Декаплінг економічного зростання від екологічної шкоди: теоретичний аспект

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Анотація. Актуальність дослідження обумовлена необхідністю поглибленого вивчення декаплінгу, як індикатора ефективності реалізації державою концепції сталого розвитку, що в умовах сучасних тенденцій світової економіки є домінуючою серед держав світу. Метою дослідження є вдосконалення та конкретизація теоретичних основ декаплінгу економічного зростання від екологічної шкоди. Методологічну основу дослідження склали методи емпіричного аналізу, синтезу, індукції, порівняння, гіпотетично-дедуктивний метод, а також системний підхід до опрацювання наукових праць українських і зарубіжних вчених, стратегічних документів екологічного характеру авторитетних міжнародних організацій, присвячених темі декаплінгу. У статті визначено три контентних ознаки декаплінгу економічного зростання від екологічної шкоди, пов'язаних з економічним ростом економічної системи та екологічною шкодою, яку вона чинить, а також двома групами факторів екологічної шкоди: ресурсними та факторами впливу на навколишнє середовище. Автором було удосконалено визначення декаплінгу на основі аналізу існуючих дефініцій даного поняття, шляхом виокремлення у них спільних контентних ознак та їх синтезу в єдине ціле. Розглянуто види декаплінгу та підходи до класифікації його ступенів: за методикою Організації з економічного співробітництва та розвитку, а також авторською методикою П. Тапіо. З'ясовано, що абсолютний декаплінг є пріоритетним ступенем у контексті реалізації державою концепції сталого розвитку, так як відповідає визначенню у ході дослідження ознакам декаплінгу та базовим засадам сталого розвитку. Запропоновано шляхи ефективного розвитку та інтенсифікації декаплінг-процесів у рамках реалізації державою концепції сталого розвитку. Практична цінність отриманих результатів дослідження пов'язана із їхнім подальшим застосуванням у процесах стратегічного планування на національному рівні, а також при розробці економічного механізму стимулювання декаплінгу економічного зростання від екологічної шкоди

Ключові слова: концепція сталого розвитку, ресурсний декаплінг, екологічна шкода, відносний декаплінг, абсолютний декаплінг, економічна система, екоінновації

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Decoupling Economic Growth from Environmental Damage: A Theoretical Aspect

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Abstract. The relevance of the study is conditioned by the need for an in-depth study of decoupling as an indicator of the state's implementation effectiveness of sustainable development, which is dominant among the states in the context of current trends in the world economy. The purpose of the study is to improve and specify the theoretical foundations of decoupling economic growth from environmental damage. The methodological basis of the research includes the empirical analysis, synthesis, induction, comparison, hypothetical-deductive methods, as well as a systems approach to processing the studies of Ukrainian and foreign researchers, strategic environmental documents of reputable international organisations devoted to decoupling. The author identifies three content features of decoupling economic growth from environmental damage related to the economic system growth and the environmental damage it causes, as well as two groups of environmental damage factors: resource and environmental impact factors. The author improved the definition of decoupling based on the analysis of existing definitions, by identifying common content features in them and synthesising them. The study considers decoupling types and approaches to the classification of its degrees: according to the methodology of the Organisation for Economic Co-operation and Development, as well as the methodology of P. Tapio. The research established that absolute decoupling is a priority step in the state's implementation of sustainable development, as it corresponds to the decoupling features defined in the course of the study and the basic principles of sustainable development. The study includes the effective development ways and intensification of decoupling within the framework of the state's implementation of sustainable development. The practical value of the research results is related to their further application in strategic planning at the national level, as well as in the development of an economic mechanism for stimulating the decoupling of economic growth from environmental damage

Keywords: sustainable development, resource decoupling, environmental damage, relative decoupling, absolute decoupling, economic system, eco-innovations

