

Comparative study of climate change consequences in Poland and in Turkey

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Abstract: The paper presents a comparative study of basic climate change impacts' categories and analyses of climate change consequences in a structured way in relation to macroeconomic and sustainable development indicators in Poland and in Turkey. Taxonomic distance method was used to compare the basic environmental and economic aspects between the countries. The results of the comparative study of basic macroeconomic and sustainable development indicators were elaborated to provide background for the subsequently discussed identification of the mutual learning possibilities between Poland and Turkey in relation to climate adaptation and climate change mitigation actions. The comparison revealed the resemblance of the countries in many aspects so that the peer learning related to climate change adaptation and mitigation actions could be possible.

Keywords: climate change, taxonomic distance, macroeconomy, sustainable development

JEL: Q54, P52, B41, O11, E01

1. Introduction

Climate changes pose a long-term threat to the stability of the natural and human systems. As it can be derived from the EM-DAT database and IPCC reports (IPCC 2014) in various places of the world the contributions to and consequences of climate change are of different importance and magnitude. The paper analyses climate change impacts and, in a structured way with the use of a taxonomic distance method, basic macroeconomic and sustainable development indicators in Poland and in Turkey. The research goal is to compare climate change consequences and socio-economic indicators in these two different countries, also implementing a taxonomic distance

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method, in order to identify the mutual learning possibilities in relation to climate mitigation and adaptation actions.

In the presented study, first, climate change impacts and policies implemented in Poland and in Turkey were shortly discussed. Then, the applied in the study taxonomic distance method was presented. Next, the results of the comparative study of basic macroeconomic and sustainable development indicators were elaborated to provide background for the subsequently discussed identification of the mutual learning possibilities between Poland and Turkey in relation to climate adaptation and climate change mitigation actions.

2. Climate change impacts and policies in Poland and in Turkey

Although Poland and Turkey seems not to have much in common at a first glance, while considering geography, climate conditions and cultural aspects, a closer look at their geo-economic situations reveals some resemblance. Poland is the Central-Eastern European country with a moderate climate and weather influenced by both the Continental and Atlantic atmospheric conditions. Turkey, on the other hand, located within Mediterranean macro-climatic zone, at the Asia Minor Peninsula, between the Black Sea and Mediterranean Sea, has various zones of climatic conditions due to different topographical characteristics. (Iyigün et al. 2013) As Raiser et al (2016: 7-17) state “Turkey's structural and demographic potential as well as its strategic location between the markets of Europe and Asia offers attractive value proposition to investors, which could be further enhanced with improvements in business regulations and economic governance.” This statement about Turkey is also quite similar to what can be said about Poland being a bridge between the Europe's East and West. At the same time, Turkey, in terms of both area and population, is more than twice the size of Poland.

It can be said that policies and actions related to climate change are in both countries driven by the European Union's policies, goals and requirements with them being mandatory (in Poland) or implemented voluntarily (in Turkey). At the same time EU regulations and directives are allowing for a considerable level of autonomy in the implementation of the policies. Poland is the European Union Member State from the 2004 whereas Turkey is having the EU Associated Country status from the year 1963. Both countries are experiencing climate change effects to some

extent, both bearing considerable risk related to climate change in the nationally important agricultural sector. Table 1 presents more detailed comparison of selected climate change impacts in Poland and in Turkey.

