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The address of the Editorial Office: H-1013 Budapest, Krisztina körút 55.

Phone: +36-1-428-2600

Fax: +36-1-429-8000

Homepage: https://en-hitelintezetiszemle.mnb.hu/

Editorial Staff:

Dániel Palotai Editor-in-Chief: szemle@hitelintezetiszemle.hu

Endre Morvay Editor-in-Charge: morvaye@mnb.hu

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Foreword

"The future is built on exponentially expanding knowledge, which by its very nature is also subject to natural and social limits. Long-term sustainability is therefore the leading challenge of the new era ahead of us, and the process of convergence, guided by new visions, can only be organised around this idea." This is the basic thesis of the new sustainable economics, which says that a transformation of ideas on par with the Renaissance and Reformation has already begun in the world. With this issue on environmental sustainability and the green transformation of the economy, the Financial and Economic Review joins this revolution of thinking on sustainability which is unfolding before our very eyes.

The focus on sustainability and the green transition is justified by the fact that it is now clear that growth cannot be forced at the expense of nature, and that a transformation of the economy as a whole, including the financial system, is essential. This fundamental change needs to be reflected in economic thinking, first by focusing on issues related to long-term sustainability. A green revolution requires a new paradigm, in which sustainability aspects are taken into account in accordance with their weight and importance, both in theory and in practice.

All of the articles in this issue focus on environmental sustainability. In the column Our Vision, we explore one of the most topical issues from a central bank perspective: the relationship between monetary policy and the green transition. *Pál Péter Kolozsi*, *Balázs István Horváth*, *Judit Csutiné Baranyai* and *Veronika Tengely* show in their work that a new monetary policy approach is emerging at the global level, but it is not yet clear how central banks can exactly participate in the green transition. The most relevant related questions are presented in the analysis, such as how price stability, which is the most important objective of central banks, is affected by climate change and the green economic transformation; what follows from the potential conflict between the goals of the green transition and price stability, and what challenges are being faced as a result by central banks that also have the goal of sustainability in mind.

Among the studies published, the contribution by *Gábor Hajnal*, *Alexandr Maxim Palicz* and *Sándor Winkler* examines the impact of energy certification on supply-side housing prices and lending rates, with a particular focus on whether a significant price premium can be identified for green properties based on new housing projects in Budapest, and whether banks are willing to finance residential buildings with more advanced energy technologies at lower interest rates. *Bálint Várgedő* describes the impact of carbon shocks on the probability of default in the Hungarian banking system in the context of climate risk stress tests. The advantage of the methodology presented in this study lies in its ability to estimate the magnitude of

macroeconomic shocks and the transition differences across sectors, and its ease of integration into stress testing procedures. *Gábor Szigel* analyses the carbon intensity of bank-financed loan portfolios and concludes that countries with lower income and price levels are disadvantaged due to certain aspects of the methodology. *Viktória Deák*, *Nikolett Tőrös-Barczel*, *Norbert Holczinger* and *Ferenc Szebelédi* examine and present sustainable investments in the insurance sector, which is particularly relevant given the recent increase in the number of unit-linked products that aim to contribute to some kind of sustainability goal. *Balázs J. Csillag, Marcell P. Granát* and *Gábor Neszveda* investigated how ESG scores affect future returns when media coverage of environmental issues intensifies. *László Bokor'*s essay reviews the regulatory environment and market situation for ESG bonds and their funds from the perspective of sovereign risks. In their essay, *Gergely Manasses, Éva Paulik* and *Attila Tapaszti* review the trends, characteristics and current regulation of existing green-bond impact reports, and describe the challenges of evaluating impact reports, based on the literature and practical experience. The feature article by *Balázs Sárvári* describes the trends and dilemmas of green financial capacity development from the perspective of the scarcity of expert capacities, also covering international good practices in capacity development and the related activities of the Magyar Nemzeti Bank (the Central Bank of Hungary). Our book reviews and conference reports also focus on the green theme, highlighting the most important new publications and the most relevant and recent scientific conferences.

There are more and more signs that the green transformation cannot be delayed. The editorial team of the Financial and Economic Review believes that the time has come to lay the foundations for our future and to take the first decisive steps towards a green, sustainable economic and financial transformation, as a green transformation of the economy is not an option, but the only viable path. The present publication reflects this conviction, clearly demonstrating that our journal is an intellectual workshop that is ready to use the tools of science to actively work towards making the green transition not just a slogan, but a reality that can be felt in economic and financial life as soon as possible.

