BANKING REGULATION OF GREEN FINANCIAL MARKETS
БАНКІВСЬКЕ РЕГУЛЮВАННЯ ЗЕЛЕНИХ ФІНАНСОВИХ РИНКІВ

The article examines contemporary international approaches to the regulation of green financial markets from the perspective of central banks, whose regulatory activity in this field is defined by the demand to neutralize the performance of environmental hazards at the macroeconomic level. The research is aimed to illuminate the central banks' methods and levers in environmental risk management. The following instruments of green financial regulation and green financial markets development are identified and analysed: stress-testing; reserve requirements; capital requirements; creating prerequisites for the issuance, purchase and sale of green financial instruments. Based on the international theoretical and statistical data study on the specified levers, it is proven that the European Central Bank applies almost all the highlighted instruments. The development tendencies of sustainable debt instruments are assessed. It is revealed that the amount of green debt securities in central banks' portfolios is continuously growing: in the Euro area, their outstanding amount has more than doubled over 2021–2023, with their share in the amount of all debt securities having increased from 3% to 6%. Ultimately, the conducted research reflects that today central banks are only at the first stage of financial markets greening. For their further development, it is necessary to clearly specify relevant effective tools.
Key words: *central banks, environmental and climatic risks, stress-testing, green debt securities, financial market.*

У статті розглянуто сучасні світові підходи до регулювання зелених фінансових ринків з позиції центральних банків. Наразі загострюється проблема зміни навколишнього середовища, що негативно впливає не тільки на екологічну складову розвитку людства, але й на економіки країн світу. Тому метою дослідження є висвітлення методів і важелів центральних банків з управління екологічними ризиками та «озеленення» фінансових ринків. Визначено та проаналізовано такі інструменти зеленого фінансового регулювання та розвитку зелених фінансових ринків: стрес-тестування; резервні вимоги; вимоги до капіталу; створення умов для емісії та купівлі-продажу зелених фінансових інструментів на фондових ринках. На підставі аналізу міжнародних теоретичних та статистичних даних щодо означених важелів доведено, що Європейський центральний банк (ЄЦБ) використовує майже всі висвітлені інструменти. Насамперед, у 2021 році ЄЦБ провів стрес-тестування світової економіки, результати якого довели перевагу поетапного запровадження засад зеленої економіки над «тепличним» сценарієм, за якого імовірність дефолту підвищується на 7%. Досліджено питання екологізації резервних вимог на основі диференціації ставок з метою перенаправлення фінансових потоків від традиційних виробництв до «чистих» проєктів. У свою чергу, запровадження такого інструменту сприятиме створенню «зелених» нормативів капіталу комерційних банків шляхом підтримки центральними банками «зеленого фактору», якщо позиковий капітал спрямовується на розвиток ресурсозберігаючого бізнесу, та застосування підвищених вимог, якщо позикові кошти використовуються підприємствами з великими викидами забруднюючих речовин в навколишнє середовище. Оцінено тенденцію розвитку зелених боргових цінних паперів. Обсяги зелених боргових інструментів в портфелі центральних банків постійно зростають: за 2021–2023 рр. в Єврозоні їх непогашена сума зросла більше, ніж у два рази, причому їх частка у сумі всіх цінних паперів збільшилась з 3% до 6%. Означена тенденція свідчить про переосмислення проблем зміни навколишнього середовища. Отже, проведене дослідження показало, що сьогодні центральні банки знаходяться тільки на першому етапі озеленення фінансових ринків. Для подальшого їх розвитку потрібно чітко визначитися з ефективними інструментами цього процесу, підвищувати результативність регуляторної діяльності центральних банків.
Ключові слова: *центральні банки, екологічні та кліматичні ризики, стрес-тестування, зелені боргові цінні папери, фінансовий ринок.*

UDC 336.7+339.7

DOI: https://doi.org/10.32782/infrastruct78-17

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Formulation of the problem. These days, worsening of climate conditions is being increasingly recognised as an undeniable and severe process. Not only does the escalating issue of climate change raise environmental alarms all around the world but also it inflicts much harm on national economies.

Particularly, such an intricate relation between climate change and economic performance has prompted a revaluation of the role of regulators, especially central banks, in mitigating these challenges. In recognition that economic agents are often driven by short-term benefits and hence overlook long-term implications of climate change-related risks, central banks now try to guide actors on financial markets towards green transition more.

