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ECO-INNOVATION PERFORMANCE AND SELECTED COMPETITIVENESS ISSUES PERCEIVED BY MANAGERS IN THE EU MEMBER STATES – A CROSS-COUNTRY ANALYSIS

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Abstract

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This paper analyzes links between eco-innovation performance and selected competitiveness issues perceived by managers in the 26 EU member states. Different dimensions of eco-innovation performance in individual EU member states were examined based on the Eco-Innovation Scoreboard. The country-specific data on selected competitiveness issues were obtained from the survey of business leaders carried out by the IMD World Competitiveness Center. The data on the Summary Innovation Index applied in the European Innovation Scoreboard were also used. The results of the cross-country analysis indicated that overall eco-innovation performance is strongly correlated with ethical practices, social responsibility of business leaders, health, safety and environmental concerns, as well as with corporate values. Moreover, it was found that the lack of pollution problems affecting economy, credibility of managers in society, environmental laws that do not hinder competitiveness of businesses, positive attitudes toward globalization in society, sustainable development being a priority in companies, and need for economic and social reforms are of particular importance in achieving better eco-innovation performance.

Keywords: eco-innovation, competitiveness, European Union

INTRODUCTION

Eco-innovation is a key area of economic activities that take account of the requirements of sustainable development, especially in its economic and environmental dimension (Baran *et al.*, 2015). For this reason, identification and analysis of eco-innovation determinants is an essential challenge, both theoretically and practically. The aim of such efforts is to assist policy-makers in planning and implementing effective instruments stimulating eco-innovations on the one hand, and entrepreneurs – in efficient management of eco-innovation processes – on the other.

Despite differences in wording, all definitions of eco-innovation embrace the environmental component and reflect its main consequences. Consequently, eco-innovation is the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organization and which results in a reduction of environmental risk, pollution and other negative impacts to relevant alternatives (Kemp and Pearson, 2008). The European Commission defines eco-innovation as any form of innovation resulting in or aiming at significant and demonstrable progress towards the goal of sustainable development, through reducing impacts on the environment, enhancing resilience to environmental pressures, or achieving a more efficient and responsible use of natural resources

(European Commission, 2011). The Eco-Innovation Observatory defines eco-innovation as the introduction of any new or significantly improved product (good or service), process, organizational change or marketing solution that reduces the use of natural resources(including materials, energy, water and land) and decreases the release of harmful substances across the whole life-cycle (EIO, 2012b).

The existing research proves that the decision to introduce eco-innovations is influenced by a variety of factors. Therefore, various approaches to eco-innovation determinants can be found in literature. Horbach *et al.* (2012) indicate four groups of the main determinants of eco-innovation: the technology push, the market pull, the regulation/policy factors and the firm-specific factors. A distinction is usually made between internal and external drivers to eco-innovation (del Río, 2009). Thus, Bossle *et al.* (2016) point out internal factors (i.e. cost savings, adoption of certification, environmental capability, environmental managerial concern, human resources, environmental leadership and culture) that companies can manage in order to adopt eco-innovation and external factors (i.e. regulatory pressures, normative pressures, market demands, changes in technology) over which companies have little or no control.

The research of del Rio *et al.* (2016) shows that some drivers play a more prominent role as specific determinants of eco-innovation, and these are public policies and internal capabilities. In addition, many drivers to general innovation are likely to be shared by eco-innovation. Consequently, policies supporting general innovation may also lead to eco-innovation. However, eco-innovation has distinctive features, which are mostly related to the double externality problem (Rennings, 2000) and the role of public policies as a main driver to these innovations. This means that policy-makers willing to promote eco-innovation should take these different drivers into account if they want not only to support innovation as such, but to foster eco-innovation in particular. Therefore, environmental and innovative policies must be considered in an integrated way.

With regard to internal capabilities which might facilitate an eco-innovative approach, top level management commitment, technological competency, financial and human resources are highly relevant. Chen *et al.* (2012) distinguish the following internal origins of eco-innovations: environmental leadership, environmental culture and environmental capability. Nevertheless, factors such as resources, competence and dynamic capabilities have so far been underrepresented in the empirical literature on eco-innovation (del Rio *et al.*, 2016). This also includes the role of general management practices, as well as managers' and employees' values, attitudes and concerns.

