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From sustainable development to circular economy

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Abstract: This paper is a critical analysis of the sustainable development issue, especially in term of environmental sphere. Author tries to prove that even if well-off countries spend more and more money to protect environment, however the real effects of their actions are relatively week. The current model of economy cannot solve the problem with waste, CO₂ emission or extraction of natural resources because it is contrary to the interests of global economic powers. It is therefore proposed to change linear model of economy into circular, which guarantee sustainability and competitiveness simultaneously, what was proven by Spearman's rank correlation coefficient.

Keywords: sustainable development, circular economy

JEL codes: Q53, Q57

1. Introduction

Nowadays, the issue of sustainable development has been gaining more and more popular across the world. The aforementioned notion is an integral part of most policies, programs or development plans at all levels of management or education. But even if the governments, non-government organizations, institutions, entrepreneurs or consumers themselves spend billions of dollars to create sustainable world, the real effects of their actions are relatively week, especially in environmental sphere.

The objective of this paper is to show that the possibility of changing the contaminated Earth by sustainable development rules in capitalistic model is limited. The idea of circular economy, as a practical implementation of the sustainable development, seems to be the effective

way to cut down the negative externalities of global production and consumption, ensuring simultaneously economic growth and environmental sustainability.

The research herein has been conducted based on critical analysis of domestic and international literature on sustainable development and circular economy as well as of statistics published by OECD, the United Nations, Eurostat, European Commission, World Bank, World Resources Institute and Ellen MacArthur Foundations.

2. Global issues of sustainable development

The idea of sustainable development emerged in the 1960s as an answer to negative changes occurring due to population and consumption growth resulting in uncontrolled use of natural resources. The notion of sustainable development was defined for the first time in 1987 in Brundtland's Report as a “development that meets the needs of current generations without compromising the ability of future generations to meet their own needs” (United Nations, 1987). However, this definition is vague and poses many methodological problems. Generally, the sustainable development has been described usually in terms of three dimensions, as "an economic, social and environmental sphere". In 2000 we had about 200 definitions of sustainable development around (Parkin, Sommer, Uren. 2003: 133), while in 2010 the figure already exceeded 500 (Lefebvre, 2010: 18). These numbers prove that the issue of sustainable development is growing rapidly and constantly evolving, especially into durability principles.

The third - environmental sphere - plays the crucial role in these field due to the fact that it is a material basis of all human activities. This datum prompts governments all over the world to spend more money to fight against environmental devastation. Already in 1998, expenditures for environmental protection in the United States were estimated to exceed 150 billion USD annually or about 2% of GDP (Morgenster, Pizer, Shih, 1998). In European Union this founds increased from 65,651.88 mln EUR in 2004 to 87,183.99 in 2013 mln EUR (Eurostat 2013). Even China is expected to invest more than 817 billion USD in environmental protection during 2011-2015 (The Climate Group 2014). During the last United Nations Conference on Climate Change in Paris, delegates decided that developed countries intend to continue their existing collective goal to mobilize USD 100 billion per year until 2025 when a new collective goal will be set (European Commission 2016).

Nevertheless, statistics show that even if public sector, industry and specialized producers expend every year such a large amounts of money to protect environment, the results are not satisfying. A classic example is the United States - the second (after China – 28,03% of global emission CO₂) the bigger emitters of CO₂ 15,9% in 2015 (Statista 2015). But the most astonishing is that if we concern this volume per capita, we realize that Canada and the USA are two the most polluting country in the world per person, what illustrates table 1.

Table 1. Top 10 emitters of CO₂ in the world and per capita

	Top 10 emitters	Top 10 emitters per capita
1	China	Canada
2	USA	USA
3	UE	Russian Federation
4	India	Japan
5	Russian Federation	EU
6	Indonesia	Indonesia
7	Brazil	China
8	Japan	Brazil
9	Canada	Mexico
19	Mexico	India

Source: World Resources Institute.

In addition, studies show that wealthy North American emits during his life a thousand times more greenhouse gases than the poor African (Satterthwaite, 2009). Besides, since 1850 until today, 90 largest companies were in charge of more than 63% of global greenhouse gas emissions (Heede, 2014), which proves how unequal is ecological change in global world. It seems, though, that the developed countries do not always fully endorse or implement the sustainable development principles, best evidenced by the case of the USA, the largest opponent to the Kyoto protocol, or Canada that has “left Kyoto” in 2011. So it is an illusion to think that sustainable development is an appropriate system for a postindustrial economy, as evidenced by the Kuznets environmental curve, according to the rules that the richer the country, the more interested in environmental problems. The greatest incentive for any change of human attitude is profit for business or economic growth for countries, just because we are all homo oeconomicus.