I wish all those interested a stimulating and useful read.

Barnabás Virág
Chairman of the Editorial Board
of the Financial and Economic Review,
Deputy Governor of the Magyar Nemzeti Bank

Monetary Policy and Green Transition*

Pál Péter Kolozsi – Balázs István Horváth – Judit Csutiné-Baranyai – Veronika Tengely

One of the biggest challenges in the coming decades is the achievement and maintenance of environmental sustainability, regarding which the central banks have also shown an increasingly active and supportive attitude in recent years. A new monetary policy approach is emerging, but it is unclear how central banks can participate in the green transition. In this paper, we briefly present the most relevant issues in this regard, namely how price stability, which is the most important objective of central banks, is affected by climate change and the green economic transformation; what follows from the potential conflict between the goals of green transition and price stability in terms of the green activity of central banks; and what challenges are faced as a result by central banks that also have the sustainability goal in mind.

Journal of Economic Literature (JEL) codes: E58, E61, Q5

Keywords: environmental sustainability, green finance, monetary policy

1. Introduction

Climate change is one of the biggest challenges of the 21st century and has attracted increasing attention and interest in recent years. Although the phenomenon is not new, as even naturally the Earth's climate is changing constantly, human activity and population growth have accelerated this process over the past 100 to 150 years. The phenomenon of climate change – the effects of which can be extremely complex (*Zöldy et al. 2022*) – is most often illustrated by global warming, melting glaciers and increasingly frequent extreme weather conditions. The rate of increase in the global average temperature started to accelerate at an unprecedented rate in the second half of the 20th century, mainly in the northern hemisphere, and is currently around 1°C above pre-industrial levels. As this rate is unsustainable in the longer term, it needs to be slowed down, which can be facilitated by climate protection measures.

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* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Pál Péter Kolozsi is a Director at the Magyar Nemzeti Bank and Associate Professor at the MNB Knowledge Centre, Sustainable Finance Centre of John von Neumann University. Email: kolozsip@mnb.hu
Balázs István Horváth is an Economic Analyst at the Magyar Nemzeti Bank. Email: horvathba@mnb.hu
Judit Csutiné-Baranyai is an Economic Analyst at the Magyar Nemzeti Bank. Email: csutinej@mnb.hu
Veronika Tengely is a Senior Economic Analyst at the Magyar Nemzeti Bank. Email: tengelyv@mnb.hu

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The 2015 Paris Agreement on Climate Change is the world's first comprehensive climate agreement. The Agreement sets the goal of keeping the global average temperature warming threshold well below 2°C above pre-industrial levels and, as a continuation of efforts following its successful implementation, below 1.5°C. It is also important to increase the ability to adapt to the adverse impacts of climate change and to foster climate resilience, along with development that involves low greenhouse gas emissions. Although the level of commitment is steadily increasing, more efforts are needed to achieve the objective of the Agreement. For example, the European Union has committed to reducing its greenhouse gas emissions by at least 55 per cent by 2030 compared to 1990 and to becoming the first climate-neutral economy and society by 2050.

Matolcsy (*2022a*) argues that we are heading towards an era when economic convergence, driven by new visions, must be organised around the idea of sustainability. This requires a new paradigm in economics, which should play an important role in conceiving a more sustainable future (*Virág 2019*). It is also becoming increasingly clear that the global economy must undergo a major transformation to meet the goals of the Paris Agreement. This requires a radical reduction in greenhouse gas emissions, as the UN says that global emissions must decrease by 7.6 per cent per year by 2030 in order to meet the climate target. However, in 2020, when global economic activity virtually stopped due to the pandemic (*Báger – Parragh 2020*), emissions decreased by only 5.8 per cent (*Schnabel 2022a*).

