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**Comparative analysis of weak and strong sustainable development models**

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**Abstract.** The concepts of weak and strong sustainable development are used in the analy­sis of sustainable development. At the scientific level, the concepts of sustai­nability and sustainable development have been tried in different ways, and over time, dif­ferent view aspects have emerged. As is generally known, sustainable development sees the best way to ensure the well-being of future generations in providing the next generation with the same resources as today. At this point, there is some discussion about the nature of the resource that needs to be protected. This discussion to­uching on the relationship between human capital and natural capital has led to the emergence of the concepts of weak and strong sustainability, i.e., models of weak and strong sustainable development.

The emergence of weak and strong sustainable development models, the basics and principles that differs them from each other, as well as the study and analysis of the arguments of the supporters of these approaches, are of great relevance. Analyzing in the article the positions of those, who support strong sustainability, it is con­c­luded that the replacement of development characterized by quantitative growth with qualitative sustainable development to increase welfare is one of the important principles of strong sus­tainable development.

**Keywords:**Sustainable development, sustainable development models, weak sustainable development, strong sustainable development, man-made capital, natural capital.

**Weak sustainable development**

The origin of the concept of weak sustainability is related to the theory of neoc­lassical economic development. The methodological features of the concept were created by Solow.

Weak sustainability approaches justify the fact that as an anthropocentric appro­ach for man-made capital is more important than natural capital. Therefore, environ­men­tal pollution by generations, where physical capital such as cars, factories and harbors or consumption of non-renewable sources exist, should not be considered a problem. It can be concluded that as long as natural capital becomes human pro­duction, there is no threat to sustainability **[Ayres, Van Den Bergh, Gowdy, 1998**].

An indicator that can be used to measure weak sustainability was proposed by Pearce and Atkinson. This indicator represents a measure based on neoclassical saving by excluding the depreciation of human capital and natural capital from the resources of a country. This indicator, later called the real reserve by Hamilton, is defined in the 𝑍 = 𝑆𝑌-δ𝑀𝑌-δ𝑁𝑌format.

Here, depreciation values of human production and natural capital are repre­sented by 𝑍 -real savings, 𝑌-national income, 𝛿𝑀- and depreciation values of human production and natural capital are shown accordingly. If this weak sustainability in­dex shown in the equation above is greater than zero, we can say that weak sus­tainability is valid for the corresponding economy.  The World Bank has adopted this indicator to measure sustainability and has begun to publish calculations of actual savings for certain regions of the world.

Weak sustainability approach has been widely criticized by the environmental economy because of the fundamental assumption that technological capital can replace natural capital. In addition, the afore-mentioned sustainability index proposed by Pearce and Atkinson has been criticized by many others. One of the most of these criticisms deserving attention is that accor­ding to the aforementioned equation, Nau­ru, the Pacific Ocean island country, is the most sus­tainable country where 80% of its natural environment has been destroyed by mining for nearly a hundred years ext­raction of rich phosphate sources [**Barbier, Burgess, Folke, 1995**, pp. 44, 45].

Using the index proposed by Ayres Pearce and Atkinson, Martínez-Alier, Cabe­za Gutes aid that industrialized North countries can be regarded as countries with high levels of sus­tai­nability, although they have destroyed a significant portion of their natural resources in the past.

Gowdy and O’Hara have criticized the view that ecosystems and extinction of species or depletion of fossil fuel do not contradict sustainability, while maintai­ning the criteria for weak sustainable development.

According to the idea of weak sustainable development, despite of certain res­trictions, growth is a key tool in providing and maintaining the quality of the environ­ment. This approach, which is consistent with the Brundtland Report, offers greater growth for all industrialized and developing countries.

The weak sustainability approach coincides with the Kuznets curve hypot­hesis promoted in the neoclassical economy. Accordingly, economic growth provi­des resour­ces to help solution of environmental problems and thus improves qua­lity through ecological regulation and growth.

Believing that exchange between sources can be made smoothly, without prob­lem, a weak sustainability approach sees no environmental threat to the end­less continuation of economic growth. Because of this approach the technological and natural capital that makes up the capital fund, can be easily exchanged with each other, the total capital fund should be maintained.

Taken into account the gross exploitation of resources today, implementation of a weak sustainable development approach first of all, can be an important step. At least, it recognizes the limitations of growth and that it is necessary to save certain capital for future without consuming it. However, the disadvantage of this approach - it does not take into account the fact that human life would be unstable if natural resources were depleted without any replacement. So, in this case, the man-made capital cannot help.

Taken into account the current situation of the world, it is believed that a deve­lopment must be ensured for environmental responsibility that does not affect the services provided by the ecosystem. From this view point, arguments for a strong sus­tainability approach, which is opposite to this approach and are more real, are accep­ted more attractive [**Daly, 1991**].

**Strong sustainable development**

A strong sustainable development approach, which is a more cautious appro­ach to the limits of economic growth, emphasizes that sustainable development can be achieved by environmental responsibility. Ensuring environmental responsi­bility is seen as one of the most important prerequisites for economic expediency and soci­al solidarity.

A strong sustainability approach argues that technological and natural capital cannot be completely interchangeable and, to some extent, are mutually com­ple­mentary. According to this approach, there is no substitute for natural capital and natural capital has become a limiting ele­ment of economic activity today. This ap­proach accepted by most environmental economists is based primarily on ensu­ring environmental sustainability [4, **Ekins, Simon, Deutch, Folke, de Groot, 2003**].