The above-mentioned factors can affect both the enterprise competitiveness and propensity to eco-innovate. It is worth noting, as indicated by Brunnermeier and Cohen (2003), that eco-innovations are more likely to be adopted in competitive environments. This concerns the specificity of individual sectors and industries as well as individual countries, which means that country-specific differences (e.g., management practices, values, attitudes, environmental awareness, environmental consciousness of consumers) might partly account for different eco-innovation performance. Thus, comparative cross-country studies can be of tremendous value, both from the theoretical and the practical point of view.

This paper comprises an analysis aiming to: present and compare eco-innovation performance between the EU individual member states, present and compare selected competitiveness issues perceived by managers in the EU member states and, above all, to identify the relationships between eco-innovation performance and selected competitiveness issues and determine the strength of these correlations in the countries under consideration.

MATERIALS AND METHODS

In order to achieve the goal of the research, the following data sources have been used: the Eco-Innovation Scoreboard, the World Competitiveness Yearbook and the European Innovation Scoreboard.

Overall eco-innovation performance and its different dimensions have been analyzed based on the Eco-Innovation Scoreboard (Eco-IS) and the Eco-Innovation Index (Eco-I-Index), which assess and illustrate eco-innovation performance across the EU member states. They aim at capturing different aspects of eco-innovation by applying 16 indicators grouped into five dimensions:

- E-1 – Eco-innovation inputs (comprising financial and human resources investments aiming to trigger eco-innovation activities, i.e. governments environmental and energy R & D appropriations and outlays, total R & D personnel and researchers, and total value of green early stage investments),
- E-2 – Eco-innovation activities (illustrating to what extent companies in a specific country are active in eco-innovation, i.e. firms having implemented innovation activities aiming at a reduction of material input per unit output, firms having implemented innovation activities aiming at a reduction of energy input per unit output, and ISO 14001 registered organizations),
- E-3 – Eco-innovation outputs (quantifying the outputs of eco-innovation activities in terms of eco-innovation related patents, academic literature and media coverage),

- E-4 – Resource efficiency outcomes (putting eco-innovation performance in the context of a country's resource efficiency, i.e. material productivity, water productivity, energy productivity, and GHG emissions intensity),
- E-5 – Socio-economic outcomes (illustrating to what extent eco-innovation performance generates exports of products from eco-industries, employment in eco-industries and circular economy, and revenue in eco-industries and circular economy).

The Eco-I-Index shows how well individual EU Member States perform in different dimensions of eco-innovation compared to the EU average (Giljum *et al.*, 2014).

The data on selected competitiveness issues perceived by managers have been obtained from the survey carried out by the IMD World Competitiveness Center. The IMD conducts a yearly Executive Survey to complement the statistics used in the World Competitiveness Yearbook (WCY). The survey is focused on issues fundamental for competitiveness of countries that are not easily quantifiable, for which hard data are unavailable. It is sent to top and middle managers representing a cross-section of the business community of each WCY country. The respondents assess the competitiveness issues by answering questions on a scale of 1–6. The obtained data are then converted to a 0–10 scale (IMD, 2014).

For the purpose of the analyses presented in this paper, 9 variables concerning management practices, 7 variables describing attitudes and values as well as 3 variables representing environmental issues have been selected out of 118 variables characterizing competitiveness issues within the WCY. They comprise statements as follows:

- Management practices (C-MP):
  - C-MP-1 – Adaptability of companies to market changes is high,
  - C-MP-2 – Ethical practices are implemented in companies,
  - C-MP-3 – Credibility of managers in society is strong,
  - C-MP-4 – Corporate boards supervise the management of companies effectively,
  - C-MP-5 – Auditing and accounting practices are adequately implemented in business,
  - C-MP-6 – Customer satisfaction is emphasized in companies,
  - C-MP-7 – Entrepreneurship of managers is widespread in business,
  - C-MP-8 – Social responsibility of business leaders is high,
  - C-MP-9 – Health, safety & environmental concerns are adequately addressed by management,
- Attitudes and values (C-AV):
  - C-AV-1 – Attitudes toward globalization are generally positive in your society,
  - C-AV-2 – The image abroad of your country encourages business development,
  - C-AV-3 – The national culture is open to foreign ideas
  - C-AV-4 – Flexibility and adaptability of people are high when faced with new challenges,
  - C-AV-5 – The need for economic and social reforms is generally well understood
  - C-AV-6 – Value system in your society supports competitiveness,
  - C-AV-7 – Corporate values take into account the values of employees,
- Environmental issues (C-EI):
  - C-EI-1 – Sustainable development is a priority in companies,
  - C-EI-2 – Pollution problems do not seriously affect your economy,
  - C-EI-3 – Environmental laws and compliance do not hinder the competitiveness of businesses.