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Introduction

At present, sustainable development is on the agenda of the entire leading world community, since it is generally recognised, as declared in the final document of the UN Sustainable Development Summit, which was attended by 189 countries, within the framework of the 70th session of the UN General Assembly in New York in September 2015 “Transforming our World: The 2030 Agenda for Sustainable Development” [1], where 17 purposes and 169 tasks were approved upon implementation. Sustainable development is a scenario of safe human community development amid depletion of non-renewable natural resources, environmental pollution, the unlimited impact of anthropogenic factors on the ecosystem, and so on. It provides for a new model of the world order, which prioritises the harmonious coexistence of man and nature in an ecological economy, in order to preserve our planet for future generations and not economic growth by increasing the turnover of resources involved in production.

In such circumstances, special attention of the scientific community is paid to the peculiarities of the functioning of economic systems within the modern world economy, namely, ways to ensure their growth in conditions of limited resources and the effectiveness indicators of greening the economy. In the interaction of the economic system and the environment, according to sustainable development, decoupling of environmental damage from economic growth is provided, which implies a violation of the direct relationship between the economic system growth and its negative impact on the ecosystem. Eco-balanced sustainable development of states is ensured precisely through decoupling, improvement, and concretisation of the theoretical foundations within the subject of this study.

In English the word “decoupling” is used in various sciences, such as physics, mechanics, electronics, finance, economics, etc., denoting the gap in the relationship between processes and phenomena. In research on the economy of nature management and environmental protection, sustainable development, green or circular economy, this word is used in such phrases: “decoupling in the economy” [2; 3], “ecological decoupling” [4], “ecological and economic decoupling” [5; 6], “decoupling of economic growth and environmental impact” [7], “decoupling of economic growth and consumption” [8], and “decoupling of environmental pressure from economic growth” [9], etc. Such a variety of approaches to formulations necessitates clarification and improvement of the conceptual framework on decoupling issues within sustainable development.

The decoupling within sustainable development is covered in the studies of P. Tapio [10], M. Fisker-Kowalski [11], K.Y. Zeng and V.M. Wong [12], O.O. Veklich and B.M. Danylyshyn [13], O. Vatchenko, K. Svistun [2], O.M. Rook [14], A.V. Barzhina [15], I.M. Sotnik and L.A. Kulik [7] et al. Despite the interest of researchers

in this subject, the author considers it appropriate to deepen research in this area in order to systematise theoretical material, concretise and improve definitions, as well as the essence of basic concepts in order to apply them in both in the theoretical and practical forms.

The purpose of the study is an improvement and concretisation of the theoretical foundations of decoupling economic growth from environmental damage. This scientific research is aimed at performing the following tasks: to improve the definition of decoupling of economic growth from environmental damage based on the analysis of existing definitions, by identifying common content features and their synthesis; to study the decoupling types and degrees; to determine the priority degree of decoupling, based on its compliance with the selected decoupling features and the basic principles of sustainable development; to suggest ways to effectively develop decoupling within the framework of the state's implementation of sustainable development.

Methodology

The methodological basis of the research of decoupling economic growth from environmental damage was a systems approach to examining Ukrainian and foreign studies, which highlight this issue, as well as strategic environmentally-themed documents of reputable international organisations, in particular the report of the Organisation for Economic Co-operation and Development “Indicators to Measure Decoupling of Environmental Pressure from Economic Growth” from 2002, the methodological report of the Eco-Innovation Observatory established by the European Commission “Europe in transition: Paving the way to a green economy through eco-innovation” from 2010, the final document research services of the European Parliament “Decoupling Economic Growth from Environmental Damage” from 2020, report of the International Resource Panel “Assessing Global Resource Use. A systems approach to resource efficiency and pollution reduction” under the auspices of the United Nations Environment Programme from 2017, which allowed studying the existing approaches to determining the essence of decoupling in the context of sustainable development, the types and degrees of decoupling, which served as the theoretical basis for scientific conclusions and proposals.