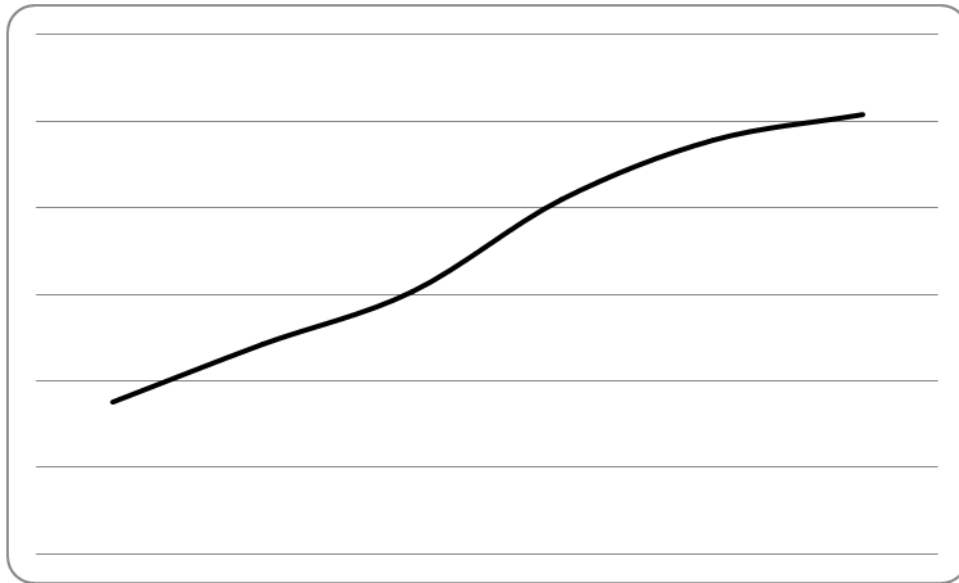
Already in 2009, during Copenhagen Summit, researchers calculated that to limit on global warming to 2°C till 2040, we need maximum rate of emissions reductions required 9% per

year (Copenhagen Diagnosis, 2009), which from the viewpoint of current economy unreal (especially in Poland – largely based on carbon economy).

The situation is even worse in terms of natural resources, especially water which is necessary for our existence. Unfortunately, more than a billion people currently live in water-scarce regions, and as many as 3.5 billion could experience water scarcity by 2025 (World Resources Institute). The more dramatic situation is in China, where along with dynamic economic growth, the water resources dropped from 2253 m³ per capita in 1997 to 1812 m³ now. What is more, the latest research shows that lack of access to clean water will be soon one of the main factors hindering the further development of the Middle Kingdom (Sobkowiak, 2011).

Another example to illustrate this point is connected with the global extraction of material resources which continues to grow, especially in the G8 and OECD countries, fully committed to sustainable development policy (OECD, 2009). The total volume of material resources extracted or harvested worldwide reached nearly 60 billion metric tonnes (Gt) per year in 2007, a 65% increase from 1980 and an estimated 8-fold increase over the last century when material extraction was less than 7 Gt per year (Krausmann, 2009: 2696-2705). It is estimated that from 1980 till 2020, global extraction will be 200% in metal ores, 81% - fossil energy carriers, 68% - biomass, 114% non-metallic minerals (OECD, 2008). After financial crisis, as the economic recovery takes hold, growth in global extraction is anticipated to return, with one projection expecting it to reach 100 Gt by 2030. On the other hand, a question emerges as to the reasons for which, in spite of long term environmental program implementation, most developed economies such as the USA or Canada continue their dependency on fossil fuels.

The same situation is about waste. By 2100, estimations show that, the growing global urban population will be producing three times as much waste as it does today (World Bank, 2013). In 2007, Americans threw out about 570 billion pounds of municipal solid waste. Compared to other nations, the United States has a record of generating waste at an alarming rate. Each American discards an average of more than 1,650 pounds of garbage every year, or around 4.6 pounds per capita daily, practically double in comparison to 1960 average of 2.7 pounds per day (Toxics Action Center). This permanent increase of waste clearly shows the figure 1.

Figure 1. Municipal Solid Waste Generation Rates in USA, 1960 – 2007 (in million tons)

Source: U.S. Environmental Protection Agency, 2007.

What is interesting, back in 1986 it was forecasted that US enterprises could easily reduce the quantity of waste generated by 50% over a 5-year period, thus cutting manufacturing costs significantly (Taylor, 1986: 48). However, this has not been done due to no regulations on that score, but most of all lack of good will.

