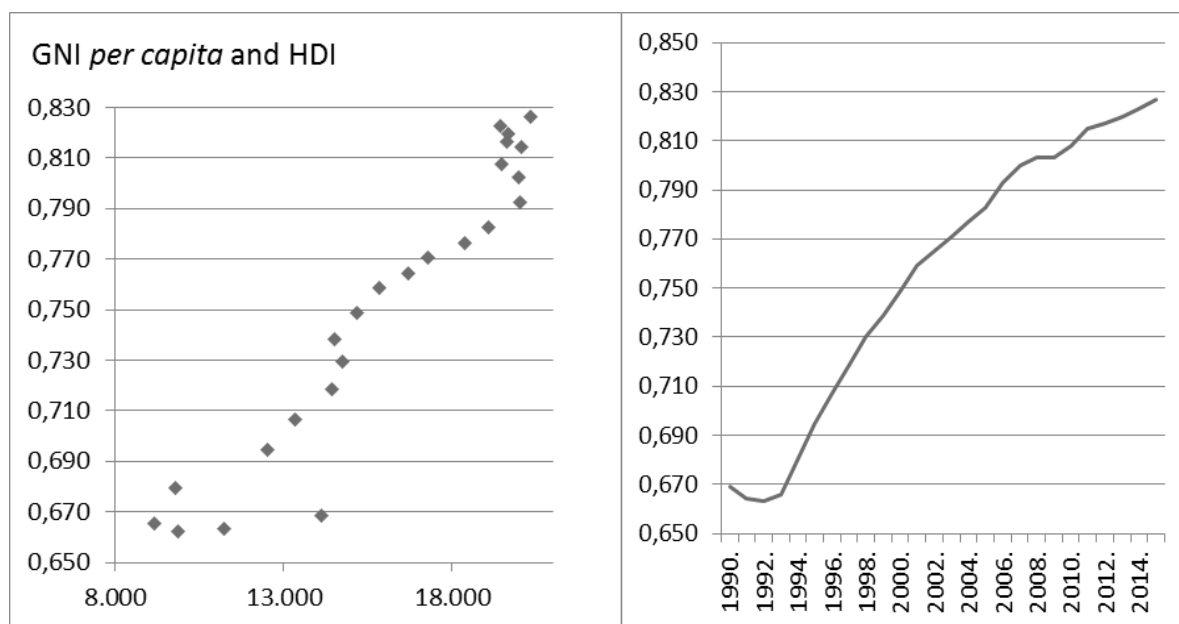
Figure 1. Scatter diagram, x = GNI *per capita,* international $, y = HDI
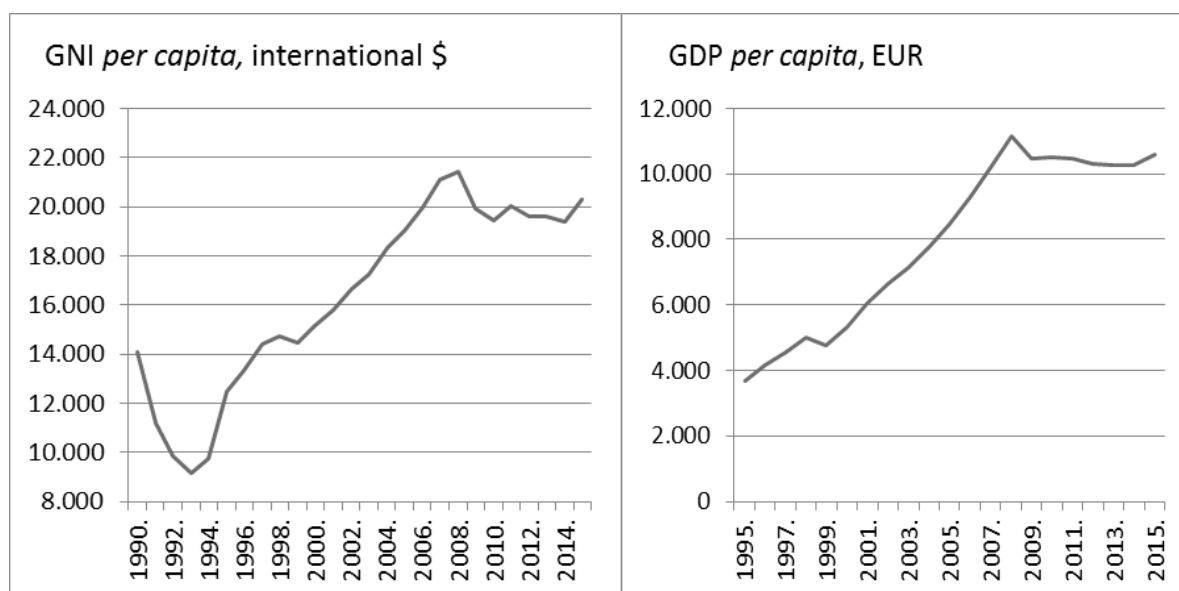