In the course of the study, such general scientific methods were used as: the empirical analysis, which studied the existing definitions of decoupling and identified common content features in them; the synthesis method, which allowed formulating the author's definition of decoupling of economic growth from environmental damage by integrating certain common content features; the induction method, based on which absolute decoupling was identified as a priority step in ensuring the effective implementation of sustainable development;

the comparison method – to determine the compliance of absolute decoupling with the basic principles of sustainable development; hypothetically-deductive method at the stage of establishing ways to effectively develop decoupling in the state.

The study was conducted in two stages. Firstly, the authors specified decoupling in the context of sustainable development. Secondly, the authors defined the priority degree of decoupling within ensuring the effective implementation of sustainable development based on the comparison of decoupling features identified in the analysis of existing definitions and the basic principles of sustainable development, the conceptual framework of which is defined by the resolution adopted by the UN

General Assembly on September 25, 2015, “Transforming our World: The 2030 Agenda for Sustainable Development”.

Results and Discussion

Decoupling in the context of sustainable development

Decoupling environmental pressures from economic growth is first considered by Organisation for Economic Cooperation and Development (OECD) in the report “Indicators to Measure Decoupling of Environmental Pressure from Economic Growth” from 2002 [9] (Fig. 1), in which the term “decoupling” is identified as a gap in the relationship between “environmental damage” and “economic gain”, which became one of the main purposes of the OECD Environment Strategy for the first decade of the 21st century.

Figure 1. Analysis of existing definitions of decoupling in the context of sustainable development

At present, in the foreign and Ukrainian scientific literature, there are many definitions of this decoupling type, which are determined by researchers depending on the subject of their study. To define this concept in all possible parameters, the existing definitions of decoupling should be analysed, followed by identifying common content features between them, to then synthesise them into a single definition. The study order is demonstrated in Figure 1.

As the above analysis of the existing “decoupling” definitions presents, there are three content features in common:

1. The predominance of economic system growth over the environmental damage that it causes. Since decoupling is interpreted as a gap, there is a positive gap between the economic growth which is an objective of economic and environmental damage, as the price for such growth, i.e. decoupling occurs when the ratio of economic growth to environmental damage will have a value greater than unity.

2. Environmental damage is assessed by two groups of factors: resource factors and environmental impact. Environmental losses can occur both at the entrance to the economic system in the form of exhaustive raw materials and non-renewable energy resources used in production, and at the exit in the form of harmful emissions into the environment (greenhouse gases, industrial effluents into reservoirs, garbage, etc.).

- 3). The growing gap between economic system growth and the environmental damage it causes. Decoupling implies a steady extension of the gap between economic growth and environmental damage, which is assumed either by stopping maximising environmental losses from the economic system, or reducing them by introducing eco-innovations in production, expanding the use of alternative energy sources, recycling raw materials, garbage disposal without harm to the ecosystem, and so on.

For its part, the application of the synthesis method to the general content features defined above in the analysed definitions allows determining *decoupling* as a state of the economic system, in which its economic growth prevails over its environmental damage on the ecosystem through two groups of factors: resource and environmental impact factors with the prospect of increasing such a gap in the future.

Determining the priority degree of decoupling in ensuring the effective implementation of sustainable development

As evident from the definition, decoupling, depending on environmental damage type, is divided into two types: *decoupling non-renewable resources*, which implies a break the link between economic growth and the use of non-renewable resources in socio-production processes; *environmental impact decoupling*, which means the functioning of the economic system without releasing

harmful products of its vital activity into the ecosystem.

Notably, both types of decoupling are equally important for the sustainable development of the world community, since resource decoupling is necessary to ensure the stable functioning of the economic system in conditions of lack of resources, especially further depletion of which can hinder the development of the world economy as a whole, for example, oil, rare minerals, fertile land, etc. For its part, environmental impact decoupling is a requirement of the current catastrophically polluted environment, when toxic emissions from human activities pose a direct threat to the ecosystem, as well as to human health and life.