Table 1: Comparison of selected climate change impacts in Poland and in Turkey

Impacts	Turkey	Poland
Temperature	The number of summer days, hot days and nights increased at the same time the number of cool days and nights decreased. Average temperature across Turkey between the years 1971-2000 was 13,20°C. Upward trend projections.	The average temperature increased in the last decades and has a prevailing steadily increasing trend.
Precipitation	The total annual precipitation trends tend to increase in the north of the country and tend to decrease in Southeast Anatolia, Mediterranean and Aegean Regions.	No distinct change in the total amount of precipitation is observed or foreseen, but its structure changes, particularly in summer, when the frequency of heavy rains and prolonged droughts increases.
Extreme weather-events and disasters	Significant increase in the number of natural disasters such as tornados, floods, lightning events, extreme temperatures and hail.	Frequency of the occurrence of weather related events increases (especially risks of floods and agricultural droughts, forests fires, lowering the groundwater levels having negative effects on wetlands and grasslands).
Fresh Water Resources	Available water: 112 billion m ³ (incl. 98 billion m ³ surface water); 3 fold increase of water consumption is foreseen by 2030. As of 2030, water stress at a rate exceeding 40% in Turkey's middle and western regions and between 20-40% in southeast and eastern regions is expected.	The renewable resources amount to about 1,600 m ³ per capita per year (about 62 million m ³ per year). Expected scarcity for next years.
Tourism	Expected decrease in seaside tourism because of extremely hot weather; decrease in winter tourism.	Poland can attract more seaside tourist thanks to warmer weather conditions; decrease in winter tourism.
Agriculture	It is estimated that there will be a decline in the yield of production in seven geographical regions in Turkey and across the country; thus the amount of production will decline; there will be changes in the production patterns in regions, the exports of wheat and sunflower will decrease and imports of corn and cotton will increase.	Focus on more climate resilient production that also strives to reach climate mitigation goals; some changes in production patterns are foreseen to maximise the yields.
Forestry	Increasing risk of forest fires due to the hotter weathers. In general increase in forests areas and their productivity.	In general increase in productivity from forests; a small increase in forest areas is planned.

Energy	Based on oil and natural gas resources; dynamic development of renewable energy sources is the set policy goal; within the last decade the energy intensity decreased.	Based on hard coal and lignite, increasing share of renewable energy sources; declining trend of energy losses in the network and intensity rates in industry; in total increasing trend in energy consumption; planned improvement in energy efficiency.
Transport	The biggest contribution from the air transport, which very important for trade and business relations.	Planned investments in more environmentally neutral transports (rail, river), development of reliable less polluting public transport, especially in the cities.
Security	Conflicts over diminished resources; risk to coastal cities is big threat; loss of territory and border disputes.	Conflicts over resources, risk to coastal cities as well as flood and drought prone areas.

Source: Own elaboration based on the Sixth National Communications of Climate Change (Republic of Turkey Ministry of Environment and Urbanization, 2016; The Ministry of Environment of Poland, 2013)

The comparison of climate impacts presented in the Table 1 reveals that the climate changes are emerging in both countries, being more immediate, persistent and visible in Turkey. In both countries economically important sectors such as agriculture or tourism are threatened by climate change, but the different extent. There are also actions taken to mitigate climate change, especially within the energy and transport sectors. A very dynamic trend is observed in Turkey towards the development of renewable energy sources while the country is also having the natural advantages with that respect.

Climate mitigation refers to permanent elimination or reduction of the long-term risk and hazards of climate change to human life and property (e.g. low carbon emission energy production). Climate adaptation is an adjustment of natural or human systems to climate change, e.g. in agriculture, infrastructure, buildings (e.g. solutions that protect you against climate negative effects, like flood protection measures or air conditioning, etc.). In Turkey, Ministry of Environment and Urbanization published "Climate Change Strategy 2010-2020". The Ministry defined mitigation plan in 3 phases (short-, medium- and long-term) for 5 sectors, which include: energy, transportation, industry, waste as well as land use, agriculture and forestry. In Poland the national strategy towards climate change prepared in 2015 is identifying main areas and relevant actions for adapting to the future climate conditions.

3. Applied comparison method

The comparison was performed in both qualitative (as presented in the previous chapter) and quantitative (by means of taxonomic distance measure) ways. The elements for comparison were selected to best feature the climate changes and related impacts. The taxonomic methods applied were used by Hellwig 1968, Pociecha et al. 1988, Grabiński et al. 1989, Nowak 1990, Borys, Walesiak 1994, Dubel 2006. The taxonomic distance was calculated with the use of Euclidean distance metric with regard to the basic national indicators, such as: population growth rate, GDP, Gross Domestic Product per capita, primary energy consumption per capita, greenhouse gas emission per capita as well as other indicators related to economy and sustainable development presented in the Table 2. These particular variables were chosen as indicators to collectively describe economic and environmental issues that climate has the influence on.

The similarities between the countries were measured based on the following formula:

$$d_{ik} = \sqrt{\sum_{j=1}^n |x_{ij} - x_{kj}|^2}$$

where:

x_{ij} - value of feature j for object i,

x_{kj} - value of feature j for object k,

4. Results of the comparative study

The results of this comparative study are presented below. They provide background for the mutual learning possibilities in relation to climate adaptation and climate change mitigation actions are presented in the next section. Taxonomic distances calculated according to Euclidean distance metric are showed in Table 3.

