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THE VOLUME OF WOOD FOREST RESOURCES IN THE EUROPEAN UNION COUNTRIES

Anna TURCZAK, The West Pomeranian Business School in Szczecin, Faculty of Economics and Computer Science, 53 Żołnierska Street, 71-210 Szczecin, Poland, aturczak@zpsb.pl

The contributions of forests to the well-being of humankind are extraordinarily vast and far-reaching. They are an important element in mitigating climate change. The aim of the paper is to determine the influence of particular factors on the diversity of the European Union countries in terms of the amount of wood forest resources compared with the country size. Two factors affecting the variable have been analysed in the paper: 1) the growing stock per 1 hectare of forest area and 2) the quotient of the forest area and the land area without inland water. Those two independent variables are directly proportional to the dependent variable, thus the higher the growing stock density and the higher the forest cover, the bigger the amount of wood forest resources of the analysed country. The causal analysis allowed to answer the question how the two factors affect the variable considered in the twenty eight countries, namely, what the direction and the strength of their influence are. The logarithmic method was used to carry out the causal analysis. The average results obtained for the entire European Union were compared with those received for each country separately and, on this basis, final conclusions were drawn. Data for 2005, 2010 and 2015 have been used for all needed calculations.

Keywords: *forest cover, forest growing stock, the European Union, wood forest resources*.

INTRODUCTION

The key term in political sciences, public administration and management sciences for the last few decades has been governance (Bevir, 2010; Held and McGrew, 2002; Hooghe and Marks, 2001; Pierre, 2000; Pierre and Peters, 2000). Etymologically, the word can be traced back to the Greek verb 'kubernan', which means 'to pilot' or 'to steer' (Kjaer, 2004). Within a short time, forest governance has become a very popular concept, both among scientists and practitioners (Arts et al., 2012). In its broadest sense the concept refers to governing or steering society towards sustainable forest management by whatever institutions, but the most common interpretation is of new modes of governing forest issues that go beyond traditional government, such as policy networks, certification schemes, social corporate responsibility, participatory forest management, markets for ecosystem services, public-private partnerships and the like (Arts and Visseren-Hamakers, 2012). The field is therefore extensive and complex.

Forest governance is also gaining ground in response to climate change. Since forests play a role as carbon sinks, they are increasingly seen as a key factor in combating climate change, making them part of the global debate on reducing greenhouse gas emissions. 'Good' forest governance from the climate change perspective is more and more driven by multilateral institutions, conventions and coalitions at supranational levels (Van Oosten and Hijweege, 2012).

To govern something in the right way means to get to know it in depth first. Furthermore, it is necessary to quantify it and to identify the factors affecting it. Following Görg (2007), Keen et al. (2005), Leeuwis and Aarts (2010), Massey (2005), Van Paassen et al. (2011), Wals et al. (2009), Wenger (2000) and others, forest learning is an important element of forest governance.

The aforementioned approach has resulted in the formulation of the aim of the paper. The aim is to determine the influence of particular factors on the diversity of the European Union countries in terms of the amount of wood forest resources in relation to the country size. Two factors affecting the variable, namely:

1) the growing stock density, which is the proportion of the volume (over bark) of standing trees to the forest land involved, and
2) the forest cover, which is the proportion of the forest area to the land area of the country (without lands under waters),
3) shall be analysed in this article.

The difference between the value of the studied variable for a given country and the value of this variable for the European Union will be defined as a deviation. Such a deviation may be negative, zero, or positive. Thus, in each case the deviation is mentioned in this paper, it shall be assumed as the deviation from the mean EU value. The logarithmic method will be used to assess the influence of the deviations of the said factors on the deviation of the volume of timber forest resources compared with the country size.