Furthermore, there are many approaches to determining the degree of decoupling in the economic literature. In this case, focusing on the indicators for measuring the decoupling of environmental pressure from economic growth proposed by the Organisation for Economic Co-operation and Development (OECD), according to which [9]:

- 1) *relative decoupling*, in which environmental damage increases, but not as fast as economic growth occurs.

According to the author, this effect can be achieved due to ecological and economic incentives for the rational use of natural resources within the framework of the national strategy for Sustainable Development, which includes:

- environmental taxes, which are set depending on the amount of environmental damage that the enterprise causes to the environment;

- financial and credit mechanism, which provides for soft loans to enterprises in the case of rational use of natural resources and implementation of environmental protection activities;

- pricing policy with environmental priority, which is aimed at increasing the price of products that were manufactured in environmentally harmful production, and its possible withdrawal from sale in the future in the conditions of environmentally fair market development.

- 2) *absolute decoupling*, in which environmental damage does not increase or even decrease with economic growth.

To ensure absolute decoupling, along with environmental and economic incentives, it is necessary to introduce eco-innovations on the way to organising a circular and green economy. The European Commission, in its 2010 The Eco-innovation Action Plan, defined eco-innovations: “as any form of innovation that aims or results in considerable and demonstrated progress towards achieving the sustainable development goal by reducing environmental impact, increasing resilience to environmental stress, or achieving more efficient and responsible use of natural resources” [18].

It is eco-innovations that can provide the economic system with alternative raw materials (renewable), the

maximum preservation of the product value within the production cycle, the transition from selling the product to the service model, when the service for using the product is sold, and not the product itself, waste recycling and recovery of raw materials with its reuse [19], the creation of treatment systems for industrial waste, etc.

1. *Coupling*, which means a parallel synchronous increase in environmental damage and economic growth.

2. *Negative decoupling*, which implies a situation in which environmental damage does not correlate with economic growth, that is, their development is not interrelated.

According to Petri Tapio's classification of decoupling degrees, "economic growth and environmental damage can be interrelated processes (*coupled*), delimited (*decoupled*), or negatively delineated (*negatively decoupled*). On the other hand, the growth of variables can be positive and negative, which is expressed by increasing the relationship between them (*expansive coupling*) or decreasing (*recessive coupling*)" [10]. This classification allows outlining a wide range of relationships between economic growth and environmental damage, as it has eight degrees of decoupling: *strong negative decoupling*, *weak negative decoupling*, *expansive negative decoupling*, *weak decoupling*, *strong decoupling*, *recessive decoupling*, *expansive coupling*, *recessive coupling* [10].

Comparing the methods for measuring the decoupling of economic growth from environmental damage according to the OECD and according to P. Tapio, the authors agree with the opinion of Yong Li, Hushenggao, Weisun, who prefer the Tapio approach, since it does not require binding to the base year, but focuses on changing data for different years, which allows adequately assessing the effectiveness of environmental policies implemented [20]. In addition, the Tapio method offers a wider range of assessments, which increases the objectivity of decoupling study results.

For this study, it is important to determine which degrees of decoupling from the proposed classifications fall under the previous definition based on common content features. Evidently, the desired and real goal of sustainable development implementation and therewith an effectiveness indicator of this process is to achieve absolute decoupling of economic growth from environmental damage, when the economic system becomes more closed and circular since it provides for the predominance of economic system growth over the environmental damage that it causes, as well as the growth of such a gap. According to the author, only complex constructive changes and effective state policy can lead to such a result, that is, absolute decoupling cannot be a random and spontaneous phenomenon, but a logical result of purposeful actions and, therefore, not a short-term and fragmentary, but a permanent and irreversible process.