Table 2: Diagnostic features for taxonomic comparison between Poland and Turkey

No	Diagnostic features	Units
1	Economy	
1.1	GDP	(Billions \$)
1.2	GDP per Capita	(Thousands \$)
1.3	GDP per Capita Growth	(Annual %)
1.4	Agriculture, Value Added	(% of GDP)
1.5	Industry, Value Added	(% of GDP)
1.6	Services, Value Added	(% of GDP)
2	Demography	
2.1	Crude Rate of Population Change	(per 1000 person)
2.2	Population Ages, 0-14	(% of Total)
2.3	Population Ages, 15-64	(% of Total)
2.4	Labour Force, Female	(% of Total Labour Force)
2.5	Populations in Urban Agglomerations of more than 1 million inhabitants	(% of Total Population)
2.6	Net Migration	(Thousand people)
2.7	Mortality Rate Under-5	(per 1000 births)
3	Environment and Water	
3.1	CO ₂ Emissions per Capita	(Metric Tons)
3.2	Improved Water Source Access	(% of Population with access)
3.3	Improved Sanitation Facilities Access	(% of Population with access)
4	Energy	
4.1	Total Primary Energy Consumption per Capita	(Million Btu)
4.2	Renewable Electricity Output	(% of Total Electricity Output)
4.3	Renewable Energy Consumption	(% of Total Final Energy Consumption)
5	Agriculture	
5.1	Agricultural Land	(% of Land Area)
5.2	Arable Land	(% of Land Area)
5.3	Forest Area	(% of Land Area)
5.4	Permanent Cropland	(% of Land Area)
5.5	Cereal Yield	(Tons per hectare)

Source: selection of diagnostic features - own elaboration

The results reveal quite a lot of similarities between the analysed countries. The smaller the taxonomic distance d_{ik} , the more similar the countries are to each other. The value of GDP (1.1), the net migration (2.6) and cereal yield (5.5) are most unlike in the analysed countries and also most variable in time from all the analysed features.

Table 3: Diagnostic features for taxonomic comparison between Poland and Turkey (d_{ik})

No	2006	2007	2008	2009	2010	2011	2012	2013	2014
1	ECONOMY								
1.1	188	218	200	178	252	246	289	299	254
1.2	1.3	1.9	3.5	2.8	2.5	3.4	2.6	3	4
1.3	0.68	3.81	4.44	8.61	3.57	2.04	1.25	0.98	2.07
1.4	6.3	5.1	5.6	6.2	6.6	5.8	5.8	5.1	5.1
1.5	4.7	5.1	5.7	7.8	6.9	6.5	6.9	5.7	5.4
1.6	1.8	0	0.2	1.6	0.4	0.8	1.1	0.6	0.3
2	DEMOGRAPHY								
2.1	13.3	12.5	12.6	13.7	14.9	13.5	12	14.9	13.6
2.2	12.3	12.3	12.2	12.1	11.9	11.6	11.5	11.3	11
2.3	5.7	5.7	5.8	5.6	5.49	5	4.6	4.1	3.4
2.4	19	18.4	18.3	17.4	16.4	15.7	15.1	14.4	14.4
2.5	28.7	29.4	30.2	30.8	31.5	32	32.3	32.6	32.8
2.6	177	144	261	4	309	41	94	138	55
2.7	18.4	16.9	15.5	14.4	13.3	12.3	11.2	10.2	9.1
3	ENVIRONMENT AND WATER								
3.1	4.55	4.6	4.6	4.43	4.56	4.16	4.21	3.92	4.21
3.2	0.7	0.2	0.2	0.5	1	1.3	1.5	1.6	1.7
3.3	0.2	0.5	0.8	1	1.4	1.7	2	2.4	2.7
4	ENERGY								
4.1	44	46	47	44	45	42	45	47.18	47
4.2	23.8	28.7	22	22.6	15.6	13	13.9	71.8	17.2
4.3	8.9	9.5	8.1	7.1	5.2	4.4	4.5	82.1	2.2
5	AGRICULTURE								
5.1	0.2	1.7	0.5	0.8	0.1	0.4	3.5	1.4	2.5
5.2	10.2	8.6	10.5	10	11.3	11.7	7.6	9.5	9
5.3	16.1	16.1	16	16	15.9	15.8	15.8	15.7	15.6
5.4	2.4	2.4	2.6	2.6	2.6	2.6	2.6	2.7	2.9
5.5	607	59	890	774	694	662	464	753	548

Source: own elaboration, based on World Bank: 2015, Eurostat database, access October 2016.