RESEARCH METHOD

The examined variable α (the wood forest resources expressed in m^3 per 1 ha of land area) can be presented as a product of factors β (the growing stock expressed in m^3 per 1 ha of forest area) and γ (the extent of forested territory expressed in percent). The value of variable α regarding the entire European Union will be the basis of reference and shall be marked by $\overline{\alpha}$. In turn, the value of this variable calculated for the *i*-th country will be denoted as α_i . Due to the fact that $\alpha_i = \beta_i \cdot \gamma_i$ and $\overline{\alpha} = \overline{\beta} \cdot \overline{\gamma}$, when dividing α_i by $\overline{\alpha}$, the obtained result is:

$$\frac{\alpha_i}{\overline{\alpha}} = \frac{\beta_i \cdot \gamma_i}{\overline{\beta} \cdot \overline{\gamma}} , \tag{1}$$

where α_i , β_i , γ_i are the values of variables α, β, γ referring to the *i*-th country and $\overline{\alpha}$, $\overline{\beta}$, $\overline{\gamma}$ are the mean values of variables α, β, γ referring to the EU. The same can be shown in a different way, namely:

$$\mathrm{A}_i = \mathrm{B}_i \cdot \Gamma_i , \tag{2}$$

where $\mathrm{A}_i = \frac{\alpha_i}{\overline{\alpha}}$, $\mathrm{B}_i = \frac{\beta_i}{\overline{\beta}}$ and $\Gamma_i = \frac{\gamma_i}{\overline{\gamma}}$.

From mathematical point of view, logarithms to any base can be taken of both sides of an equation, provided that the numbers that the logarithms have been taken of are positive (Turczak, 2016). The values of ratios A_i , B_i , and Γ_i are always greater than zero, hence the logarithms can be taken of both sides of the equation (2). The logarithm to the base *e* will be used in further calculations.

Taking the natural logarithms of both sides of the equation (2), the following expression can be obtained:

$$\ln \mathrm{A}_i = \ln(\mathrm{B}_i \cdot \Gamma_i) . \tag{3}$$

Then, using the logarithm property stipulating that the logarithm of a product of some numbers is equal to the sum of the logarithms of these numbers (Turczak, 2017), and then dividing both sides of the equation by the term $\ln \mathrm{A}_i$, the equation presented below can be derived:

$$\frac{\ln \mathrm{A}_i}{\ln \mathrm{A}_i} = \frac{\ln \mathrm{B}_i}{\ln \mathrm{A}_i} + \frac{\ln \Gamma_i}{\ln \mathrm{A}_i} , \tag{4}$$

or shown in a different way:

$$1 = \log_{\mathrm{A}_i} \mathrm{B}_i + \log_{\mathrm{A}_i} \Gamma_i , \tag{5}$$

where $\log_{\mathrm{A}_i} \mathrm{B}_i$ and $\log_{\mathrm{A}_i} \Gamma_i$ are the impacts of the deviations of β factor and γ factor on the deviation of α variable.

The next step is to multiply both sides of the equation (5) by the value of deviation calculated for variable α. This results in the expression:

$$\alpha_i - \overline{\alpha} = (\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i + (\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i , \tag{6}$$

where $\alpha_i - \overline{\alpha}$ is the total deviation of variable α and $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i$, $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i$ are the deviations of variable α caused by the deviations of factor β and factor γ.

In this article, the causal analysis will allow to answer the question how the said factors influence the deviations of wood forest resources quantities in the twenty eight countries compared to the mean volume characterizing the European Union. The research will be conducted based on data from 2005, 2010 and 2015.

RESEARCH RESULTS

Comparing the volume of wood forest resources

The interesting issue is how the EU Member States vary in terms of the amount of timber forest resources compared with the country size. Table 1 contains the relevant data.

Table 1. The amount of wood forest resources (in m^3/ha of land area without inland water)