So, what can we do to cure our planet and provide durability? The main problem is operating in neo-liberal, capitalist system, dominated by maximization of profits and destructive force of entropy. We take, use and dispose. This system is linear and by consequence unsustainable. B. Commoner already in 1972 argued that “we have broken out of the circle of life, converting its endless cycles into man-made, linear events” (Commoner, 1972: 12). There is no such thing like “reusing”, “reducing” or “recycling” build in this process. Today, the researchers propose even the term “*anthropocene*” to illustrate that our planet has entered a new epoch, with environmental crisis but also with a geological revolution of human origin, just because the Earth has tipped into a state unknown for millions of years (Bonneuil, Fressoz, 2016). Taking everything into account, it seems reasonable to change the existing unsustainable paradigms of economy into circular model.

3. Circular economy – practical implementation of sustainable development

The concept of circular economy has been around for centuries and particularly strong in locations that had limited access to financial, material or natural resources. The idea is based on the **3R** principle (Reduce, Reuse, Recycle), and describes an economy that is able to reuse its waste by moving it to the start of the production and consumption cycle to be used as components or raw materials. But the most important is the assumption that for every stakeholder (consumer or producer) any activity should be profitable. Only in this way, people will be able to change their attitude and become more homo sustiens. It is all about the creating a system of business connections at all levels (Geng, Doberstein, 2008):

- micro level: creation of eco-projects, eco-products, waste minimization, implementation of environmental management system, etc.
- macro-level: creation of eco-industrial parks,
- mezo-level: creation of eco-cities, eco-communities, eco-regions.

Building up such a network and then inter-sectoral coordination requires governments to take priority in this action. From such a perspective, a circular economy can be defined as an industrial system that is restorative or regenerative by design. It replaces the end of life concept with restoration, shifts business towards the use of renewable energy, eliminates the use of toxic chemicals, which impair re-use and aims for the elimination of waste through intelligent design of materials, products and systems and, within this, business models (Ellen MacArthur Foundation, 2012). This model decouples economic growth and development from the consumption of finite resources, that's why very often it is identified with the circular innovation. The main difference between circular and linear model is presented in table 2.

Table 2. Characterizations of linear, transition and circular economies

Linear economy	Transition economy	Circular economy
<ul style="list-style-type: none"> • Linear flows (landfill, incineration) • Efficiency; waste avoidance • No-renewable energy 	<ul style="list-style-type: none"> • Low-value circular flows (e.g. recycling, AD) • Mix of renewable and non-renewable energy 	<ul style="list-style-type: none"> • High-value circular flows (e.g. reuse, reman, cascaded value extraction for organics) • Circular business models (e.g. sharing, leasing) • Renewable energy

Source: Ellen McArthur Foundation 2015: 97.

The main advantage of the circular economy is the possibility of being equally more sustainable and competitive. The principal benefits are growing GDP by 0,8-7%, adding 0,2-3% jobs and reducing carbon emissions by 8-70% (Ellen McArthur Foundation, 2015a: 24). According to McKinsey calculations, Europe can take advantage of the impending technology revolution to create a net benefit of 1.8 trillion Euros by 2030, or 0.9 trillion Euros more than in the current linear development path (Ellen McArthur Foundation, 2015b: 37). This figures make this concept more and more popular across the world, even if such a transformation is long-term and requires a lot of reforms and funds. For instance, the European Commission adopted in 2015 the package to stimulate Europe's transition towards a circular economy by i.a.:

- funding of over 650 million Euros under Horizon 2020 and 5.5 billion Euros under the structural funds;
- actions to reduce food waste to meet the global Sustainable Development Goal to halve food waste by 2030;
- development of quality standards for secondary raw materials to increase the confidence of operators in the single market;
- measures in the eco-design working plan for 2015-2017 to promote reparability, durability and recyclability of products, in addition to energy efficiency;

According to The Economist (2015), the leader of implementation the 3R principles among OECD countries is Denmark, then Netherlands, Norway, Germany, Spain, Canada Japan, USA, Great Britain, France, Australia, Italy and Greece. In each of these countries the notion of circular economy has different context, depending on their economic, political and social expectations and possibilities. However, if we compare this ranking with IMD World Competitiveness Scoreboard from 2015, we realize that there is a strong correlation between these two values (Spearman's rank correlation coefficient = 0,6), which proves that realizing 3R rules has a positive influence on competitiveness of countries.