An increasing number of central banks are actively addressing the issue of environmental sustainability, in order to avoid the risks and economic damage associated with climate change. In UBS's annual survey of nearly 30 central banks, 32 per cent of respondents identified climate change as a potential risk to the world economy (*UBS 2021*). Of the 135 central banks examined by *Dikau – Volz* (*2021*), 70 had direct or indirect sustainability mandates.[1]

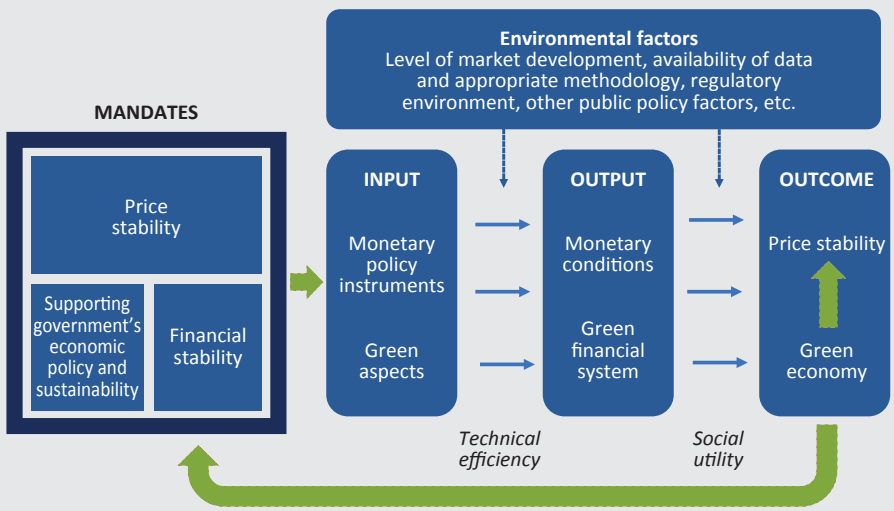
In the case of central banks, the relative importance of the risks associated with the green transition, the related opportunities and the feasibility margin are significantly influenced in the short term by the macroeconomic, financial market and geopolitical environment in which the given central bank operates. In this respect, in the early 2020s the increase in inflationary pressure, the increase in energy prices and the geopolitical rearrangement resulting from the Russian-Ukrainian war are undoubtedly of paramount importance, each posing a challenge that may take precedence over the green transition in the short run. In the longer term, however, a theoretical framework can be envisaged in which central bank

[1] The Central Bank of Hungary (Magyar Nemzeti Bank, MNB) received a green mandate from the Parliament in the spring of 2021.

room for maneuver, constraints and feedback related to the green transition can be placed. We attempt to do this in this analysis.

In our paper, the starting point was the conceptual model of *Mandl – Dierx – Ilzkovitz* (*2008*), which was designed to analyse public policy measures and distinguishes between effects that occur in the shorter term and are more technical in nature (output), and effects that occur in the longer term and can also be construed at the macro level (outcome) (*Figure 1*). The conceptual scheme was originally designed to analyse fiscal measures in economic policy, but it can also be applied to monetary policy programmes (see *Kolozsi – Hoffmann 2016*). In order to assess the relationship between the green transition and monetary policy, we have created an extended scheme in which feedback is highlighted – on the one hand, in terms of the environmental sustainability of the economy and central bank mandates, and, on the other, in terms of the different mandates and the instruments deployed.

Figure 1
Central bank green activity according to the enhanced version of the Mandl – Dierx – Ilzkovitz conceptual model



Source: Based on additions to Mandl – Dierx – Ilzkovitz (2008)

In the schematic model, central bank mandates result in central bank measures, which manifest in monetary conditions depending on the external factors,[2] or, where green aspects are taken into account, in the "greening" of the financial system. This

[2] In addition to the general level of development of the markets, this includes, for our purposes, the level of development of the green credit and green securities markets, the availability of sustainability data and the existence of methodologies suitable for processing the data.

ideally leads to price stability and the emergence of a green economy, which in turn will influence which of the central bank mandates will gain prominence based on the hierarchy of goals. Of course, these relationships are not so evident, since it is not trivial what instruments central banks can use in their green frameworks[3] and what effect the transformation of the financial system has on the sustainability of the economy as a whole (see *Carney 2021*), and how the data needed for the analyses can be obtained (*Kolozsi et al. 2022*; *Boros et al. 2022*). Taking into account all of these constraints and acknowledging the complexity of the relationships, we focus on a few of the most important issues from a strategic point of view, which are as follows:

(1) How does the green transformation of the economy affect price stability, the most important goal of the central bank?