Country	2005	Country	2010	Country	2015
Slovenia	185.7	Slovenia	201.7	Slovenia	214.2
Austria	133.7	Austria	137.0	Austria	140.2
Estonia	104.8	Estonia	108.3	Estonia	109.7
Slovakia	100.9	Slovakia	104.8	Slovakia	108.5
Germany	100.4	Germany	103.7	Latvia	106.9
Luxembourg	100.3	Luxembourg	100.3	Germany	105.0
Czech Republic	95.1	Latvia	98.7	Czech Republic	102.5
Latvia	89.4	Czech Republic	97.7	Luxembourg	100.3
Lithuania	74.1	Lithuania	78.1	Romania	83.9
Finland	71.6	Poland	77.5	Poland	83.0
Sweden	70.8	Finland	76.3	Lithuania	82.2
Croatia	68.0	Sweden	71.8	Finland	76.3
Poland	62.3	Croatia	71.8	Sweden	73.4
Romania	58.8	Romania	59.9	Croatia	73.3
Belgium	55.8	Bulgaria	59.2	Bulgaria	64.5
EU-28	**55.1**	Belgium	58.8	**EU-28**	**62.5**
Bulgaria	54.2	**EU-28**	**58.6**	Belgium	61.9
France	45.7	France	48.2	France	52.0
Italy	39.8	Italy	43.4	Italy	46.9
Hungary	36.7	Hungary	38.6	Hungary	42.1
Denmark	26.6	Denmark	27.5	Denmark	29.2
United Kingdom	22.1	United Kingdom	24.5	United Kingdom	26.9
Netherlands	20.7	Netherlands	22.5	Spain	24.1
Spain	20.5	Spain	22.3	Netherlands	24.0
Portugal	20.4	Portugal	20.5	Portugal	20.5
Greece	13.5	Greece	14.1	Ireland	17.1
Ireland	10.1	Ireland	13.2	Greece	14.8
Cyprus	9.1	Cyprus	10.8	Cyprus	12.1
Malta	2.5	Malta	2.5	Malta	2.5

Source: own computation based on Eurostat database (accessed on 10/11/2017).

The largest quantity of wood forest resources has been recorded in Slovenia – in 2015 it was on average 214.2 m^3 of the stock of living trees per each hectare of land surface of the country. Thus, the value was 151.7 m^3 larger (243% larger) than the mean value obtained for all the discussed countries. In turn, the smallest quantity was observed in Malta – in 2015 the relative measure of timber forest resources in Malta equalled only 2.5 m^3/ha of land area, i.e. 60.0 m^3 less (96% less) than the mean volume in the EU.

Comparing the forest growing stock density

The task is the assessment of the forest growing stock density in each of the studied countries in relation to the mean value in the European Union. All the data needed have been presented in Table 2.

Table 2. The volume of forest growing stock (in m^3/ha of forest area)

Country	2005	Country	2010	Country	2015
Germany	307.6	Slovenia	325.7	Slovenia	345.8
Slovenia	301.0	Germany	317.0	Germany	320.8
Luxembourg	299.1	Luxembourg	299.1	Luxembourg	299.1
Austria	286.2	Austria	292.5	Austria	298.5
Czech Republic	277.7	Czech Republic	284.0	Czech Republic	296.6
Slovakia	256.1	Slovakia	265.2	Romania	281.4
Belgium	251.1	Belgium	262.0	Belgium	274.7
Malta	228.6	Poland	254.3	Slovakia	274.3
Lithuania	219.0	Malta	228.6	Poland	269.2
Romania	211.5	Lithuania	225.7	Lithuania	236.2
Poland	207.5	Croatia	211.6	Malta	228.6
Denmark	205.0	Romania	211.5	Croatia	215.9
Croatia	202.3	Estonia	210.5	Netherlands	215.2
Estonia	202.0	Netherlands	203.5	Estonia	213.4
Netherlands	191.8	Denmark	201.0	United Kingdom	207.4

Country	2005
United Kingdom	177.8
Hungary	172.1
Latvia	168.9
Bulgaria	161.9
France	158.4
EU-28	**149.4**
Italy	134.0
Sweden	103.0
Ireland	99.8
Finland	98.4
Spain	59.4
Portugal	56.1
Cyprus	48.5
Greece	47.2

Country	2010
United Kingdom	194.5
Latvia	183.1
Hungary	175.4
Bulgaria	172.6
France	161.3
EU-28	**156.6**
Italy	141.7
Ireland	124.0
Sweden	105.0
Finland	104.4
Spain	61.4
Portugal	57.4
Cyprus	57.4
Greece	47.4

Country	2015
Denmark	204.5
Latvia	198.2
Bulgaria	182.8
Hungary	182.2
France	168.3
EU-28	**164.9**
Ireland	154.9
Italy	148.9
Sweden	106.5
Finland	104.4
Spain	65.8
Cyprus	64.4
Portugal	58.5
Greece	49.4

Source: own computation based on Eurostat database (accessed on 10/11/2017)..