The authors believe that the orientation of the state's sustainable development policy to absolute decoupling is appropriate since it will lead to positive changes for all components of sustainable development: economic, social, Innovative, environmental because this type of decoupling provides for the following:

- o economic growth, which means that the development of the economic component of sustainable development is ensured;

- o reducing environmental damage amid economic growth, which will have a positive impact on the environmental and social components;

- o the existence and growth of a gap between economic growth and environmental damage, which is possible only through the introduction of innovations in economic processes and in production in particular, and thus ensures the innovative component of sustainable development.

Conclusions

Effective implementation of sustainable development and the introduction of a green economy in the state require powerful innovative development with an increased number of eco-innovations in production, broad promotion of healthy food among the population, saving resources and careful attitude to the environment, the establishment of an environmentally fair market, etc. It is a comprehensive innovative approach to the implementation of sustainable development that will ensure sustainable and irreversible absolute decoupling of economic growth from environmental damage, and ensure the prosperity of the economic system in harmony with the environment.

In addition, further research on this issue will lead to increased attention during the national socio-economic strategy development to the need to achieve absolute decoupling as a result of the implementation of such a strategy. Focusing on such results will allow avoiding formalisation within setting strategic goals and making decisions on effective innovative means to achieve them. Such an emphasis in implementing sustainable development will provoke the state to give a clear message to the innovation market about the demand for eco-innovations that can ensure absolute decoupling of economic growth from environmental damage, as well as launch a mechanism for stimulating scientific and technological development in the state as a whole.

Furthermore, an important aspect in this context is to ensure the harmony of all sustainable development components in the course of achieving the absolute decoupling of the economic system's growth from the environmental damage it causes. After all, the green economy introduction, for example, should not put a burden on eco-energy consumers with multiplied tariffs,

if the population's living standard does not increase. In other words, decoupling should be accompanied by economic benefits for their deep and sustainable cultivation

in a country that has embarked on the path of sustainable development.