The difference between strong and weak sustainability was first suggested by Pearce, Markan­dya and Barbier, the difference between strong and weak sustaina­bility has been made even clearer with contributions by Turner and Pearce and has been increasingly accepted by ecological scientists in response to the idea of sustainability in neoclassical ecological literature.

The concept of strong sustainability is based on the concept of environmental economists living in a world where people have absolute biophysical boundaries. The natural consequence of this notion is that the environmental economy is diffe­rent from the other types of capital (physical capital (K), human capital (H) and social capital (SC). Accordingly, natural capital is primarily a life support system for living beings on earth [**Pearce, Atkinson, 1993**].

Along with providing with food, drinking water and other renewable sources for living beings, ecosystems also carry vital functions such as heritage infor­mation protection, soil protec­tion and restoration, water circulation, conversion of organic and mineral nutrients, filtration of polluters and absorption of plants, the absorption and assimilation of crops. Thus, ecosys­tems and biodiversity reveal a multifunctional framework in terms of shape and scope that other types of capital do not possess.

Secondly, the fact that irreversibility or almost impossibility of irreversibility of natural capital (quasi-irreversibility) should also be taken into account. Some types of natural capital cannot be reconstructed after the destruction. However, as in the beginning of human history, human can increase production if capital is destroyed. Neumayer, while giving ozone depletion and global warming almost as an example of irreversibility, gives the loss of biodiversity as an example of irre­ver­sibility. When the ozone layer and climate are allowed to be restored - although this process takes time when viewed from the view point of a human life - they will be able to return to their former states [**Cabeza Gutes, 1996**].

Due to the above-mentioned features of natural capital, strong sustainability goes against the likelihood that human capital can be replaced by natural capital. Human capital and man-made capital; various forms of natural capital (eg: copper-aluminum); can be significant sub­sti­tutes for renewable and non-renewable natural capital. But according to Daly, natural capital supplements human production, be­ca­use it provides raw materials and energy for production and absorbs waste produced by human capital. Therefore, it is important to keep reserves for dif­ferent types of capital separately. In this respect, strong sustainability is defined as follows:

𝐾̇≥0, ̇≥0, 𝑆𝐶̇≥0, 𝑁̇≥0.

There are two different opinions regarding a strong sustainability approach in the relevant literature. The first of these interpretations; the sum total cost of both technological and natural capital and the total cost of natural capital should be at least constant. According to this inter­pretation, strong sustainability includes weak sus­tainability. In addition, it is necessary to invest in natural capital again to deve­lop renewable sources of income from the use of non-renewable sources in order to keep the total value of natural capital reserves stable. These interpretations can be seen in the shadow project approach proposed by Pearce and others. This approach, based on cost-benefit analysis, requires that the environmental impact of the projects to be implemented is less than the environmental value of the shadow projects that will be used to compensate for the damage caused by these projects [**Serageldin, 1993]**.

The second interpretation of strong sustainability’s that the irreplaceable natural capital should be achieved by conserving the stock as a physical reserve, not as a monetary value. According to Hicksgil definition, income is a constant consumption. However, the consumption based on the destruction of natural capital should not be called income, because the consumption of natural capital is, in fact, a negative investment. If so, the recovery capacity should not be exceeded if flows from this natural capital fund are used. Thus, the ecological functions of natural capital will not be violated. An extension of this interpretation is suggested as the notion of critical natural capital (CNC). Ekins P., Simon S., Deutsch L., Folke C. and De Groot R., ba­sed on environmental assets to identify sensitive na­tural capital, has revealed three criteria based on a 1952 study by Ciriacy-Wantrup. Accordingly, these environmen­tal assets are defined by the elegant natural capital that cannot be substituted by welfare ensuring, which is irreversible and its loss causes other large-scale losses. Daly proposes a program consisting of four items for strong sustainability. The first item is that the current volume set by an eco­nomy as a measure of metabolism must be limited by the world’s carrying capa­city; second item should not only increase quantities of technological advan­ce­ments, but also ensure efficient growth; third, the rate of renewable sources collection should not exceed the renewal rate; waste disposal should not exceed the environmental absorption capacity. According to the last provision, non-renewable natural resources should not be consumed faster than the rate at which renewable substitutes are created [**Neumayer, 1999**].

**The Conclusion**

Weak and strong sustainability approaches are a continuation of the ongoing debate over the link between economic growth and the environment. The common point of approaches that aim for sustainable development is to explore what needs to be done to improve people’s well-being over the long term.  As the underlying arguments of these approaches differ, action proposals change as well. Proponents of weak sustainability, in favor of growth policies, argued that growth is indis­pensable in solution of environmental problems.

They believe that technological development, natural and human production, will not be depleted of resources and will continue to grow steadily, thanks to capital capability and people’s ability to solve problems.

Those, who support strong sustainability claim that development has the li­mits. So, ac­cording to them, limited growth is essential to meet the basic needs of the people in the world. At the same time, the replacement of development charac­teri­zed with quantitative growth by quali­tative sustainable development to improve wel­fare, is also an important principle of strong sustainable development [7 CABEZA GUTÉS, M. (1996)].

If a weak sustainability approach continues to see growth as a way out for prob­lems, sup­porters of strong sustainability often argue that economic growth should be stopped after a certain point, that is, “sustainable economies”. In addi­tion, another group defends strong sustai­nable development while supporting for limited substi­tution, and while offering for continued development by different mea­sures they de­fend the position of weak sustainability supporters.

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