The largest amount of growing stock per 1 ha of forest area has been observed in Germany (2005) and in Slovenia (2010 and 2015). In 2015 the value of the measure in Slovenia was more than twice the mean volume in the group of all the twenty eight countries. Greece recorded the lowest forest growing stock density in the examined years – the value of the measure in Greece was about 30% of the mean value obtained for the EU Member States in total.

Comparing the forest cover

The next task is to compare the forest area in proportion to the land area (excluding lakes and large rivers) in the studied countries. The necessary data have been given in Table 3.

Table 3. The extent of forested territory (in percent)

Country	2005
Finland	72.8
Sweden	68.8
Slovenia	61.7
Latvia	52.9
Estonia	51.9
Austria	46.7
Slovakia	39.4
EU-28	**36.8**
Portugal	36.3
Spain	34.4
Czech Republic	34.3
Lithuania	33.8
Croatia	33.6
Luxembourg	33.5
Bulgaria	33.5
Germany	32.6
Poland	30.0
Italy	29.7
France	28.8
Greece	28.7
Romania	27.8
Belgium	22.2
Hungary	21.3
Cyprus	18.8
Denmark	13.0
United Kingdom	12.5
Netherlands	10.8
Ireland	10.2
Malta	1.1

Country	2010
Finland	73.1
Sweden	68.4
Slovenia	61.9
Latvia	53.9
Estonia	51.4
Austria	46.8
Slovakia	39.5
EU-28	**37.4**
Spain	36.4
Portugal	35.7
Lithuania	34.6
Czech Republic	34.4
Bulgaria	34.3
Croatia	33.9
Luxembourg	33.5
Germany	32.7
Italy	30.6
Poland	30.5
France	29.9
Greece	29.8
Romania	28.3
Belgium	22.4
Hungary	22.0
Cyprus	18.8
Denmark	13.7
United Kingdom	12.6
Netherlands	11.1
Ireland	10.6
Malta	1.1

Country	2015
Finland	73.1
Sweden	68.9
Slovenia	62.0
Latvia	53.9
Estonia	51.4
Austria	46.9
Slovakia	39.6
EU-28	**37.9**
Spain	36.7
Bulgaria	35.3
Portugal	35.1
Lithuania	34.8
Czech Republic	34.5
Croatia	34.0
Luxembourg	33.5
Germany	32.7
Italy	31.5
France	30.9
Poland	30.8
Greece	29.8
Romania	29.8
Hungary	23.1
Belgium	22.5
Cyprus	18.7
Denmark	14.3
United Kingdom	13.0
Netherlands	11.2
Ireland	11.0
Malta	1.1

Source: own computation based on Eurostat database (accessed on 10/11/2017).

In the examined years, the biggest share of the forest area in the land area was noted in Finland – nearly three quarters of the land territory was forested in this country. The smallest share of the forested surface in the land area was observed in the case of Malta – in those years the level of the measure in Malta was about thirty four times lower than the mean value obtained for all the discussed countries.

Computing the impacts and impact effects of the two factors

The last task to be carried out is the evaluation of the influence of deviations of the analysed factors on the deviations of the wood forest resources quantities in relation to land territories in the given countries.

It was established in this paper that the value of the dependent variable (α) may be calculated by multiplication of 1) the living stock of standing wood per 1 ha of forest area (β) and 2) the quotient of the forest area and the land area (γ). The (2) ratio equality was derived from this relationship.

In the last part of this research the remaining stages of the logarithmic method will be performed. This will result in receiving information regarding the impact effect of the first factor and the impact effect of the second factor on the deviation of the dependent variable. The results obtained for 2005, 2010, and 2015 are shown in Table 4.