Figure 2.The trend of HDI



Figure 3.  The trend of GNI *per capita*
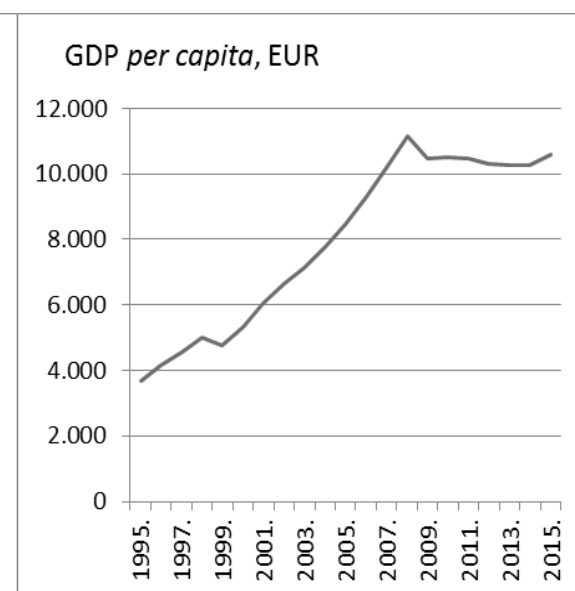


Figure 4. The trend of GDP *per capita*

Charts (Figure 1, Figure 2 and Figure 3) show very similar linear movement from 1995 to 2008. From 1990 to 1994it is nonlinear, although with similar ups and downs (war period), while 2009 onwards their movements diverge (the period of economic crises) GNI *per capita* suddenly falls, while HDI keeps its straightforward movement of growth. Movement of GNI *per capita* is similar to the movement of GDP *per capita* in a period from 1995 until 2015 (Figure 4).

The result of correlation analysis between the displayed variables is shown in Table 1.

| Year | Gross national income (GNI) *per capita* (2011 PPP $) | Human Development Index (HDI) | Results X = GNI *per capita* Y = HDI | | GDP *per capita*, EUR | Results X = GDP *per capita* Y = HDI | |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | **x** | **y** | | | **x** | | |
| 1990 | 14.105 | 0,669 | *r* | *0,9526930* | | | |
| 1991 | 11.192 | 0,664 | | | | | |
| 1992 | 9.827 | 0,663 | $\mu_{11}$ | 196,61 | | | |
| 1993 | 9.130 | 0,666 | $\sigma_x$ | 3725,21 | | | |
| 1994 | 9.767 | 0,680 | $\sigma_y$ | 0,0554 | | | |
| 1995 | 12.479 | 0,695 | | | 3.667 | *r* | *0,9667737* |
| 1996 | 13.319 | 0,707 | | | 4.154 | | |
| 1997 | 14.391 | 0,719 | *Std Dev* $\sigma_{\hat{y}}$ | 0,016837 | 4.569 | $\mu_{11}$ | 96,89 |
| 1998 | 14.707 | 0,730 | *CV$\hat{y}$, %* | 2,228 | 4.998 | $\sigma_x$ | 2545,08 |
| 1999 | 14.465 | 0,739 | | | 4.751 | $\sigma_y$ | 0,0394 |
| 2000 | 15.161 | 0,749 | | | 5.334 | | |
| 2001 | 15.788 | 0,759 | | | 6.047 | | |
| 2002 | 16.653 | 0,765 | Sum of squares | | 6.635 | *Std Dev* $\sigma_{\hat{y}}$ | 0,01007 |
| 2003 | 17.268 | 0,771 | Interpreted by model | | 7.135 | *CV$\hat{y}$, %* | 1,297 |
| 2004 | 18.324 | 0,777 | | 0,072426893 | 7.769 | | |
| 2005 | 19.033 | 0,783 | Non-interpreted (residual) deviation | | 8.468 | Sum of squares | |
| 2006 | 19.974 | 0,793 | | 0,007371453 | 9.322 | Interpreted by model | |
| 2007 | 21.103 | 0,800 | Total | 0,0797983 | 10.187 | | 0,030435 |
| 2008 | 21.443 | 0,803 | *r²* | *0,9076240* | 11.166 | Non-interpreted (residual) deviation | |
| 2009 | 19.935 | 0,803 | | | 10.471 | | 0,002128 |
| 2010 | 19.428 | 0,808 | | | 10.508 | Total | 0,032563 |
| 2011 | 20.008 | 0,815 | | | 10.469 | *r²* | *0,9346514* |
| 2012 | 19.581 | 0,817 | | | 10.312 | | |
| 2013 | 19.616 | 0,820 | | | 10.284 | | |
| 2014 | 19.380 | 0,823 | | | 10.249 | | |
| 2015 | 20.291 | 0,827 | | | 10.586 | | |