The analyses also make use of the Summary Innovation Index (SII), which is a composite indicator used in the European Innovation Scoreboard (European Commission, 2016a). It measures overall innovation performance of each EU member state and distinguishes between 3 main types of indicators (Enablers, Firm activities and Outputs) and 8 innovation dimensions, capturing 25 indicators in total. The indicator is used to identify possible differences in correlations between variables describing selected competitiveness issues and indicators concerning eco-innovation and overall innovation performance.

For the purpose of this study, data on 26 EU member states have been obtained. Due to the fact that Malta and Cyprus are not covered by the WCY framework, the presented analyses do not take the two countries into account.

In order to quantify the correlations between the variables under consideration, the Pearson correlation coefficients have been applied.

RESULTS

The indicators characterizing the overall Eco-Innovation Index (Eco-I-Index) and its particular dimensions (E-1–E-5), and the Summary Innovation Index (SII) for the analyzed EU member states are presented in Tab. I.

The presented indicators show that Denmark takes the top position with regard to the overall Eco-I-Index. The next places in the overall eco-innovation performance area are taken by Finland, Ireland, Germany and Sweden, while Bulgaria, Poland and Croatia come last. Considering individual dimensions of eco-innovation performance, it should be emphasized that Denmark and Ireland have by far the greatest achievements with respect to Eco-innovation inputs (E-1). When it comes to Eco-innovation activities (E-2) and Socio-economic outcomes (E-5), the best results

I: *Indicators characterizing eco-innovation and innovation performance in the EU member states*

Country	Eco-I-Index	E-1	E-2	E-3	E-4	E-5	SII
Austria	107.78	97.64	126.00	135.51	106.80	73.05	0.591
Belgium	97.18	89.45	116.00	110.65	98.38	70.59	0.602
Bulgaria	48.62	18.77	71.00	27.48	45.70	81.13	0.242
Croatia	66.72	21.48	100.00	89.03	80.03	48.76	0.280
Czech Republic	98.68	62.83	181.00	47.38	65.71	147.32	0.434
Denmark	166.93	368.16	71.00	157.48	107.66	86.09	0.700
Estonia	79.59	78.46	129.00	52.72	47.56	100.40	0.448
Finland	140.18	182.43	152.00	190.28	76.82	120.21	0.649
France	114.84	111.44	110.00	108.08	108.49	137.83	0.568
Germany	128.64	154.14	162.00	139.95	106.85	87.29	0.632
Greece	71.98	57.16	37.00	101.21	78.18	60.88	0.364
Hungary	80.83	72.00	98.00	27.27	80.93	125.93	0.355
Ireland	133.60	310.27	135.00	64.65	104.48	62.91	0.609
Italy	105.92	74.60	118.00	116.86	115.75	101.20	0.432
Latvia	74.94	43.07	60.00	94.81	69.93	108.93	0.281
Lithuania	73.09	42.88	94.00	58.61	80.62	86.86	0.282
Luxembourg	124.04	106.14	115.00	205.14	131.46	59.94	0.598
Netherlands	98.11	66.08	77.00	106.06	124.44	108.09	0.631
Poland	58.56	39.66	54.00	58.44	62.41	76.56	0.292
Portugal	101.56	79.03	167.00	82.98	85.62	98.55	0.419
Romania	81.73	38.53	138.00	53.48	64.19	119.87	0.180
Slovakia	71.64	37.56	101.00	51.50	78.25	87.37	0.350
Slovenia	96.14	73.97	92.00	97.91	77.87	142.18	0.485
Spain	106.18	94.25	134.00	102.36	111.75	105.42	0.361
Sweden	124.49	120.93	154.00	159.74	102.38	93.05	0.704
United Kingdom	105.87	126.07	116.00	73.63	126.33	87.22	0.602

Data source: European Commission, 2016a; European Commission, 2016b

belong to the Czech Republic. Luxembourg comes first in the Eco-innovation outputs (E-3) and the Resource efficiency outcomes (E-4).

An analysis of the Summary Innovation Index (SII) indicates that Sweden, Denmark, Finland and Germany reach the best values in this area. For Romania and Bulgaria the SII is by far the lowest.