Analysis of recent research and publications. In fact, primary sources of information are to be divided into two large groups: data of a predominantly statistical nature collected and provided by the recognised international organizations, such as the UN, NASA, ECB, BIS, NGFS, UNEP, and private research.

In the framework of information retrieved from the credible international organizations, one can specifically highlight not only its factual but also methodological novelty. In particular, the European Central Bank (ECB) has recently introduced a new approach for performing a quantitative analysis of phenomena associated with the impact of climate change. It distinguishes between three groups of experimental statistical indicators encompassing

sustainable finance, carbon emissions and physical risks [1].

Regarding private research, a significant variance in its goals, objects of analysis, results, and critical argumentation is observed. In general, it can be noted that recent works have rooted many of the latest economic terms with an environmental lining: for example, green swans (derivation from so-called black swans), green finance and instruments, green banking and "greening" monetary policy. Most authors use the concept of "green" in the sense of "environmentally friendly" and "aware of climate change" here.

For instance, in the ADBI Working Paper, green central banking is interpreted as "central banking that takes account of environmental risks, including risks from climate change" [2, p. 1]. And in the Asian Journal of Sustainability and Social Responsibility, green banking altogether is described as "financing activities … with an aim to reduce greenhouse gas emissions and increase the resilience of the society to negative climate change impacts", what quite falls in line of the first declaration [3, p. 4]. Therefore, semantic unity of terms and their respective definitions is expected to be found within all scientific works on climate change considerations in central banks policies.

On the other hand, there are several questions that cause some conceptual frictions between different authors. Namely, disagreements concern the extent (contents) of a toolkit within central banks mandate to address climate change-related challenges. A common breakdown of instruments that central banks can use to mitigate environmental risks encompasses monetary policy, bank capital regulation and stress-testing components [4, p. 3]. However, some authors also include central bank soft power and guidelines, tailoring a more detailed approach [2, p. 5]. On top of that, not all instruments from these areas are equally recognised for their efficiency amongst researchers. For example, profound criticism has been inflicted upon capital regulation for "the impact of green or brown capital requirements on financial stability [being] unimportant from a macroprudential standpoint" [4, p. 33]. Furthermore, stress-testing is sometimes criticized for being inaccurate in terms of long-term predictions because this technique was originally designed for testing within the 3-5 years timeframe [5, p. 2].

Overall, the literature on climate change in the central banks' framework contains vast empirical research and is abundant with varying opinions on the matter.

Formation of the objectives of the article. The aim objective of the article is to explore the question: can central banks manage climate change problems, and if so, through what tools and methods? Delving into this inquiry is crucial not only for understanding the evolving role of central banks in the face of environmental challenges but also for interpreting the potential impact of their "greening" interventions on the financial system's capacity of navigating complexities of climate change.

Presentation of the main research material. With respect to the deteriorating effects climate change has on economy, regulatory authorities are beginning to incorporate environmental considerations into their policies. Central banks are naturally found within such regulatory authorities but they need a legal mandate to take on a proactive role in green transition. Therefore, it is high time the question whether or not central banks really have sufficient credentials to manage climate change risks is addressed.

Scholastically, central banks are public institutions which main (but not the only) activity centres around managing monetary policy in order to achieve objectives determined by their national frameworks. In the majority of cases, a core task specifically mandated to a central bank lies within acquisition and support of price stability, as evidenced by the European Central Bank (ECB), the Sveriges Riksbank (Sweden), and the Swiss National Bank. However, there are central banks that arrange more diverse responsibilities. For instance, the US Federal Reserve System pursues maximum employment and moderate long-term interest rates, aside from stable prices; the monetary policy goals of the Bank of England include delivering price stability and supporting the government policy aimed at ensuring growth and employment; social equality is one of the objectives set for the Banco Central de la República (Argentina) [6, p. 7].

Despite such a plethora of central banks' mandates, it is now being argued that their role should be interpreted to incorporate environmental considerations, indeed. This statement is supported by the surveys of central bankers conducted in 2020 and 2021. The results point that while in 2020 only 46% of the respondents believed that tackling climate change falls within central bank mandates, in 2021 this number amounted for 63% [4, p. 8].