Table 1. Correlation analysis GNI *per capita* – HDI value and GDP *per capita* – HDI value

The results show a strong positive linear relationship between GNI *per capita and* HDI r = 0,9527, as well as a correlation between BDP *per capita* and HDI r =0,9668, which is in accordance with the results showing a very strong influence of economic indicators to an HDI level. Interconnected to these, coefficients of determination r², shows how models are representative. The first model 90,76% of the total variationin *y* canbeexplainedbythelinearrelationshipbetween *x* and *y* and in second 93,47%. Coefficients of variation in regression, which evaluates the relative closeness of the predictions to the actual values, show small the residuals relative to the predicted value (2,228% and 1,297%) and it is suggestive of good models fit.

The results given do not show the big difference in between the two analyses and are in accordance to the author's expectation showing similarity to McGillivray [11] and Cahill [1] whose results in HDI research have shown to exhibit positive and statistically significant correlation with the GDP or GNI *per capita*. Since according to Kovacevic [10] for the high-income countries the GNI per capita, as new income index, has lower values than GDP *per capita*, while for most of the low income countries the GNI per capita index is higher, there is a presumption that using GNI *per capita* places Croatia on the higher rank of social development by HDI. As the results show how GDP *per capita* correlates stronger to HDI than to GNI *per capita* it is necessary to make further analysis, as well as an analysis of relationship between HDI and other component indicators, in particular due to the Ogwang [12] and Kovacevic [10] results where life expectancy shows the strongest relationship with the HDI, and GDP has the weakest relationship.

## 5. Conclusion

The Human development literature review in the last thirty years shows the mostly matching results, but in some parts of results invokes a need for a re-examination and conversion of the relationship between the human development indicators. In accordance to some results economic indicators are sufficient to measure the level of human development due to the fact it shows a strong correlation to HDI, and to the others, this role is to be given to the life expectancy indicator. There are also results found showing the somewhat different influence of GNI to HDI than it does GDP. Because of that, this paper has analysed the interconnection in between GNI per capita to HDI as well as GDP per capita to HDI in Croatia in a period from 1990 to 2015 aiming to determine the strength of the connection between the indicated indicators. The results have shown a strong positive correlation in these relationships and the very small difference in explaining the variation of the HDI.

Although HDI remains very well accepted as a usable comparative component of human development on the global and national scale further research developments are to include the interrelationship in between green GDP and Human Sustainable Development Index contributing the benefits of green economy and sustainable development of the globe.

## 6. References

[1] Cahill, M. B. (2005). Is the Human Development Index Redundant, *Eastern Economic Journal,* Vol. 31, No. 1, pp. 1-5. *ISSN* 0094-5056 e*ISSN* 1939-4632 *Available from: http://web.holycross.edu/RePEc/eej/Archive/Volume31/ V31N1P1_5.pdf, Accessed:* 2018-01-18.
[2] Croatian Bureau of Statistics (2018). Gross Domestic Product for the Republic of Croatia, NUTS 2013 - 2nd Level and Counties, 2015, *First Release*, Vol. 55, No.

12.1.3., 15 February 2018, Zagreb, *Available from:* http://digured.srce.hr/arhiva/42/51915/12-1-3_Bruto%20domaci%20proizvod%20za%20Republiku%20Hrvatsku,%20NKPJS%20-%202.pdf, *Accessed:* 2018-02-12.

[3] Croatian Bureau of Statistics (2015). Gross Domestic Product for the Republic of Croatia, NUTS 2 Level and Counties, 2000 – 2012 (ESA 2010), *First Release*, Vol. 51, No. 12.1.6, 13 March, 2015, Zagreb, *Available from:* https://www.dzs.hr/Hrv_Eng/publication/2014/12-01-06_01_2014.htm, *Accessed:* 2018-02-12.