The results of the Eco-I-Index and the Summary Innovation Index prove that the same four countries, though in a slightly different order, are characterized by the highest level of both eco-innovation and general innovation of all the EU member states.

The indicators characterizing selected competitiveness issues perceived by top and middle managers in the EU member states under analysis are presented in Tab. II (i.e. variables concerning management practices) and Tab. III (i.e. variables describing attitudes & values and environmental issues).

Considering the opinions expressed by managers in the analyzed EU member states in response to the survey on individual selected competitiveness issues, the following categories were assessed the highest: Adaptability of companies (C-MP-1) – in Denmark, Ireland and Germany; Ethical practices (C-MP-2), Credibility of managers (C-MP-3) and Auditing and accounting practices (C-MP-5) – in Finland and Denmark; Corporate boards (C-MP-4) – in Finland and Luxembourg; Customer satisfaction (C-MP-6) – in Romania, Ireland and Poland; Entrepreneurship (C-MP-7) – in Poland, Lithuania and Estonia; Social responsibility (C-MP-8) and Sustainable development (C-EI-1) – in Denmark; Health, safety & environmental concerns (C-MP-9) – in Denmark and Sweden;

Image abroad or branding (C-AV-2) – in Germany and Ireland, Flexibility and adaptability (C-AV-4), Value system (C-AV-6), Attitudes toward globalization (C-AV-1), National culture (C-AV-3), and Need for economic and social reforms (C-AV-5) – in Ireland; Corporate values (C-AV-7) and Pollution problems (C-EI-2) – in Denmark

II: *Indicators characterizing competitiveness issues related to management practices in the EU member states*

Country	C-MP-1	C-MP-2	C-MP-3	C-MP-4	C-MP-5	C-MP-6	C-MP-7	C-MP-8	C-MP-9
Austria	6.70	7.22	6.22	6.64	7.47	7.59	6.63	6.34	7.58
Belgium	6.19	7.04	6.30	6.15	7.85	7.13	6.08	6.00	7.19
Bulgaria	3.82	3.45	3.16	4.07	4.51	6.91	5.21	3.68	4.43
Croatia	2.79	3.83	3.14	3.30	5.37	5.16	4.45	3.51	4.07
Czech Republic	5.93	5.44	5.33	5.07	6.72	6.38	6.18	5.24	5.81
Denmark	7.70	8.28	7.70	6.82	8.36	7.87	6.13	7.54	8.47
Estonia	6.74	5.89	5.57	5.72	7.72	7.75	6.95	5.33	6.36
Finland	6.35	8.44	7.41	7.14	9.12	7.33	5.80	6.94	8.04
France	4.66	7.02	6.13	5.13	7.27	6.65	5.26	5.64	6.61
Germany	7.40	8.09	5.63	6.48	8.21	7.69	6.78	6.92	7.89
Greece	4.42	4.64	4.50	5.23	5.74	6.68	5.69	4.72	5.29
Hungary	5.13	5.13	3.96	5.12	6.59	6.68	5.58	3.81	4.53
Ireland	6.04	7.79	6.98	6.88	7.23	8.13	6.72	6.38	7.87
Italy	5.88	5.23	5.35	5.06	5.81	6.54	5.03	4.95	5.88
Latvia	7.05	5.60	6.01	6.05	7.58	7.52	5.88	5.09	5.28
Lithuania	6.67	5.64	5.32	6.16	8.17	7.84	7.02	5.51	5.33
Luxembourg	5.63	7.17	6.96	6.96	7.81	7.62	6.77	6.81	7.48
Netherlands	6.49	7.85	6.35	6.05	7.31	7.14	5.75	6.47	7.54
Poland	6.50	4.39	4.42	4.75	7.04	8.12	7.14	4.41	5.19
Portugal	5.00	5.02	4.85	5.12	6.30	6.25	4.86	3.91	4.74
Romania	4.86	4.35	5.56	4.89	6.06	8.51	6.06	4.93	7.02
Slovakia	5.35	5.08	5.55	5.37	7.17	6.69	6.19	4.65	6.35
Slovenia	4.26	4.18	3.20	2.32	4.83	6.32	4.99	4.24	5.51
Spain	5.08	5.07	4.65	4.49	6.65	6.19	4.92	4.30	5.57
Sweden	7.14	8.06	6.76	6.58	8.00	7.77	5.89	6.90	8.23
UK	6.32	7.53	6.40	6.28	7.62	7.24	5.44	5.93	7.77

Data source: IMD, 2014

and Sweden; and Environmental laws (C-EI-3) – in Sweden and Ireland.