Proceeding on this assumption, several initiatives to include climate change considerations in central banks' practice have been recently supplemented. In particular, in 2017, eight central banks and supervisors established the Network of Central Banks and Supervisors for Greening the Financial System (NGFS) aiming "to help strengthening the global response … to enhance the role of the financial system to manage risks and to mobilize capital for green and low-carbon investments in the broader context of environmentally sustainable development" [7]. In 2021, NGFS cooperated with other supranational organizations to launch the Climate Training Alliance (CTA), an online platform tailored to promote awareness and expertise amongst central

banks and supervisors [8]. So far, implementation of these projects has led to the co-development of scenario testing methodologies that allow central banks evaluate risks associated with climate change.

Another straightforward example of fostering climate change consideration within central banks credentials is found within the ECB. Due to climate change threatening financial stability, management of environmental risks falls within the ECB's purview [9]. Some other central banks (for instance, the Bank of England, the US Federal Reserve, the Bangladesh Bank,) tend to regard dealing with climate change implications as their mandates component, too.

Altogether, it can be concluded that nowadays the majority of central banks becomes increasingly disturbed by the effects of environmental risks on economy and hence explicitly includes management of these risks to their mandates.

With the Bank of England pioneering in addressing climate change issues since 2015, awareness of environmental risks has now spread among most central banks, pushing them to rearrange their existing toolkits. As it has been mentioned, there are several ways of approaching contents of these toolkits. For the sake of performing a comprehensive analysis, two main fields of applying monetary authorities' credentials are going to be researched: establishment of green financial regulations and green financial markets development.

To achieve greening effects of financial regulation, central banks can calibrate and employ various instruments from their vast toolkit. In particular, they can arrange stress-testing of financial and credit institutions and the whole financial system for climate change impact assessment; prescribe their engagement in green transition by enforcing adjustments to reserve and capital requirements.

In general, stress-testing marks "simulation techniques used to test the resilience of institutions and investment portfolios against possible future financial situations" [4, p. 21]. Performance of stress tests for different climate change related scenarios could be especially useful because they are meant to provide a "footage" of the economy development after passing a certain landmark, which, for example, could be such an extremum as sudden drastic worsening of climate.

In 2021, the ECB conducted an economy-wide climate stress test. It was aimed at evaluating the impact of 3 alternative climate scenarios distinguished by the measures of transition and physical risks on the resilience of non-financial companies and banks over the next 30 years. The test's bank-level findings revealed that most banks would benefit from an orderly transition rather than from a hot house scenario because of the 7% higher probability of default. As for non-financial companies, in the hot house scenario they are going to undergo loss of profit by up to 40% because of production disruptions, and their default probabilities could be up to 6% higher in 2050 in comparison with the orderly transition scenario [10, p. 42–55]. Therefore, stress-testing for climate change provide monetary authorities with information as to current robustness of financial institutions and the system overall and hence the capacity to adjust their regulatory decisions.

Let us consider reserve requirements, which are defined by the minimum amount of reserve funds that commercial banks are obliged to form. To encourage advancement of sustainable banking practices, they could be adjusted in two strategic ways. Primarily, central banks can establish differential reserve requirements tied to the composition of banks' portfolios. This way, the reserves rates for the portfolios emphasizing greener, less carbon-intensive assets would be low, and vice versa, potentially shaping sustainable credit allocation and investments. The second approach that is featured in the literature involves inclusion of "…carbon certificates to commercial banks' reserves, aiming to boost the carbon certificates market" [2, p. 7]. Overall, both in theory and in practice, tailoring specific reserve requirements allows to steer credit toward investments in more eco-friendly projects.

Likewise, central banks modify capital regulation criteria to address climate change risks. As a result, different capital requirements for loans are settled, and depending on the asset profile, they could be either loosened as a so-called green supporting factor, or "GSF", or increased under a so-called brown penalising factor, or "BPF" [4, p. 8]. Currently, there is no solid evidence of practical usage of greening capital requirements by central banks. The necessity to introduce greening capital regulations is high, though, since 40% of banks' portfolios consist of loans to the biggest contributors to overall CO_2 emissions: manufacturing, wholesale and retail, transport and electricity and gas. Capital regulation could potentially become an efficient instrument in addressing climate change implications in the process of bank lending as a means of direct modulation of credit flows by central banks.