Table 4. The occurring deviations of variable α and the causes of the deviations

Country	1° / 2°	**2005**	**2010**	**2015**
Group I:	$\mathrm{B}_i > \mathbf{1}$, $\Gamma_i > \mathbf{1}$	$(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i > \mathbf{0}$, $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i > \mathbf{0}$		
Slovenia	1°	**3.374** = 2.014 · 1.675	**3.440** = 2.080 · 1.654	**3.429** = 2.097 · 1.635
	2°	(**+130.7**) = (+75.3) + (+55.4)	(**+143.0**) = (+84.8) + (+58.3)	(**+151.7**) = (+91.2) + (+60.5)
Austria	1°	**2.428** = 1.915 · 1.268	**2.337** = 1.868 · 1.251	**2.243** = 1.811 · 1.239
	2°	(**+78.6**) = (+57.6) + (+21.0)	(**+78.4**) = (+57.7) + (+20.7)	(**+77.7**) = (+57.1) + (+20.6)
Estonia	1°	**1.903** = 1.352 · 1.407	**1.847** = 1.344 · 1.374	**1.755** = 1.294 · 1.356
	2°	(**+49.7**) = (+23.3) + (+26.4)	(**+49.7**) = (+24.0) + (+25.7)	(**+47.2**) = (+21.6) + (+25.6)
Slovakia	1°	**1.832** = 1.714 · 1.069	**1.788** = 1.693 · 1.056	**1.737** = 1.663 · 1.044
	2°	(**+45.8**) = (+40.8) + (+5.1)	(**+46.2**) = (+41.9) + (+4.3)	(**+46.0**) = (+42.4) + (+3.6)
Latvia	1°	**1.624** = 1.131 · 1.436	**1.684** = 1.169 · 1.440	**1.711** = 1.202 · 1.424
	2°	(**+34.4**) = (+8.7) + (+25.7)	(**+40.1**) = (+12.0) + (+28.1)	(**+44.4**) = (+15.2) + (+29.2)
Group II:	$\mathrm{B}_i > \mathbf{1}$, $\Gamma_i < \mathbf{1}$	$(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i > \mathbf{0}$, $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i < \mathbf{0}$		
Germany	1°	**1.824** = 2.059 · 0.886	**1.769** = 2.025 · 0.874	**1.681** = 1.946 · 0.864
	2°	(**+45.4**) = (+54.5) + (−9.2)	(**+45.1**) = (+55.7) + (−10.7)	(+42.5) = (+54.5) + (−12.0)
Czech Republic	1°	**1.728** = 1.858 · 0.930	**1.667** = 1.813 · 0.919	**1.640** = 1.799 · 0.912
	2°	(**+40.1**) = (+45.4) + (−5.3)	(**+39.1**) = (+45.5) + (−6.5)	(+40.0) = (+47.5) + (−7.5)
Luxemburg	1°	**1.823** = 2.002 · 0.910	**1.712** = 1.910 · 0.896	**1.606** = 1.814 · 0.885
	2°	(**+45.3**) = (+52.4) + (−7.1)	(**+41.7**) = (+50.2) + (−8.5)	(+37.9) = (+47.6) + (−9.7)
Romania	1°	**1.068** = 1.416 · 0.754	**1.022** = 1.351 · 0.756	**1.343** = 1.706 · 0.787
	2°	(**+3.7**) = (+19.8) + (−16.1)	(**+1.3**) = (+17.8) + (−16.5)	(+21.4) = (+38.8) + (−17.4)
Poland	1°	**1.133** = 1.389 · 0.815	**1.321** = 1.624 · 0.814	**1.328** = 1.633 · 0.813
	2°	(**+7.3**) = (+19.3) + (−12.0)	(**+18.8**) = (+32.8) + (−13.9)	(**+20.5**) = (+35.4) + (−14.9)
Lithuania	1°	**1.346** = 1.466 · 0.918	**1.333** = 1.441 · 0.925	**1.315** = 1.433 · 0.918
	2°	(**+19.1**) = (+24.5) + (−5.5)	(**+19.5**) = (+24.8) + (−5.3)	(**+19.7**) = (+25.9) + (−6.1)
Croatia	1°	**1.236** = 1.354 · 0.913	**1.225** = 1.351 · 0.906	**1.173** = 1.309 · 0.896
	2°	(**+13.0**) = (+18.6) + (−5.6)	(**+13.2**) = (+19.6) + (−6.4)	(**+10.8**) = (+18.3) + (−7.4)
Bulgaria	1°	0.985 = 1.083 · 0.909	**1.010** = 1.102 · 0.916	**1.032** = 1.109 · 0.931
	2°	(−0.8) = (+4.4) + (−5.2)	(**+0.6**) = (+5.7) + (−5.2)	(**+2.0**) = (+6.6) + (−4.6)
Belgium	1°	**1.014** = 1.681 · 0.603	**1.002** = 1.673 · 0.599	0.991 = 1.666 · 0.595
	2°	(**+0.8**) = (+28.8) + (−28.0)	(**+0.1**) = (+30.2) + (−30.1)	(−0.6) = (+31.7) + (−32.3)
France	1°	0.829 = 1.060 · 0.782	0.821 = 1.030 · 0.798	0.832 = 1.021 · 0.815
	2°	(−9.4) = (+2.9) + (−12.3)	(−10.5) = (+1.6) + (−12.0)	(−10.5) = (+1.2) + (−11.7)
Hungary	1°	0.667 = 1.152 · 0.579	0.658 = 1.120 · 0.588	0.673 = 1.105 · 0.609
	2°	(−18.4) = (+6.4) + (−24.8)	(−20.0) = (+5.4) + (−25.5)	(−20.4) = (+5.2) + (−25.6)
Denmark	1°	0.484 = 1.372 · 0.353	0.469 = 1.284 · 0.365	0.467 = 1.240 · 0.376
	2°	(−28.4) = (+12.4) + (−40.8)	(−31.1) = (+10.3) + (−41.4)	(−33.3) = (+9.4) + (−42.7)
United Kingdom	1°	0.402 = 1.190 · 0.338	0.419 = 1.242 · 0.337	0.430 = 1.258 · 0.342
	2°	(−32.9) = (+6.3) + (−39.2)	(−34.1) = (+8.5) + (−42.6)	(−35.6) = (+9.7) + (−45.3)
Netherlands	1°	0.376 = 1.284 · 0.293	0.384 = 1.300 · 0.296	0.384 = 1.305 · 0.295
	2°	(−34.3) = (+8.8) + (−43.1)	(−36.1) = (+9.9) + (−46.0)	(−38.5) = (+10.7) + (−49.2)
Malta	1°	0.046 = 1.530 · 0.030	0.043 = 1.460 · 0.030	0.041 = 1.386 · 0.029
	2°	(−52.5) = (+7.3) + (−59.8)	(−56.1) = (+6.8) + (−62.8)	(−60.0) = (+6.1) + (−66.1)
Group III:	$\mathrm{B}_i < \mathbf{1}$, $\Gamma_i > \mathbf{1}$	$(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i < \mathbf{0}$, $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i > \mathbf{0}$		
Finland	1°	**1.301** = 0.659 · 1.975	**1.302** = 0.667 · 1.953	**1.222** = 0.633 · 1.929
	2°	(**+16.6**) = (−26.3) + (+42.9)	(**+17.7**) = (−27.2) + (+44.9)	(**+13.9**) = (−31.6) + (+45.5)
Sweden	1°	**1.287** = 0.690 · 1.866	**1.225** = 0.671 · 1.828	**1.174** = 0.646 · 1.819
	2°	(**+15.8**) = (−23.3) + (+39.1)	(**+13.2**) = (−26.0) + (+39.2)	(**+10.9**) = (−29.7) + (+40.5)
Group IV:	$\mathrm{B}_i < \mathbf{1}$, $\Gamma_i < \mathbf{1}$	$(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \mathrm{B}_i < \mathbf{0}$, $(\alpha_i - \overline{\alpha}) \cdot \log_{\mathrm{A}_i} \Gamma_i < \mathbf{0}$		
Italy	1°	0.723 = 0.897 · 0.805	0.740 = 0.905 · 0.817	0.751 = 0.903 · 0.831
	2°	(−15.3) = (−5.1) + (−10.2)	(−15.3) = (−5.1) + (−10.2)	(−15.6) = (−5.5) + (−10.0)
Spain	1°	0.372 = 0.398 · 0.935	0.381 = 0.392 · 0.971	0.386 = 0.399 · 0.968