In contrast, the following categories were assessed as by far the lowest: Adaptability of companies (C-MP-1), Corporate boards (C-MP-4), Customer satisfaction (C-MP-6), Entrepreneurship (C-MP-7), Health, safety & environmental concerns (C-MP-9), Flexibility and adaptability (C-AV-4), Value system (C-AV-6) and Sustainable development (C-EI-1) – in Croatia; Auditing and accounting practices (C-MP-5) and Pollution problems (C-EI-2) – in Bulgaria; Ethical practices (C-MP-2), Credibility of managers (C-MP-3) and Social responsibility (C-MP-8) – in Bulgaria and Croatia; Attitudes toward globalization (C-AV-1) – in France; Image abroad or branding (C-AV-2) – in Greece; National culture (C-AV-3) and Need for economic and social reforms (C-AV-5) – in Croatia, France and Slovenia; Corporate values (C-AV-7) – in Poland; and Environmental laws (C-EI-3) – in Slovenia.

The correlations (based on the Pearson correlation coefficients) between indicators characterizing eco-innovation/innovation performance and selected competitiveness issues in the EU member states are presented in Tab. IV.

The correlations between the Eco-I-Index and the indicators related to the analyzed competitiveness issues turn out to be statistically significant for most variables. In particular, strong correlations have been found between the Eco-I-Index and Ethical practices ($r_{\text{Eco-I-Index \& C-MP-2}} = 0.82$), Pollution problems ($r_{\text{Eco-I-Index \& C-EI-2}} = 0.81$), Social responsibility ($r_{\text{Eco-I-Index \& C-MP-8}} = 0.79$), Health, safety & environmental concerns ($r_{\text{Eco-I-Index \& C-MP-9}} = 0.78$), and Corporate values ($r_{\text{Eco-I-Index \& C-AV-7}} = 0.78$).

For indicators characterizing individual components of the Eco-Innovation Scoreboard and the competitiveness issues under analysis, the correlations are weaker and their statistical significance is smaller.

III: *Indicators characterizing competitiveness issues related to attitudes&values and environmental issues in the EU member states*

Country	C-AV-1	C-AV-2	C-AV-3	C-AV-4	C-AV-5	C-AV-6	C-AV-7	C-EI-1	C-EI-2	C-EI-3
Austria	5.09	7.30	6.78	6.08	4,37	5.40	6.85	7.15	7.89	6.30
Belgium	5.15	5.37	6.89	5.93	4,54	5.15	6.63	6.04	6.11	4.85
Bulgaria	4.87	3.19	5.37	4.36	4,91	4.71	4.57	5.24	4.69	4.74
Croatia	3.64	4.07	4.32	3.79	3,72	3.39	4.53	3.66	6.14	5.16
Czech Republic	6.15	6.18	5.93	6.04	4,11	5.16	5.93	4.89	6.37	5.09
Denmark	7.38	7.77	6.89	7.54	6,63	6.07	7.74	7.97	8.92	7.05
Estonia	6.18	6.63	6.46	6.46	6,75	6.32	6.46	7.12	6.55	5.89
Finland	7.12	7.41	6.63	6.35	6,27	6.48	7.22	7.37	8.55	7.14
France	2.63	4.13	4.35	4.55	3,73	4.46	5.93	5.61	6.98	6.19
Germany	6.88	8.60	6.88	6.18	5,49	6.88	7.49	7.38	8.35	6.16
Greece	4.31	2.38	5.89	6.00	4,69	4.64	4.79	5.10	6.11	4.87
Hungary	3.13	3.51	5.47	4.31	4,91	4.00	4.45	4.96	6.08	6.43
Ireland	8.58	8.58	8.81	8.75	8,04	7.83	7.00	6.29	8.54	7.57
Italy	5.87	4.35	6.38	6.45	6,02	4.67	5.75	4.88	5.75	4.74
Latvia	5.65	5.93	6.15	6.74	5,80	6.29	5.89	5.26	7.93	7.05
Lithuania	5.38	5.70	6.23	6.60	5,08	5.50	5.70	4.69	6.17	6.26
Luxembourg	5.96	6.49	6.81	5.85	5,36	6.56	6.91	6.82	7.28	6.04
Netherlands	7.48	7.63	8.18	6.89	5,95	6.35	7.28	6.66	6.91	6.54
Poland	4.08	3.04	7.08	7.35	4,35	5.08	3.92	6.08	5.80	5.04
Portugal	5.51	4.85	7.72	6.43	4,71	4.85	4.82	4.80	6.86	6.40
Romania	5.19	2.83	6.03	6.67	4,41	4.63	5.13	7.75	5.24	5.06
Slovakia	5.66	5.69	6.08	6.26	4,38	5.58	5.23	5.15	6.08	5.31
Slovenia	3.70	4.93	4.44	3.94	3,76	4.06	4.69	4.67	5.90	4.65
Spain	5.53	4.97	6.77	5.81	4,11	4.81	5.05	5.53	6.90	6.44
Sweden	7.69	8.14	7.07	6.52	6,37	6.20	7.72	7.23	8.68	7.60
UK	6.75	7.49	7.09	6.70	5,75	6.88	5.93	5.18	7.54	6.04