In addition to financial regulations, financial markets represent another domain for central banks pursuits of "greening" initiatives. Specifically, central banks can play a pivotal role in promoting active trading of environmentally friendly assets through issuance of green bonds guidelines, as well as set example of purchasing sustainable debts securities from business with minor carbon footprint.

In order to encourage financial institutions to issue sustainable debt instruments, central banks can prepare and publish respective guidelines with extensive explanation of criteria for identification of sustainable projects and businesses, specifications of usage of bond proceeds and disclosure standards. It

is expected that rising awareness in such a way could significantly promote sustainable debt instruments issuance thanks to "establishing and enforcing criteria for green bond labels" [4, p. 13].

On top of the aforementioned, central banks can signal financial institutions about the importance of purchasing sustainable debt securities through holding them in their own portfolios. By setting a positive example, they can influence other actors on financial markets to diversify their assets in a way that would benefit not only the environment but also financial stability in the long run. Nowadays, central banks, governments and second-tier institutions could choose to buy from a wide range of sustainable debt securities thanks to their growing supply. In particular, in the Euro area their outstanding amount has more than doubled over 2021-2023, with their share in the amount of all debt securities having increased from 2.97% to 6.08% (Figure 1). Such tendency could pinpoint awareness of climate change risks.

In this regard, the breakdown of sustainable debt securities based on a sustainability criterion is worth mentioning. There are green, social, sustainability, and sustainability-linked debt securities. Green securities are the ones that are called for funding projects with evident environmental advantages; and the Figure 1 clearly illustrates that in the beginning of 2023 their supply, which comprises the biggest part of sustainable debt securities issuance overall, was 2.27 times greater than in the beginning of 2021.

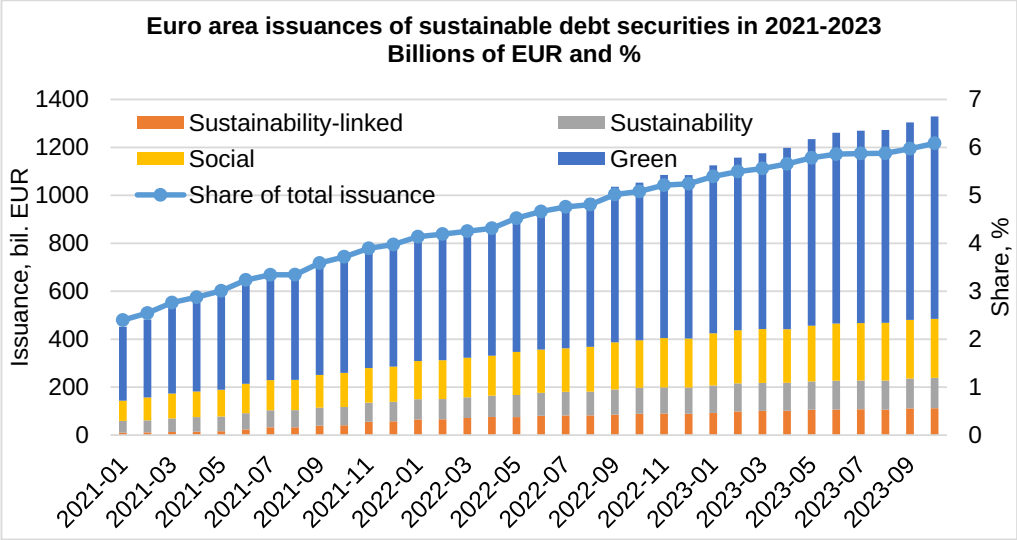

Figure 1. Euro area issuances of sustainable debt securities in 2021–2023, bil. EUR and %

Source: the ECB Data Portal [1]