(2) What follows from the potential conflict between the goals of green transition and price stability in terms of the green activity of central banks?

(3) As a result of the above, what challenges are faced by central banks that also have the sustainability goal in mind?

To answer these questions, in our essay we review the relevant literature and present the relevant central bank experiences and analyses.

2. Effect of the green transition on inflation

In the past, the majority of studies highlighted and estimated the impact of climate change on economic growth,[4] whereas today's focus also includes the assessment and quantification of inflationary effects. This is explained by the fact that climate change contributes to the rise in inflation volatility and in the price level itself, which jeopardises the efficiency of monetary policy channels and the fulfilment of the central banks' price stability criterion, making it increasingly difficult to keep inflation expectations well-anchored.

Schnabel (*2022b*) divided the inflationary impact of climate change into three interrelated, yet separable shocks. The first one is 'climateflation', which results from the physical impact of climate change (floods, drought, or the increase of heat fluctuations, as the case may be). The second, 'fossilflation', relates to fossil fuels, and results from a large part of the economies being heavily exposed to coal and hydrocarbons (petroleum, natural gas), while in many countries an important element in the fight against climate change is precisely the fact that the price of

[3] For possible central bank green instruments, see (*NGFS 2021*).
[4] These included the MNB's 2019 Growth Survey. For more on the emergence of green thought in economic theory, see *Kutasi* (*2022*).

fossil fuels is rising because of the environmental damage caused. The carbon dioxide quota system is undergoing significant changes, with an increasing number of countries introducing or planning to introduce a carbon tax, while quotas are becoming more and more expensive, causing production costs and consequently inflation to increase. The third shock is 'greenflation', which means an increase in the price of raw materials that are particularly affected by the green transition. In the following, we focus primarily on this third category.

The phenomenon of 'greenflation' is increasingly being addressed by analysts and economic policymakers. Globally, the transition to a green economy and the achievement of green goals entails costs. Government measures, as well as a significant demand in the private sector, may make it more expensive to implement investments involving green goals, and the decrease in the price of the relevant technologies has not yet been able to counter this on the supply side. The side-effect of this is the phenomenon of 'greenflation', i.e. an increase in the price of metals and minerals (aluminium, lithium, copper) that are essential for solar and wind energy, electric cars and other renewable technologies. The transition to renewable technologies is initially very costly, but in the longer term, efficiency gains and benefits from economies of scale can alleviate the burden of initial investment and do not jeopardise the viability of clean and sustainable energy.

Despite the growing body of literature on the economic impact of climate change, estimation results are surrounded by substantial uncertainty. One good indicator of the high degree of uncertainty is the fact that, compared to other topics, central banks tend to use more conditional language when it comes to climate change (*Arseneau et al.* 2022). The pace of global warming, the rate of adaptation to technological progress and the impact of climate change on global activity are difficult to accurately model or assess. The majority of the available studies primarily examine the effects of climate change on GDP (see *Kahn et al. 2019; Batten et al. 2020; Colacito et al. 2019*); however, the analysis of consumer prices is also becoming more and more central. As a member of the Executive Board of the European Central Bank (ECB), *Benoît Cœuré* (*2018*) emphasised in his speech, 'Monetary Policy and Climate Change', that central banks face regular, even persistent, supply shocks. He considers that the change in relative prices largely depends on the extent to which the economy moves away from hydrocarbon-based energy production towards renewable energy sources. He argued that it was the task of the central banks to be prepared for each scenario and to properly anchor inflation expectations.

In the process of green transition and climate change, two stages or risk categories can be distinguished according to the literature: physical risks (i.e. risks occurring while climate change is taking place) and risks related to transition (also known transition risks, i.e. those involved in the fight against climate change). Risks of the former type are due to the interaction between the increasing average temperature and more frequent extreme weather conditions, including the exposure of the socio-economic systems to these factors. Accordingly, there are two subgroups of physical risks: gradual global warming and its associated physical changes, such as rising sea levels or changes in precipitation patterns, and the impact of natural disasters (hurricanes, floods, heat waves, etc.). The former subgroup can also be referred to as chronic effects, and the latter subgroup as acute effects. Transaction risks refer to the risks posed by the transition of the economy and society to lower-carbon operations (for example, when an electricity supplier changes to an operating model for the production of electricity from renewable sources only). In particular, from year to year it is becoming increasingly clear that in the long run, operations with a high level of reliance on fossil fuels cannot be maintained, which makes the climate-friendly transformation of the world economy essential. In a green economy, the ratios in the energy mix change dramatically during the transition, but supply is not always able to keep up with the sudden increase in demand during this time. The imbalance between supply and demand will be reflected in price increases in the short term. In addition, geopolitical impacts are also reflected in price developments.