Data source: IMD, 2014

The relationships between Eco-innovation inputs (E-1) and competitiveness issues are in most cases statistically significant and relatively strong. In particular, this concerns – in terms of the correlation strength – Pollution problems ($r_{E\text{-}1\ \&\ C\text{-}EI\text{-}2} = 0.75$), Ethical practices ($r_{E\text{-}1\ \&\ C\text{-}MP\text{-}2} = 0.70$), Social responsibility ($r_{E\text{-}1\ \&\ C\text{-}MP\text{-}8} = 0.68$), and Need for economic and social reforms ($r_{E\text{-}1\ \&\ C\text{-}AV\text{-}5} = 0.64$). Considering the relationships between Eco-innovation outputs (E-3) and competitiveness issues, the strongest correlations occur in relation to Social responsibility ($r_{E\text{-}3\ \&\ C\text{-}MP\text{-}8} = 0.70$), Corporate values ($r_{E\text{-}3\ \&\ C\text{-}AV\text{-}7} = 0.66$), Ethical practices ($r_{E\text{-}3\ \&\ C\text{-}MP\text{-}2} = 0.65$), and Pollution problems ($r_{E\text{-}3\ \&\ C\text{-}EI\text{-}2} = 0.64$). Moreover, statistically significant, mean correlations have been identified between Resource efficiency outcomes (E-4) and a few indicators related to competitiveness issues, of which – based on the relationship strength – Ethical practices ($r_{E\text{-}4\ \&\ C\text{-}MP\text{-}2} = 0.63$), Health, safety & environmental concerns ($r_{E\text{-}4\ \&\ C\text{-}MP\text{-}9} = 0.56$), and Social responsibility ($r_{E\text{-}4\ \&\ C\text{-}MP\text{-}8} = 0.55$) can be distinguished. It may come as a surprise that in relation to Eco-innovation activities (E-2) and Socio-economic outcomes (E-5) no statistically significant correlations are found with any of the analyzed variables concerning competitiveness issues.

The characteristic thing is that the analysis of correlations between the Summary Innovation Index (SII) and indicators related to the competitiveness issues under consideration indicates that the correlations are generally stronger than in the case of the Eco-I-Index. This concerns Ethical practices ($r_{SII\ \&\ C\text{-}MP\text{-}2} = 0.90$), Corporate values ($r_{SII\ \&\ C\text{-}AV\text{-}7} = 0.84$), Social responsibility ($r_{SII\ \&\ C\text{-}MP\text{-}8} = 0.83$), Health, safety & environmental concerns ($r_{SII\ \&\ C\text{-}MP\text{-}9} = 0.82$), and Image abroad or branding ($r_{SII\ \&\ C\text{-}AV\text{-}2} = 0.78$) in the first place. Only in relation to Pollution problems ($r_{Eco\text{-}I\text{-}Index\ \&\ C\text{-}EI\text{-}2} = 0.81$, $r_{SII\ \&\ C14} = 0.75$), Credibility of managers ($r_{Eco\text{-}I\text{-}Index\ \&\ C\text{-}MP\text{-}3} = 0.75$, $r_{SII\ \&\ C\text{-}MP\text{-}3} = 0.71$),

IV: *Correlation between indicators characterizing eco-innovation/innovation performance and selected competitiveness issues in the EU member states (Pearson correlation coefficients)*