Turkey is one of the twenty biggest world economies and it is also developing dynamically, despite of the world financial meltdowns. Poland is one of the EU economies that managed quite well in the unfavourable economic situation in Europe. In Turkey the population is estimated to reach about 93.50 million in the year 2050 and the society is relatively young compared to EU countries, whereas in Poland the population is foreseen to stay at the contemporary level, about 38

million people with the problem of aging society. Turkish society is about 10 years younger than Polish when the median age is concerned (almost 40 years old in Poland and about 30 years old in Turkey).

Taxonomic distance of GDP between Turkey and Poland has a slightly increasing trend as presented in the Table 1. Also, the taxonomic distance of GDP per capita has an increasing trend with some fluctuations, as depicted in Fig. 1. Main reason behind the increasing taxonomic distance is Poland's relatively high GDP growth rate and also relatively high increase of population in Turkey and decreasing population of Poland.

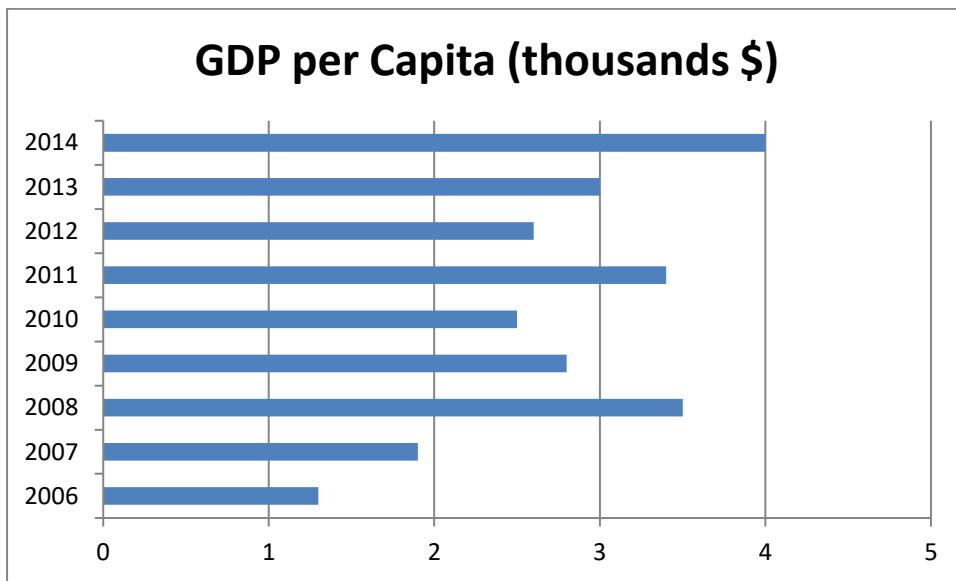


Figure 1: Taxonomic distances of GDP per capita of Turkey and Poland

Source: own elaboration, based on World Bank: 2015.

One of the most similar areas when analysing these two countries are changes in the added value in the services sector, as presented in Fig.2, and the differences are declining.