Climate change exerts its impact on macroeconomic variables through supply and demand channels. Overall, inflation and inflation expectations are becoming more volatile and uncertain. *Tables 1* and *2* summarise the main channels and effects related to output and price changes, based on a comprehensive study by the *ECB* (*2021*).

Table 1
Inflation channels and expected effects of climate change risks – supply and demand shocks

		Physical risks		Transition risks
		Gradual warming	Extreme events	
Supply shock	**Food, energy and other raw material supply**	Decline in agricultural productivity and yields	Disruption to supply and production chains	–
Demand shock	**Energy demand**	Increased demand for electricity in summer exceeds decreased demand in winter	–	Higher carbon tax leading to lower demand for fossil fuels Transition to renewable energy reduces demand for fossil fuels
	Trade	Disruption to trade routes due to geophysical changes (such as rising sea levels)	Changes in food prices and disruptions to trade flows	Taxes, regulations and restrictions may cause disruption to trade routes; Risks of bias from asymmetric or unilateral climate policies

Source: Based on ECB (2021)

On the supply side, global warming and extreme weather can have inflationary effects on the prices of food, energy and other raw materials, although the direct impact on consumer prices may be dampened by the fact that raw materials (according to some analyses) only account for a very small part of the price of the final products (see *WEF 2021* analysis with Boston Consulting Group). On the demand side, the seasonality of energy demand may change due to increased energy demand in relation to warmer summer weather. Disruption to trade may occur as a result of weather effects. In addition, the introduction of carbon taxes and other taxes not only contributes to higher prices, but also shifts demand away from traditional fossil fuels towards renewable energy sources.

Through supply and demand channels, the risks of climate change ultimately appear in economic output, inflation and the evolution of inflation expectations. In the case of economic output, climate change may not only cause physical damage, but may also adversely affect, for example, labour productivity or investment developments. In the case of inflation, we can expect changes in relative prices and increasing volatility in the case of already volatile food and energy prices compared to the other items in the consumer basket. In addition to inflation, the volatility of

inflation expectations may also intensify, which may justify more frequent revisions in the evolution of expectations, thereby jeopardising the appropriate anchoring of inflation expectations.

Table 2
Inflation channels and expected effects of climate change risks – aggregated effects

		Physical risks		Transition risks
		Gradual warming	Extreme events	
Aggregated effects	**Output**	Lower labour productivity, investments being used to mitigate impacts and prevent arable land loss	Physical damage (crop failures, destruction of facilities and infrastructure, disruption in supply chains)	Frictions resulting from transition policies and/or the uncertainty surrounding them Use of revenues from transition policies may influence the level of impact on emissions
	Inflation	Relative prices change as a result of changes in consumer demand, preferences and comparative cost benefits	Increased inflation volatility, in particular in food, housing and energy prices	Prices affected by climate-related transition policies, policy uncertainty, technological changes and shifts in consumer preferences
	Inflation expectations	Climate shocks, such as their impact on food and energy prices, may affect inflation expectations	Inducing more homogenous, sudden and frequent revisions of expectations	Formation of inflation expectations affected by policies

Source: editing based on ECB (2021)

3. What can central banks do?

Climate change therefore affects the macroeconomic environment, the financial and banking system[5] and prices through several channels. The question, however, is whether this implies that central banks have a role to play regarding this process. As we will see, there is no complete agreement, but there are more and more signs that a new consensus is emerging in the world of central banks.

[5] On that subject, see *Boros* (*2020*) and *Ritter* (*2022*).