References

- [1] Transforming our world: The 2030 Agenda for Sustainable Development Resolution adopted by the General Assembly on 25 September 2015 / General Assembly. Retrieved from <https://www.eea.europa.eu/policy-documents/resolution-adopted-by-the-general>.
- [2] Vatchenko, O., & Svystun, K. (2019). Decoupling in economics – essence, definition and types. *Economic Scope*, 141, 5-24.
- [3] Arsakhanova, Z.A., Khazhmuradov, Z.D., & Khazhmuradova, S.D. (2019). Decapling in the economy – essence, definition and types. *Society, Economy, Management*, 4(4), 13-18.
- [4] Yeliseyeva, G. (2014). Impact assessment of the green economy development using the concept of decoupling. *Intelligence XXI*, 2, 127-135.
- [5] Noonan, E., & Vrizzi, S. (2020). Decoupling economic growth from environmental harm. Retrieved from [https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/651916/EPRS_ATA\(2020\)651916_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/651916/EPRS_ATA(2020)651916_EN.pdf).
- [6] CFI Education Inc. Decoupling. The act of creating gaps. (n.d.). Retrieved from <https://corporatefinanceinstitute.com/resources/knowledge/finance/decoupling/>.
- [7] Sotnyk, I.M., & Kulyk, L.A. (2014). Decoupling analysis of economic growth and environmental impact in the regions of Ukraine. *Economic Annals-XXI*, 7-8(2), 60-64.
- [8] Hennicke, P., Khosla, A., Dewan, Ch., Nagrath, K., Niazi, Z., O'Brien, M., Singh Thakur, M., & Wilts, H. (2014). *Decoupling economic growth from resource consumption: A transformation strategy with manifold socio-economic benefits for India and Germany*. Retrieved from https://www.giz.de/de/downloads/giz2014-en-IGEG_2_decoupling-econimic-growth.pdf.
- [9] Indicators to measure decoupling of environmental pressure from economic growth. (2002). Retrieved from <http://www.oecd.org/dataoecd/0/52/1933638.pdf>.
- [10] Tapio, P. (2005). Towards a theory of decoupling: Degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001. *Transport Policy*, 12, 137-151.
- [11] Decoupling natural resource use and environmental impacts from economic growth: A Report of the Working Group on Decoupling to the International Resource Panel / M. Fischer-Kowalski et al. 2011. Retrieved from <https://www.resourcepanel.org/reports/decoupling-natural-resource-use-and-environmental-impacts-economic-growth>.
- [12] Zeng, X.Y., & Wong, W.M. (2014). Decoupling of environmental pressures from economic activities: Evidence from Taiwan. *Global journal of Business Research*, 8(4), 41-50.
- [13] Danylyshyn, B.M., & Veklych, O.O. (2008). Decoupling effect as a factor of interrelation between economic growth and pressure on environment. *Bulletin of National Academy of Sciences of Ukraine*, 5, 12-18.
- [14] Tur, O.M. (2012). *Economic substantiation of the strategy of ecologically oriented development of the national economy* (Candidate's thesis, Sumy State University, Sumy, Ukraine).
- [15] Barzhyna, A.V. (2018). Decoupling effect as a tool for analysing the influence of economic development on environmental conditions in terms of sustainable development. *Economy and Society*, 16, 606-611.
- [16] Akulov, A.O. (2013). Decoupling effect in the industrial region (the case of the Kemerovo Oblast). *Economic and Social Changes: Facts, Trends, Forecast*, 4(28), 177-185.
- [17] Bringezu, S., Ramaswami, A., Schandl, H., O'Brien, M., Pelton, R., Acquatella, J., Ayuk, E., Chiu, A., Flanegin, R., Fry, J., Giljum, S., Hashimoto, S., Hellweg, S., Hosking, K., Hu, Y., Lenzen, M., Lieber, M., Lutter, S., Miatto, A., Singh Nagpure, A., Obersteiner, M., van Oers, L., Pfister, S., Pichler, P., Russell, A., Spini, L., Tanikawa, H., van der Voet, E., Weisz, H., West, J., Wijkman, A., Zhu, B., & Zivy, R. (2017). *Assessing global resource use: A systems approach to resource efficiency and pollution reduction 2017*. Retrieved from https://www.resourcepanel.org/sites/default/files/documents/document/media/assessing_global_resource_use_amended_130318.pdf.

- [18] Europe in transition: Paving the way to a green economy through eco-innovation. Methodological Report. Eco-innovation Observatory, Brussels. (2010). Retrieved from http://www.eco-innovation.eu/media/Methodological_Report_2010.pdf.
- [19] Korolchuk, L. (2019). Cluster model of eco-innovation development of the crossborder region: Decoupling factor. *Economic Forum*, 2, 90-94.
- [20] Li, Y., Gao, H., & Sun, W. (2020). Analysis of the decoupling relationship between China's economy and the indicators of the power industry from national and provincial aspects. *Polish Journal of Environmental Studies*, 29(6), 4183-4198.