Indicator	Eco-I-Index	E1	E2	E3	E4	E5	SII
C-MP-1	0.49*	0.47*	0.15	0.34	0.27	0.01	0.53**
C-MP-2	0.82***	0.70***	0.32	0.65***	0.63***	–0.06	0.90***
C-MP-3	0.75***	0.66***	0.27	0.59**	0.52**	–0.06	0.71***
C-MP-4	0.59**	0.55**	0.22	0.49*	0.43*	–0.26	0.61**
C-MP-5	0.57**	0.49*	0.26	0.50*	0.35	–0.05	0.60**
C-MP-6	0.24	0.36	0.01	0.13	0.01	–0.13	0.21
C-MP-7	0.10	0.21	0.02	0.05	–0.07	–0.23	0.17
C-MP-8	0.79***	0.68***	0.24	0.70***	0.55**	–0.11	0.83***
C-MP-9	0.78***	0.67***	0.33	0.61**	0.56**	–0.06	0.82***
C-AV-1	0.58**	0.59**	0.37	0.34	0.33	–0.16	0.55**
C-AV-2	0.70***	0.63**	0.38	0.47*	0.48*	–0.07	0.78***
C-AV-3	0.41*	0.46*	0.23	0.19	0.39*	–0.31	0.44*
C-AV-4	0.37	0.51**	0.10	0.11	0.21	–0.23	0.28
C-AV-5	0.49*	0.64***	0.09	0.23	0.21	–0.20	0.47*
C-AV-6	0.52**	0.57**	0.22	0.33	0.34	–0.21	0.58**
C-AV-7	0.78***	0.64***	0.35	0.66***	0.52**	–0.08	0.84***
C-EI-1	0.57**	0.52**	0.22	0.50*	0.19	–0.03	0.52**
C-EI-2	0.81***	0.75***	0.30	0.64***	0.50*	–0.10	0.75***
C-EI-3	0.61**	0.60**	0.24	0.38	0.36	0.01	0.51**

Note: * $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$

Environmental laws ($r_{\text{Eco-I-Index \& C-EI-3}} = 0.61$, $r_{\text{SII \& C-EI-3}} = 0.51$), Attitudes toward globalization ($r_{\text{Eco-I-Index \& C-AV-1}} = 0.58$, $r_{\text{SII \& C-AV-1}} = 0.55$), Sustainable development ($r_{\text{Eco-I-Index \& C-EI-1}} = 0.57$, $r_{\text{SII \& C-EI-1}} = 0.52$), and Need for economic and social reforms ($r_{\text{Eco-I-Index \& C-AV-5}} = 0.49$, $r_{\text{SII \& C-AV-5}} = 0.47$) are the correlations of the aforementioned variables with the Eco-I-Index stronger compared to those with the SII.

CONCLUSION

The main aim of the analysis presented in this paper was to identify the relationships between eco-innovation performance and selected issues taken into consideration while making an assessment of competitiveness of individual countries.

The analysis results indicate that statistically significant and strong correlations occur between indicators characterizing eco-innovation performance in the 26 EU member states and indicators describing the perception of selected competitiveness issues by business leaders in those countries. In particular, the presented cross-country analysis shows that: the more ethical practices are implemented in companies, the higher the business leaders' social responsibility, the more adequately health, safety & environmental concerns are addressed by the management and the more corporate values take account of the employees' values – the higher overall eco-innovation performance is achieved. The analysis also indicates that the relationships between indicators characterizing competitiveness issues and overall innovation performance are even stronger. This confirms the observations made in previous studies (del Rio *et al.*, 2016), which suggest that many drivers to general innovation are likely to be shared by eco-innovation, and that policies supporting general innovation also lead to eco-innovation.

However, it has to be emphasized that for some competitiveness issues their correlations with the Eco-I-Index turn out to be stronger than those with the SII. The identified relationships indicate that the lack of pollution problems affecting economy, high credibility of managers in the society, environmental laws that do not hinder competitiveness of businesses, positive attitudes toward globalization in society, sustainable development being a company's priority, and need for economic and social reforms are of particular importance in achieving better eco-innovation performance.

Considering the issues discussed above, it may be stated that they should be shaped both by the policy-makers involved in the development of instruments supporting eco-innovations and by the entrepreneurs deciding to implement them.