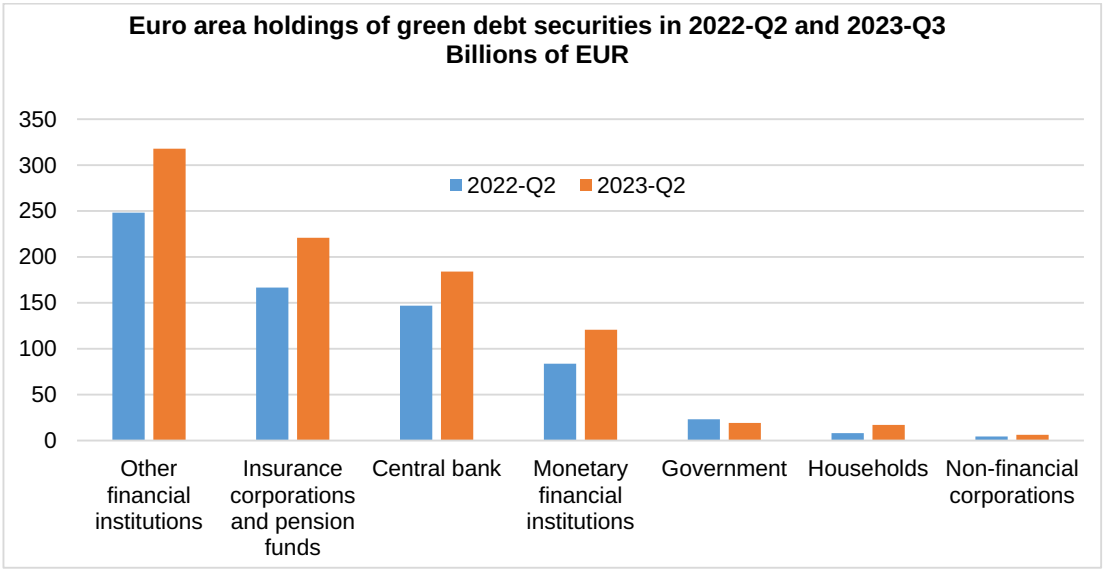

Figure 2. Euro area holdings of green debt securities in 2022-Q2 and 2023-Q3, billions of EUR

Source: the ECB Data Portal [1]

So by choosing from this abundant pool of sustainable debt certificates, participants of financial markets can enrich their assets portfolio with green no-carbon-footprint assets. Central banks might do so to realise their environmentally oriented mandate. Actually, from the Figure 2, it can be clearly seen that it is exactly central banks who are one of the most active buyers of green debt securities. In the second quarter of 2023 central banks in the EA held 25.35% more green debt securities than in the second quarter of a previous year, coming third to insurance corporations and pension funds and non-monetary financial institutions by nominal value of their holdings. It perfectly fits into a pattern of promoting operations with sustainable debt securities by the example of monetary authorities engagement.

Altogether, central banks in the EA have been multiplying the outstanding amounts of overall sustainable securities in their holding since 2021, as the Figure 3 highlights: while they held 132.948 billion of euro as of 31.03.2022, this number increased up to 174.373 billion of euro, what is 31.16% greater, as of 31.03.2022. At the same time, if consider the streak of annual percentage changes of these increments to the sustainable assets portfolio from the Figure 4, then it becomes evident that growth rate features a tendency of eventually slowing down. It might come naturally from the initial boom or result from losses associated with green transition and therefore decrease of interest in environmental projects, what is way worse, considering the earlier discussed results of the stress-testing of economy for varying climate change scenarios.

To sum up, it should be noted that by purchasing and holding sustainable debt securities central banks guide financial and other institutions that act