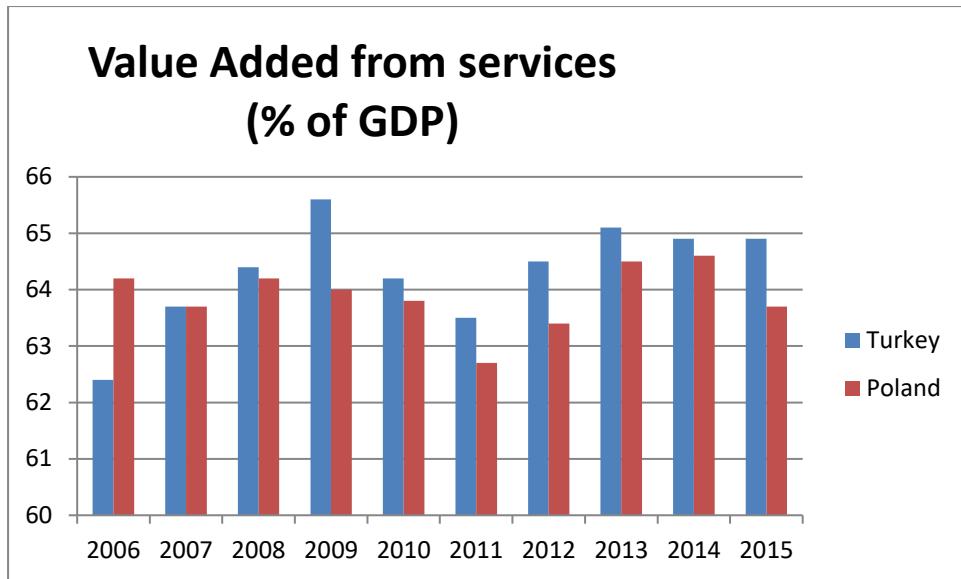


Figure 2: Value Added form Services in Turkey and Poland

Source: own elaboration, based on World Bank: 2015.

CO₂ emissions per capita of both countries have increased in the recent years, but taxonomic distances of CO₂ emissions per capita between Poland and Turkey have significantly decreased at the same time, see Fig. 3. Primary reasons for that is usage of coal for heating in both countries and the Polish efforts to control CO₂ emissions to achieve goals required by the European Union.

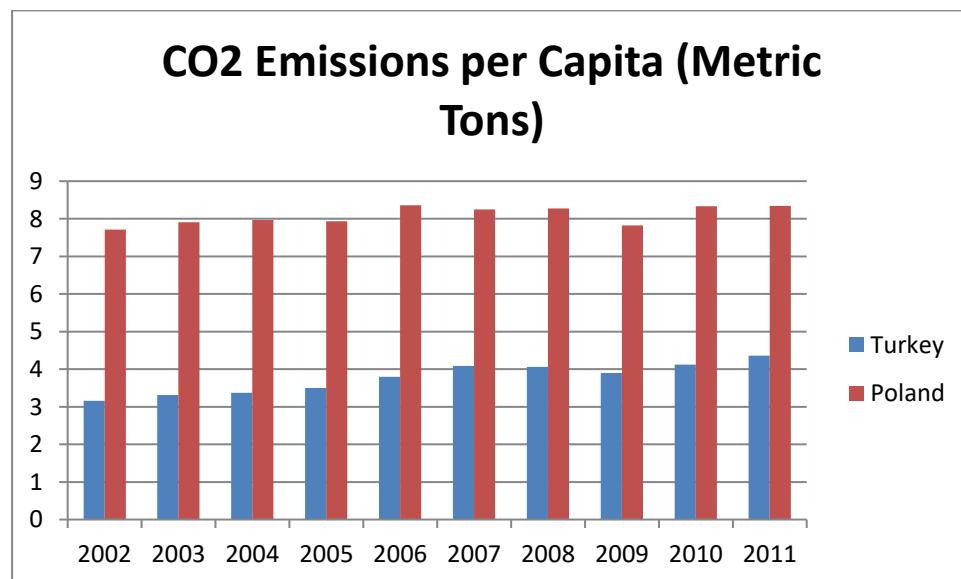


Fig. 3: CO₂ emissions per capita of Turkey and Poland

Source: own elaboration, based on World Bank: 2015.

5. Discussion of mutual learning possibilities in relation to climate adaptation and climate change mitigation actions in Poland and in Turkey

Mutual learning possibilities in relation to climate adaptation and climate change mitigation actions are discussed in this section. The Twinning studies reviewed by the World Bank (Ouchi, 2004: 1-61) give examples of peer learning of the countries with regard to institutional development. Provided the presented in this paper comparison and inspired by the examples of the twinning projects it can be said that especially in relation to mitigation and adaptation practices in the cities or in the agricultural sector, the mutual learning could be possible.