Table 3. Spearman's rank correlation between 3R indicator and IMD World Competitiveness Scoreboard 2015

	Country	3R indicator	IMD ranking	New IMD rangs	D	D ²
1	Denmark	1	8	4	-3	9

2	Netherlands	2	15	6	-4	16
3	Norway	3	7	3	0	0
4	Germany	4	10	5	-1	1
5	Spain	5	37	11	-6	36
6	Canada	6	5	2	4	16
7	Japan	7	27	9	-2	4
8	USA	8	1	1	7	49
9	GB	9	19	8	1	1
10	France	10	32	10	0	0
11	Australia	11	18	7	4	16
12	Italy	12	38	12	0	0
13	Greece	13	50	13	0	0
					ΣD^2	148

Source: own elaboration based on: IMD World Competitiveness Scoreboard 2015 and 3R indicator according to The Economist.

$$\text{Spearman's rho}_{2015} = 1 - \frac{6 \Sigma D^2}{N(N^2 - 1)} = 0,6$$

In Denmark – the pilot country which tasted the development potential of 3R – the overall impact of the circular economy was estimated at 7,3 billion EUR and creating at the same time 54.000 jobs. The distribution of potential economic impact created by 2035 presents table 4.

Table 4. Estimated annual value created by 2035 in Denmark (in %)

Industrialized production and 3D printing of building modules	33
Value capture in cascading bio-refineries	17
Remanufacturing and new business models	17
Sharing and multi-purposing of buildings	16
Reuse and high value recycling of components and materials	7
Reduction of avoidable food waste	7
Performance models in procurement	3
Total	100

Source: Ellen McArthur Foundation 2015: 99.

Of course, there are many barriers which hinder the 3R project. In Denmark, the critical was after all – economics barrier which is connected with capital intensive and/or uncertain payback times as well as technology – not yet fully available at scale. According to regulatory failures, the most worrying is inadequately defined legal framework that govern areas. The last but not least – social factors related to customs and habit, i.e. ingrained patterns of behavior by consumers and

business and capabilities and skills lacking either in-house or in the market as reasonable cost (Ellen McArthur Foundation 2015: 100-101). However, the potential profits flowing from investing in the circular economy outweigh the costs of the entire project.

Today even China try to follow the path of circular economy. And it is not a coincidence. For a few decades already, the Chinese economy has been growing at an unprecedented rate, unfortunately resulting in major deterioration of the environment. The consequences are most obvious in the smog-ridden cities where access to clean drinking water is a luxury. On the other hand, two third of the 1990s economic growth happened at the expense of the environment (Lévy, 2009: 56). This forces China to introduce promptly appropriate regulations, which integrate economic growth and ecology – China Circular Economy Promotion Law, adopted in 2009, based on circular economy principles both on the local and the central levels with the budget 36 bln yuan just for circular economy projects: circular agriculture, circular industry, eco-cities, eco-parks (Lévy, Aurez, 2014: 110).

4. Conclusions

The idea of sustainable development, even though correct as to its basic tenets, is not a cure-all to the global issues of scarcity of natural resources or degradation of the natural environment. The paradox of sustainable development consists of preserving the linear economic model without enabling reuse of resources characteristic for mass production, consumption or waste generation. The problem is, however, that natural resources have been used up beyond their recovery levels already, meaning that such linear paradigm is destructive and futile, not related to sustainability in the least.

The analysis revealed that countries dispend more and more money for environmental protection but these actions have not delivered the expected results. On the contrary, all major economic powers in the world (USA, Canada, China) are the biggest polluters, just because the short-term profit or economic growth play a crucial role in current economy.

The truth of the matter is that we cannot put an automatic halt to its economic growth nor to environmental degradation and only deal with the consequences later. For this reason, the circular economy is a real chance to link competitiveness with environmental protection. The research showed that there is a strong correlation between these two values (Spearman's rank

correlation coefficient = 0,6), which proves that implication of 3R rules has a positive influence on competitiveness of countries.

The example of Denmark presented that this strategy is possible and potential economic is very high. More and more countries, including China, follow the path of circular economy, as an alternative way to stay sustainable and competitive contemporaneously.

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Od zrównoważonego rozwoju do ekonomii cyrkularnej

Streszczenie

Niniejszy artykuł jest krytyczną analizą problematyki zrównoważonego rozwoju, zwłaszcza w sferze ekologii. Autorka podejmuje próbę wykazania, że nawet jeśli bogate kraje wydają coraz więcej środków na ochronę przyrody, to jednak efekty ich działań są relatywnie słabe. Współczesny, neo-liberalny model ekonomii nie rozwiązuje bowiem problemów związanych z odpadami, emisją CO₂ czy nadmiernym zużyciem naturalnych zasobów, gdyż jest to sprzeczne z interesem światowych potęg gospodarczych. Autorka proponuje zatem zmianę liniowego modelu gospodarowania na cyrkularny, który gwarantuje trwałość a jednocześnie i konkurencyjność, co zostało udowodnione testem korelacji ran Spearmana.

Słowa kluczowe: zrównoważony rozwój, ekonomia cyrkularna