Country	1° / 2°	2005	2010	2015
	2°	(−34.6) = (−32.2) + (−2.4)	(−36.3) = (−35.2) + (−1.1)	(−38.4) = (−37.0) + (−1.3)
Portugal	1°	0.371 = 0.376 · 0.986	0.350 = 0.367 · 0.954	0.328 = 0.355 · 0.926
	2°	(−34.7) = (−34.2) + (−0.5)	(−38.1) = (−36.4) + (−1.7)	(−42.0) = (−39.1) + (−2.9)
Ireland	1°	0.184 = 0.668 · 0.276	0.224 = 0.792 · 0.283	0.273 = 0.940 · 0.291
	2°	(−44.9) = (−10.7) + (−34.2)	(−45.5) = (−7.1) + (−38.4)	(−45.4) = (−2.2) + (−43.2)
Greece	1°	0.246 = 0.316 · 0.778	0.241 = 0.303 · 0.797	0.236 = 0.300 · 0.787
	2°	(−41.5) = (−34.1) + (−7.4)	(−44.5) = (−37.4) + (−7.1)	(−47.7) = (−39.8) + (−7.9)
Cyprus	1°	0.165 = 0.325 · 0.509	0.184 = 0.366 · 0.501	0.193 = 0.391 · 0.495
	2°	(−46.0) = (−28.7) + (−17.2)	(−47.9) = (−28.3) + (−19.5)	(−50.4) = (−28.8) + (−21.6)