[4] Deb, S. (2015). The gap between GDP and HDI: Are the Rich Country Experiences Different from the Poor?, I.A.R.I.V. OECD, Better Policy for Better Lives, *Available from:* http://www.iariw.org/papers/2015/deb.pdf, *Accessed:* 2018-01-18.

[5] Hicks, N. & Streeten, P. (1979). Indicators of Development: The Search for a Basic Needs Yardstick, *World Development*, Vol. 7., pp. 567-80. ISSN 0305-750X, *Available from:*
http://documents.worldbank.org/curated/en/653921468327325043/pdf/REP104000Indic0asic0needs0yardstick.pdf, *Accessed:* 2018-01-18.

[6] Human Development Report (2016).*Human Development for Everyone*, United Nations Development Programme (UNDP), ISBN 978-92-1-060036-1, New York. *Available from*:
hdr.undp.org/sites/default/files/2016_human_development_report.pdf, *Accessed*: 2018-01-18.

[7] Human Development Report (1990). United Nations Development Programme (UNDP), ISBN 0-19-506480-1, New York. *Available from*: http://hdr.undp.org/sites/default/files/reports/219/hdr_1990_en_complete_nostats.pdf, *Accessed*: 2018-01-18.

[8] IMF, International Monetary Fund (2016), World Economic Outlook database, ISBN978-1-51359-954-0 (paper), 978-1-47553-996-7 (PDF), 978-1-47553-981-3 (ePub), 978-1-47553-998-1 (Mobi) Washington, DC, *Available from:* www.imf.org/external/pubs/ft/weo/2016/02/, *Accessed:* 2018-01-20.

[9] Ivanova, I., Arcelus, F.J. & Srinivasan, G. (1999). An Assessment of the Measurement Properties of the Human Development Index, *Social indicators research: An International and Interdisciplinary Journal for Quality-of-Life Measurement*, Vol. 46, No. 2., pp. 157–179, ISSN: 0303-8300. eISSN 1573-0921.

[10] Kovacevic, M. (2011). Review of HDI Critiques and Potential Improvements, United Nations Development Programme (UNDP), *Human Development Research Paper* 2010/33, *Available from*: http://hdr.undp.org/sites/default/files/hdrp_2010_33.pdf, *Accessed*: 2018-01-18.

[11] McGillivray, M. (1991). The Human Development Index: Yet another Redundant Composite Development Indicator, *World Development,* Vol. 19, No. 10. pp. 1461-1468. ISSN 0305-750X, *Available from:* https://pdfs.semanticscholar.org/560e/bd419cf0776e439047ada499af1bc995362c.pdf, *Accessed:* 2018-01-18.

[12] Ogwang, T. (1994). The Choice of Principle Variables for Computing the Human Development Index. *World Development*, Vol. 22, No. 12., ISSN 0305-750X, pp. 2011–2014.

[13] Soubbotina, T. P. (2004). *Beyond Economic Growth an Introduction to Sustainable Development*, The International Bank for Reconstruction and Development/THE WORLD BANK, Washington, DC. *Available from*: https://www.gfdrr.org/sites/default/files/publication/Beyond%20Economic%20Growth_0.pdf, *Accessed*: 2018-01-18.

[14] Šošić, I. (2006). *Primijenjena statistika*, Školska knjiga, ISBN 953-0-30337-8, Zagreb

[15] UNDESA, United Nations Department of Economic and Social Affairs (2015). *World Population Prospects: The 2015 Revision.* New York, *Available from:* https://esa.un.org/unpd/wpp/, *Accessed:* 2018-01-22.

[16] UNESCO, United Nations Educational, Scientific and Cultural Organization, (2016). Institute for Statistics, *Available from:* http://data.uis.unesco.org, *Accessed:* 2018-01-18.

[17] United Nations Statistics Division (2016). National Accounts Main Aggregates Database, *Available from:* http://unstats.un.org/unsd/snaama, *Accessed:* 2018-01-18.

[18] Weimann, J.; Knabe, A. & Schob, R. (2015). *Measuring Happiness: The Economics of Well-Being*, MIT Press, ISBN: 978-0-2620-2844-8, Cambridge.

[19] World Bank (2016). World Development Indicators database. Washington, DC. *Available from:* http://data.worldbank.org, *Accessed:* 2018-01-18.