Coastal deltas with high agricultural production, wetlands and low-altitude tourism regions are the most vulnerable and threatened places in Turkey. Moreover, according to 2014 census data, 54.70% of Turkey's population live in the coastal cities. As tourism and agriculture account for about 20% of the GDP, climate changes can have significant impact of Turkish economy. In relation to the changes in agricultural sector mentioned in the Table 1, the products prices in agriculture are expected to rise. This could lead in short-term to the increase in prosperity of the producers, but also to the decrease of the consumer's and total welfare. As Turkey is applying instruments similar to common Agricultural Policy of the EU, the situation will constitute a significant burden to the Turkish public finance. The magnitude of these impacts is far smaller in Poland and the EU cohesion policy is also mitigating the negative financial effects for Poland; nevertheless the solutions applied in Turkey can constitute valuable lessons for Poland in the future, as a trend of increase in carbon retention due to land use changes is observed in Turkey. Scenario analysis revealed that up to 21% reduction in GHG emissions is possible by following the policies and plans which identified under mitigation scenario, as compared to the business as usual level by the year 2030 in Turkey. One need also account for that the considerable proportion of carbon emissions related to manufacturing could be generated outside the country. For instance, in Turkey more than 50% of the total energy footprint of Turkey's food manufacturing industry is located in various regions outside of Turkey, including the rest of the world and particularly United States and the European Union. (Kucukvar, Samadi 2015: 395-408)

Energy policy goals of both countries are very similar. They are related to the energy security and efficiency for the societal and economic development as well as growth accounting for the environmental needs. Although, this is a positive development direction, it is argued that

policies seeking to reduce GHG emissions will lead to an increase in transport costs and may foster environmental attitudes that lead tourists to change their travel patterns (WTO & UNEP: 29). On the other hand, improved efficiency in energy and transport sectors will allow saving private and social costs (Trela 2014: 5001-5006; Dubel, Trela 2014: 59-68; Trela, Dubel 2014: 69-80). Nevertheless, the likely reduction of tourism during the hotter summer months may be compensated for by promoting changes in the temporal pattern of seaside tourism, for example by encouraging visitors during the cooler months.

Another area for mutual learning concerns water management sector. Turkey and Poland are applying possible measures to reduce water stress. Applied measures include: industrial investments, works towards saving water and reusing wastewater, measures to reduce the water leakage in the supply, works on irrigation water saving. Also, the river basin-based approaches are developed and strategies in terms of fight against agricultural drought were determined and an action plans were published in both countries. The experiences exchange in that areas are desirable.

6. Conclusions

Based on the performed taxonomic analysis it can be said that there are important similarities in the macroeconomic background to allow for the mutual learning. The comparison of climate change related impacts reveals that although the countries are quite different in terms of climate conditions, many of the issues caused by the climate change are quite similar. Especially in relation to mitigation and adaptation practices within the water-energy nexus in the cities or in the agricultural sector, the mutual learning could be possible. The immediate threats of weather related events in the tourism sector must be addressed in Turkey, therefore Poland could later learn from those experiences. On the other hand, Turkey could benefit from the study of Polish experiences with implementation of the water and climate related EU policies and instruments in order to minimise the adverse effects.

Bibliography

Borys T., Walesiak M. (eds.) (1994), Zastosowania metod taksonomicznych w gospodarce. Taksonomia, z. 1, Wydawnictwo Akademii Ekonomicznej, Jelenia Góra, Wrocław.

Dubel A. (2006), Koszty i korzyści z wprowadzenia w Polsce systemu ubezpieczeń obowiązkowych od skutków powodzi, doctoral thesis, AGH, Kraków.

Dubel A., Trela M. (2014), Efektywność finansowania elektrowni fotowoltaicznych, in: eds. Czyż M., Dyduch J., Środowiskowe i finansowe uwarunkowania funkcjonowania podmiotów gospodarczych, Wydawnictwa AGH, Kraków.

EUROSTAT Database, <http://ec.europa.eu/eurostat/data/database> [19.08.2016].

EM-DAT: The CRED/OFDA International Disaster Database, www.emdat.be, Université Catholique de Louvain, Brussels, Belgium [25.08.2016].

Grabiński T. (1992), Metody taksonometrii. Wydawnictwa AE, Kraków.

Grabiński T., Wydmus S., Zeliaś A., red. (1989), Metody taksonomii numerycznej w modelowaniu zjawisk społeczno-gospodarczych, PWN, Warszawa.

Hellwig Z. (1968), Zastosowanie metody taksonomicznej do typologicznego podziału krajów ze względu na poziom ich rozwoju i struktury wykwalifikowanych kadr, „Przegląd Statystyczny”, no 4.