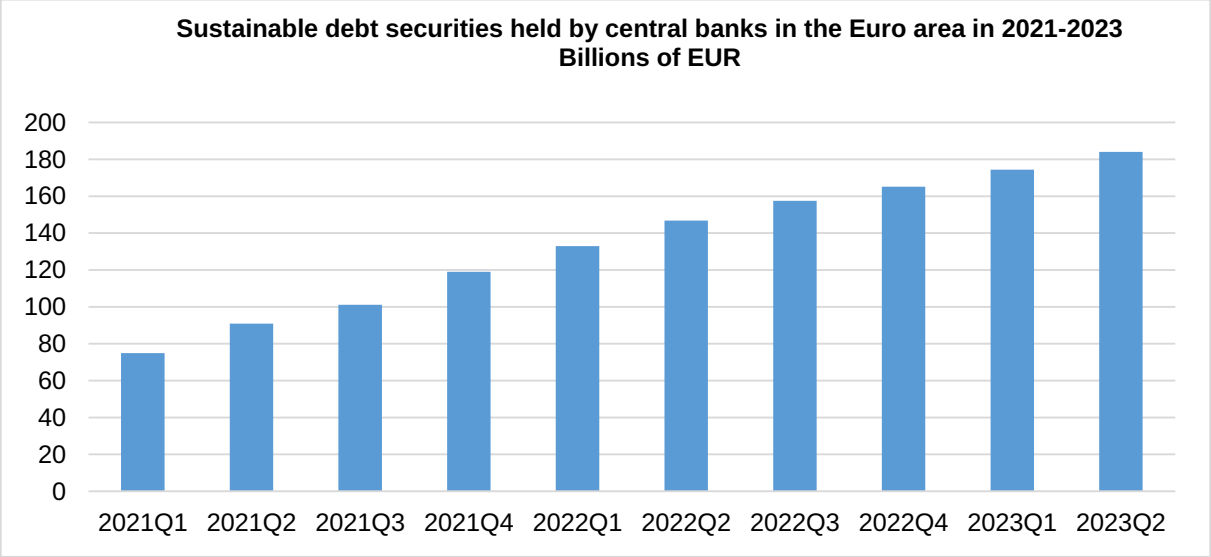

Figure 3. Sustainable debt securities held by central banks in the Euro area in 2021–2023, millions of EUR

Source: the ECB Data Portal [1]

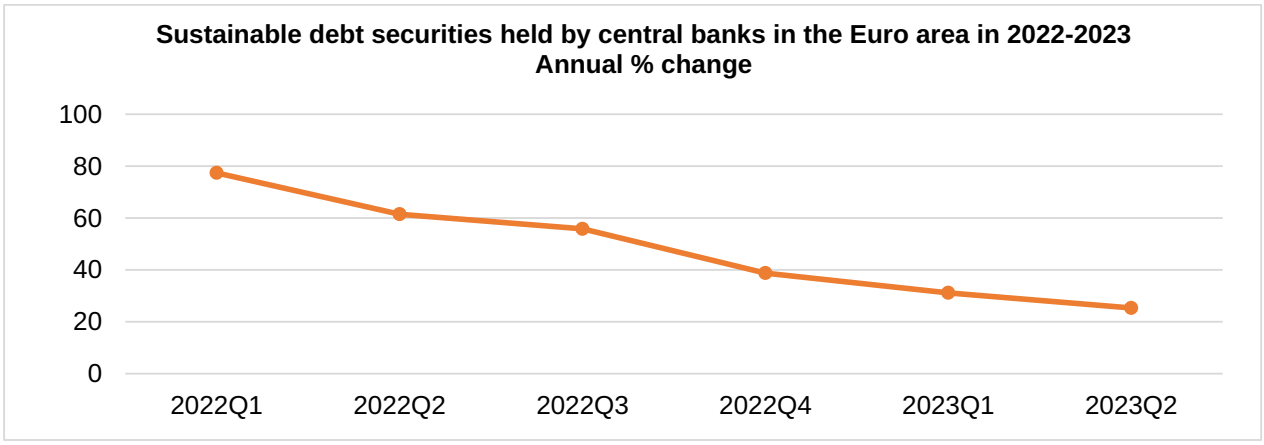

Figure 4. Sustainable debt securities held by central banks in the Euro area in 2021–2023, annual % change

Source: the ECB Data Portal [1]

on financial markets in direction of allocating their money resources in “greener” industries and feeding initiatives of ceasing climate changes with sufficient funds. This way, central banks realize their mandate of addressing environmental challenges.

Conclusions from the study. The research proves that in the 21st century climate change has become one of the key challenges for society and economy worldwide. Although at first glance it may seem like environmental problems cannot influence economic development, this is not true. Pollution and long-term changes in weather patterns are expected to impact supply and demand formation on financial and labour markets, as well as to distort ratio of money expenditures to savings, thereby decreasing numbers and amounts of transactions. Because of such strong connection between the development of national economies and climate change, regulators across the globe are paying more attention to green issues. And central banks are beginning to include consideration of sustainable problems to their mandated tasks. However, the latest research papers reflect that today central banks are only at the first stage of pursuing sustainability-related objectives. Ultimately, this is due to the lack of a clearly defined efficient toolkit. Summing up all the results obtained, it can be expected that in the future we are likely to evidence an even more rapid development of green finance and an increasing performance of central banks in this field.

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