1° – the ratio equality: $A_i = B_i \cdot \Gamma_i$ 2° – the equation of impact effects: $\alpha_i - \overline{\alpha} = (\alpha_i - \overline{\alpha}) \cdot \log_{A_i} B_i + (\alpha_i - \overline{\alpha}) \cdot \log_{A_i} \Gamma_i$

Source: own computation based on Tables 1–3.

As an example, the values obtained for Lithuania shall be interpreted. In 2015 in Lithuania the amount of wood forest resources was 82.2 m^3 per 1 ha of land area and in the EU – 62.5 m^3. Thus, in Lithuania it was 19.7 m^3 per each ha of land territory greater (i.e. 31.5% greater) than the mean value computed for the EU. The difference between the value of the measure observed in Lithuania and the analogous value calculated for the group of twenty eight countries taken together was due to the following causes:

– the volume of living standing stock per 1 ha of forest area was 43.3% higher (236.2 m^3/ha against 164.9 m^3/ha), and

– the forest cover in Lithuania was lower than in the entire European Union – it was approximately 1/10 lower (34.8 percent versus 37.9 percent).

If the growing stock density had been in Lithuania at the EU level, the amount of timber forest resources in Lithuania would have been 6.1 m^3 per each ha of land area smaller than the EU mean volume, what would have been a result solely of the lower forest cover. However, had Lithuania had the forest area in proportion to the land surface the same as it was on average in the EU countries, the volume of wood forest resources in Lithuania would have been 25.9 m^3 per each ha of land territory greater than the EU mean volume, only due to the higher growing stock density.

CONCLUSIONS

Forests play a fundamental role in combating rural poverty, ensuring food security and providing decent livelihoods. They deliver vital long-term ecosystem services, such as clean air and water, conservation of biodiversity and mitigation of climate change (Global…, 2016).

The European Union accounts for approximately 5% of the world's forests and, contrary to what is happening in many other parts of the world, the forested area of the EU is slowly increasing. Socio-economically, European forests vary from small family holdings to state forests or to large estates owned by companies (Forests…, 2017).

In 2015 the EU-28 had close to 161 million hectares of forests, corresponding to 37.9% of its land area. The growing stock of timber in forests in the EU-28 totalled some 26.5 billion m^3. The task of assessing the volume of wood forest resources in individual European Union countries against the mean quantity characterizing the EU as a whole was carried out in this paper. The growing stock density and the forest cover have been adopted as the factors affecting the said variable. The causal analysis was conducted, enabling the examination of the structure of the deviations of the wood forest resources volumes in the EU Member States.

Finally, it is worth emphasizing that forests not only provide valuable timber, but also a large variety of non-timber forest products, such as food, fodder, medicines, construction materials and tools (Belcher et al., 2005; Neumann and Hirsch, 2000). These products comprise plant and animal products (Ros-Tonen, 2000). A large number of studies and reviews (e.g. Kusters et al., 2006; Ros-Tonen and Wiersum, 2005; Vedeld et al., 2007) provide insight into how non-timber forest products are used worldwide and – what is interesting – the use patterns are remarkably similar across the world. Non-timber forest products provide input to a wide range of industries, including food and beverages, pharmaceuticals, cosmetics and botanical medicines (Ros-Tonen, 2012). Thus, in the following studies, the author is going to investigate the diversity of the European Union countries in terms of the non-timber forest resources.

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