IPCC (2014), Mitigation of climate change. Contribution of working group III to the fifth assessment report of the intergovernmental panel on climate change, eds. Edenhofer O., Pichs-Madruga R., Sokona Y., Farahani E., Kadner S., Seyboth K., Adler A., Baum I., Brunner S., Eickemeier P., Kriemann B., Savolainen J., Schröder S., Stechow C. von, Zwickel T., Minx J.C., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

IPCC (2014). Climate Change 2014: Impacts, adaptation, and vulnerability. Part A: Global and sectoral aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, eds. Field C.B., Barros V.R., Dokken D.J., Mach K.J., Mastrandrea M.D., Bilir T.E., Chatterjee M., Ebi K.L., Estrada Y.O., Genova R.C., Girma B., Kissel E.S., Levy A.N., MacCracken S., Mastrandrea P.R., White L.L., Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Iyigün C., Türkeş M., Batmaz İ., Yozgatlıgil C., Purutçuoğlu V., Koç E. K. (2013), Clustering current climate regions of Turkey by using a multivariate statistical method, “Theoretical and Applied Climatology”, vol. 114, pp. 95-106.

Kucukvar M., Samadi H. (2015), Linking national food production to global supply chain impacts for the energy-climate challenge: the cases of the EU-27 and Turkey, “Journal of Cleaner Production”, vol. 108, Part A, pp. 395–408.

Ministry of Environment and Urbanization of Turkey (2007), Republic of Turkey climate change strategy 2010-2020.

Ministry of Environment and Urbanization of Turkey (2013), Turkey's fifth national communication under the UNFCCC.

Ministry of Environment of Poland (2013), The sixth national communication and the first biennial report to the conference of the parties to the United Nations Framework Convention on Climate Change, Warsaw.

Nowak E. (1990), Metody taksonomiczne w klasyfikacji obiektów społeczno-gospodarczych, PWE, Warszawa.

Ouchi F. (2004), Twinning as a method for institutional development: A desk review, The World Bank Institute, The World Bank, Washington D.C.

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Pociecha J., Podolec B., Sokołowski A., Zajac K. (1988), Metody taksonomiczne w badaniach społeczno-ekonomicznych, PWN, Warszawa.

Raiser M., Wes M., Yilmaz A. (2016), Beyond convergence: Poland and Turkey en route to high income, "Central Bank Review", vol. 16 no. 1, pp. 7–17.

Republic of Turkey Ministry of Environment and Urbanization (2016), Sixth national communications of climate change.

Sustainable Development Association Turkey (2012), Turkey's best practices on sustainable development and green economy, Unpublished work.

Trela M. (2014), Analiza kosztów prywatnych i społecznych dla autobusu miejskiego zasilanego elektrycznie i konwencjonalnie, „Logistyka”, no. 4, s. 5001–5006.

Trela M., Dubel A. (2014), Efektywność ekonomiczna elektrowni fotowoltaicznych oraz uniknięte koszty zewnętrzne w wyniku ich funkcjonowania. In: Środowiskowe i finansowe uwarunkowania funkcjonowania podmiotów gospodarczych, eds. Czyż M., Dyduch J., Wydawnictwa AGH, Kraków.

World Bank (2015), The little green data book, The World Bank, Washington D.C.

World Bank Database, <http://datacatalog.worldbank.org> [19.08.2016].

WTO & UNEP (2008), Climate change and tourism. Responding to global challenges, Madrid, Spain.

Analiza porównawcza skutków zmian klimatu w Polsce i w Turcji

Streszczenie

W artykule przedstawiono analizę porównawczą podstawowych kategorii skutków i konsekwencji zmian klimatycznych w uporządkowany sposób, w odniesieniu do wskaźników makroekonomicznych i zrównoważonego rozwoju w Polsce i w Turcji. Metoda odległości taksonomicznej została użyta do porównania krajów względem podstawowych aspektów dotyczących kwestii ekonomicznych oraz dotyczących środowiska naturalnego i klimatu. Wyniki analizy porównawczej podstawowych wskaźników makroekonomicznych i zrównoważonego rozwoju zostały przedstawione w celu identyfikacji możliwości wzajemnego uczenia się tych państw w kwestiach dotyczących działań łagodzących zmiany klimatyczne i adaptacji do zmian klimatu. Porównanie wykazało podobieństwa krajów, w wielu aspektach, co wskazuje, iż korzystanie z wzajemnych doświadczeń związanych z adaptacją i łagodzeniem zmian klimatu pomiędzy Polską i Turcją mogłyby być możliwe.

Słowa kluczowe: zmiany klimatu, odległość taksonomiczna, makroekonomia, zrównoważony rozwój

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