The policy-makers' activities should therefore be focused on implementing instruments that will eliminate pollution problems as a part of economic and social reforms, creating at the same time adequate environmental laws. According the Porter Hypothesis, properly designed environmental regulation can trigger innovation and even may partially or more than fully offset the costs of complying with them (Porter and van der Linde, 1995). It should be noted that eco-innovation differs from general innovation because it produces a double externality (Rennings, 2000). The development of eco-innovative products and services brings external benefits resulting in lower external costs compared to alternative goods and services available on the market. Unfortunately, achieving full internalization of external costs involves significant problems. For this reason, as market factors fail, eco-innovation needs political support. Consequently, there is growing evidence for the importance of "smart" and innovation-friendly framework of environmental regulation (Jaenicke, 2008). This requires instruments with appropriate stringency, flexibility and time frame that, in addition, provide economic incentives, act in combination, are based on strategic planning and goal formulation, support eco-innovation as a process and take account of different phases of eco-innovation generation (i.e. development/innovation stage and the adoption/diffusion stage). Regulatory measures needs to be supported by supply and demand measures. Supply measures should take into consideration equity support, environmental research and development, pre-commercialization, education and training for developing the human capital needed to deliver eco-innovative solutions, networking and partnerships target the development of eco-innovation and provision of essential infrastructure. Demand measures should include the shaping of environmental friendly attitudes and behaviours among customers, green public procurement, and technology transfer and know-how support (EIO, 2012a; OECD, 2009).

The entrepreneurs' task, on the other hand, is to take care for their managers' credibility and follow corporate strategies that take account of sustainable development. Thus, managerial mindset in organizations should be shaped by green organizational identity and based on environmental organizational legitimacy and widely shared system of environmental norms, beliefs, and values (Chang and Chen, 2013). Previous research shows that corporate social responsibility and sustainable development strategies have both a direct and an indirect influence, through organizational identity, on pro-environmental behavior (Gkorezis and Petridou, 2017). Moreover, green organizational creativity highly depends upon leaders and their characteristics. For example, Mittal and Dhar (2016) prove that green transformational leadership had a positive influence on green organizational identity which leads to the promotion of green creativity in the organization. Gkorezis (2015), drawing on social exchange theory, indicates that perceived organizational support positively affects employee pro-environmental behaviors. Thus, managerial support and commitment comprises significant facilitators of pro-environmentally sustainable practices (Ones and Dilchert, 2012). Furthermore, supportive behavior and decisions by the employer are likely to contribute to employees' engagement in pro-environmental behavior (Paillé and Boiral, 2013).

The conclusions concerning the correlations between the analyzed competitiveness issues and particular dimensions of eco-innovation are also interesting. The strongest relationships occur for Eco-innovation inputs and Eco-innovation outputs. This means that the stronger the intensity of selected competitiveness issues, the higher the government's environmental and energy R & D appropriations and outlays, the bigger the number of the total R & D personnel and researchers and the greater the total value of green early-stage investments. On the other hand, this also generates a bigger number of patents and academic publications related to eco-innovation.

If there are no statistically significant correlations of the analyzed competitiveness issues with Eco-innovation activities, it suggests that they have no influence on the percentage of companies that have implemented innovation activities aiming at a reduction in material input per unit output, the percentage of companies that have implemented innovation activities aiming at a reduction in energy input per unit output and the number of ISO 14001 registered organizations. Nevertheless, it has to be stressed that the percentage of companies that have implemented eco-innovation activities does not fully cover the scope and impact of eco-innovation. It seems more important how many eco-innovations are implemented, what is eco-innovation speed (i.e. firm agility to eco-innovative product launching and new environment friendly processes development) and what is eco-innovation quality (i.e. novelty and eco-efficiency of eco-innovative products and processes) rather than how many companies actually implement any eco-innovations (Ryszko, 2016). Moreover, eco-innovation number, speed and quality may indirectly result from Eco-innovation inputs and Eco-innovation outputs.

It has to be noted that the research results presented in this paper should be viewed as a preliminary stage of exploration of issues in the area under analysis. They require a more thorough identification of the problems discussed above and more complex statistical analyses are necessary to confirm the drawn conclusions. In addition, the examined relationships between the indicators analyzed herein are likely to be influenced by other variables (e.g. innovative policy, institutional structure, market structure and demand, technological characteristics, innovation path dependency etc.), differing from country to country and more research is needed to fully understand the explored interactions.

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