Список використаних джерел

- [1] Transforming our world: the 2030 Agenda for Sustainable Development: Resolution adopted by the General Assembly on 25 September 2015 / General Assembly. URL: <https://www.eea.europa.eu/policy-documents/resolution-adopted-by-the-general> (accessed date: 15.01.2021).
- [2] Ватченко О.Б., Свистун К.О. Декаплінг в економіці – сутність, визначення і види. *Економічний простір*. 2019. № 141. С. 5–24.
- [3] Арсаханова З.А., Хажмурадов З.Д., Хажмурадова С.Д. Декаплинг в экономике – сущность, определение и виды. *Общество, экономика, управление*. 2019. Т. 4, № 4. С. 13–18.
- [4] Єлісєєва Г.Ю. Оцінка впливу розвитку зеленої економіки за допомогою дослідження процесів декаплінгу. *Інтелект XXI*. 2014. № 2. С. 127–135.
- [5] Noonan E., Vrizzi S. Decoupling economic growth from environmental harm. URL: [https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/651916/EPRS_ATA\(2020\)651916_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/ATAG/2020/651916/EPRS_ATA(2020)651916_EN.pdf) (accessed date: 17.01.2021).
- [6] CFI Education Inc. Decoupling. The act of creating gaps. URL: <https://corporatefinanceinstitute.com/resources/knowledge/finance/decoupling/> (accessed date: 20.01.2021).
- [7] Сотник І.М., Кулик Л.А. Декаплінг-аналіз економічного зростання та впливу на довкілля в регіонах України. *Економічний часопис-XXI*. 2014. № 7–8(2). С. 60–64.
- [8] Decoupling economic growth from resource consumption: A transformation strategy with manifold socio-economic benefits for India and Germany / P. Hennicke et al. URL: https://www.giz.de/de/downloads/giz2014-en-IGEG_2_decoupling-econimic-growth.pdf (accessed date: 19.01.2021).
- [9] Indicators to measure decoupling of environmental pressure from economic growth. Executive summary / The OECD Environment Programme. URL: <http://www.oecd.org/dataoecd/0/52/1933638.pdf> (accessed date: 15.01.2021).
- [10] Tapio P. Towards a theory of decoupling: Degrees of decoupling in the EU and the case of road traffic in Finland between 1970 and 2001. *Transport Policy*. 2005. Vol. 12. P. 137–151.
- [11] Decoupling natural resource use and environmental impacts from economic growth: A Report of the Working Group on Decoupling to the International Resource Panel / M. Fischer-Kowalski et al. 2011. URL: <https://www.resourcepanel.org/reports/decoupling-natural-resource-use-and-environmental-impacts-economic-growth> (accessed date: 22.01.2021).
- [12] Zeng X.Y., Wong W.M. Decoupling of environmental pressures from economic activities: Evidence from Taiwan. *Global Journal of Business Research*. 2014. Vol. 8, No. 4. P. 41–50.
- [13] Данилишин Б.М., Веклич О.О. Ефект декаплінгу як фактор взаємозв'язку між економічним зростанням і тиском на довкілля. *Вісник Національної Академії Наук України*. 2008. № 5. С. 12–18.
- [14] Тур О.М. Економічне обґрунтування стратегії еколого-орієнтованого розвитку національної економіки: дис. ... канд. екон. наук: 08.00.06 / Сумський державний університет. Суми, 2012. 252 с.
- [15] Баржина А.В. Эффект декаплинга как инструмент анализа воздействия экономического развития на состояние окружающей среды в контексте устойчивого развития. *Економіка і суспільство*. 2018. Вип. 16. С. 606–611.
- [16] Акулов А.О. Эффект декаплинга в индустриальном регионе (на примере Кемеровской области). *Экономические и социальные перемены: факты, тенденции, прогноз*. 2013. № 4(28). С. 177–185.
- [17] Assessing global resource use: A systems approach to resource efficiency and pollution reduction / S. Bringezu et al. 2017. URL: https://www.resourcepanel.org/sites/default/files/documents/document/media/assessing_global_resource_use_amended_130318.pdf (accessed date: 22.01.2021).

- [18] Europe in transition: Paving the way to a green economy through eco-innovation. Eco-innovation Observatory, Brussels. 2010. URL: http://www.eco-innovation.eu/media/Methodological_Report_2010.pdf (accessed date: 16.01.2021).
- [19] Корольчук Л.В. Кластерна модель еко-інноваційного розвитку транскордонного регіону: декаплінг-фактор. *Економічний форум*. 2019. № 2. С. 90–94.
- [20] Li Y., Gao H., Sun W. Analysis of the decoupling relationship between China's economy and the indicators of the power industry from national and provincial aspects. *Polish Journal of Environmental Studies*. 2020. Vol. 29, No. 6. P. 4183–4198.