The thought of green monetary policy, i.e. the role of central banks in the fight against climate change, has become more widespread in recent years. Previously, the dominant position was that central banks should not deal with climate change and that monetary policy should not play a relevant role in the fight against climate change (*Boneva et al. 2021*). Many economists, including *Cochrane* (*2019*) argue that the active fight against climate change can endanger central bank independence due to its political nature. In addition, representatives of the earlier consensus believe that setting a further target for central banks in addition to their existing mandates could make it more difficult to achieve these (*Buiter 2021*). Similarly, Charles Goodhart (*Jeffery 2021*) claimed that the green commitment of central banks is only justified if they see a sudden and unpredictable event occurring that seriously threatens financial stability; he notes, however, that this is not the case at the time. However, as *Weitzman* (2011) points out, economists should consider the high probability of and uncertainties about extreme outcomes in relation to climate change, rather than using traditional cost-benefit analyses.

Conversely, *Schnabel* (*2021*) sets out the position that a new consensus is emerging that central banks should not remain on the sidelines in the fight against climate change, as it affects the viability of their mandates. Economists representing central banks' green engagement argue that central banks cannot ignore climate change primarily because it has a direct impact on inflationary developments and financial stability. Danae Kyriakopoulou, former chief economist of OMFIF and researcher at the London School of Economics, said that climate change amounts to a 'macro-critical' event (*Kolozsi 2022*), placing central banks under an obligation to actively support the green transition (*Kyriakopoulou 2021*). Based on a summary by *Boneva et al*. (*2021*), 5 channels can be identified through which climate change has an impact on monetary policy.

1. *Impact on key economic variables.* Climate change may increase inflation volatility due to extreme weather conditions, and the transition may permanently distort the rate of inflation upwards.

2. *Monetary policy conduct.* The transition to a carbon-neutral economy may make monetary policy decision-making more complex, as significant uncertainty may make it more difficult to accurately determine and forecast the level of equilibrium interest rates or business cycles, while also weakening the transmission mechanism. Depending on the instrument used, green central bank financing may affect the central bank balance sheet and thus the result of the central banks.

3. *Impact on central bank analytical framework.* In the analysis frameworks and models traditionally used by central banks, there is little involvement of natural resources or externalities related to their use, and the models are often only intended to provide medium-term forecasts (consistent with the fulfilment of traditional monetary policy objectives).

4. *Climate change and asset allocation.* According to the current professional consensus, capital markets may not fully reflect the risks associated with climate change and the transition to a carbon-neutral economy, but if these risks materialise they may have consequences in terms of financial stability and the real economy.

5. *Carbon bias in financial market and central bank portfolios.* Central banks have recently significantly expanded their balance sheets through their asset purchases. In general, central banks made their purchases in line with market weights, but this meant that they could have bought proportionally more of the securities of high-emission companies, which tend to be more capital-intensive.

In addition to the above, another important change is that by the second decade of the 21st century, the role and responsibility of the central banks has changed radically (*Matolcsy 2022b*). Central bank thinking and the role of central banks in the financial markets and the range of instruments they use have also undergone a significant change – and this makes central banks more suitable for contributing to the fight against climate change, as both targeted and long-term instruments have become standard, and these approaches may be relevant from a green perspective. As a consequence of the great financial crisis of 2007–2008, central banks around the world applied non-conventional, novel instruments. While central banks had previously mainly achieved their objectives by changing short-term interest rates, following the onset of the crisis, their set of monetary policy instruments was expanded to include the use of negative interest rates, forward-looking guidelines, asset purchases and long-term loans. Although the significant expansion in the range of monetary policy instruments used in practice did not go hand in hand with a broad focus on green central bank thinking, it may have contributed to the subsequent grounding of green monetary policy considerations by calling into question conventional thinking and breaking down taboos. Non-conventional instruments often have a targeted nature, which runs counter to traditional monetary policy, which takes a more general approach. As a result of asset purchases, central bank balance sheets have expanded significantly in general; consequently, central banks have a more meaningful impact on financial markets, allowing them to participate more proactively in the fight against climate change (*Brunnermeier – Landau 2020*). It is also appropriate to underline that central bank

policies now tend to be committed for a longer period than previously, and climate change is indeed a challenge that requires a long-term commitment from decision-makers (*MNB 2021*).

4. Challenges

The breakthrough is yet to come, but the outlines of the '*new normal*' are already visible. This holds that central banks cannot afford to remain neutral on the issue of environmental sustainability. Nevertheless, of course, central banks also cannot ignore their operational frameworks arising from their original – and primary – purpose. This 'multipurpose' character is the main reason for the challenges posed by the practice of green central banking. We examine four of these challenges: market neutrality, varying horizons, direct funding and central bank independence.

4.1. What will happen to market neutrality?

One important principle of the functioning of central banks is market neutrality, which means that central banks seek to minimise the impact of monetary policy on the relative prices of financial products.[6] This principle also applies to targeted programmes in the monetary policy instruments. However, the question arises as to whether or not it represents a violation of this principle, if the central bank deviates from it on the basis of a specific green aspect within the targeted instruments, as such programmes may contradict the objectives of monetary policy and the principle of market neutrality, and therefore the central bank may be forced to compromise.

Depending on the legal mandates and operating framework of the central banks, active support of green aspects can be achieved either by the pricing of the central bank facilities or by changing the eligibility conditions. Given the current increased size of central bank balance sheets, even a partial greening of central bank portfolios can have a significant impact. This also serves as a signal to market participants of the central bank's commitment, which may increase the efficiency of the programmes. For a significant number of central banks, asset purchases became an integral part of the unconventional set of monetary policy instruments once the effective lower bound on interest rates was reached. In order to maintain the principle of market neutrality, central banks typically made purchases in proportion

[6] The principle of market neutrality has not yet been fully implemented, since central banks cannot always be present on all markets with the same intensity, and the markets in which they are present are favoured over the markets in which they are not present. In other words, market bias was already a natural feature of implementation, and indeed, some already considered market neutrality as a "myth", see: *The Green Central Banking Scorecard: How Green Are G20 Central Banks and Financial Supervisors?* http://positivemoney.org/wp-content/uploads/2021/03/Positive-Money-Green-Central-Banking-Scorecard-Report-31-Mar-2021-Single-Pages.pdf

to market shares. However, this practice results in '*carbon bias*' in the portfolios of central banks, as carbon-intensive companies are also generally capital-intensive and therefore have a greater weight on corporate bond markets than their less carbon-intensive counterparts. Thus, traditional benchmarks for asset purchases based on market neutrality are not necessarily conducive to the transition to a low-carbon economy, so that the implementation of a green programme compared to previous instruments can lead to a positive distinction between green instruments or to an incentive for other activities.[7]

The greening of the Bank of England's (BoE) corporate bond purchase programme is a good example of the implementation of proactive monetary policy. In May 2021, the BoE published a comprehensive study that included the planned transformation of the programme, then presented the draft for wide discussion, and finally a decision was made in November to adjust the programme parameters from a green perspective (*BoE 2021a*). Accordingly, the BoE aims to reduce the weighted average carbon intensity of the corporate bond portfolio by 25 per cent by 2025 and to reduce the exposure to zero by 2050. Bond purchases are made according to the extent to which an issuer takes climate protection aspects into account within the given sector. To this end, the central bank uses four measures: the intensity of the pollutant emissions of the activity, the result achieved so far in reducing emissions, whether climate change information has been published and whether it has an emission reduction target (*BoE 2021b*). The central bank also stated that in the future it may impose sanctions (such as reducing purchases, withdrawing from the scope of the scheme or selling previously purchased assets) on issuers who do not comply with the gradually tightening requirements of the scheme.

Green monetary policy can distort financial markets due to the current scarcity of green instruments. The transmission of monetary policy may be hampered, for example, by the exclusion of certain institutions from access to central bank assets. In addition, in the absence of a clear taxonomy and accepted market standards for green and polluting investment and viable guidelines, central banks lack an objective definition and possibly a legal basis for establishing their green policy. In view of these constraints and trade-offs, central banks should carefully consider the costs and benefits of activities to proactively mitigate climate change (*Boneva et al. 2022*).

[7] For the effects of central bank programmes on the development of green bond markets in Hungary, see *Bécsi et al.* (*2022*).

4.2. How to address the tragedy of the horizon?

The nature of the supply shock resulting from the volatility of energy prices is somewhat similar to that of the transition to zero emissions. The similarity is that in both cases monetary policy is confronted with an effect that can be interpreted as a negative supply shock. This means that the origin of the shock to the economy is the increase in the price of energy sources for some reason, for example due to production costs or due to taxes on energy sources. However, it varies in terms of the temporality of the shock and its impact on the macro-economy and therefore requires a different monetary policy response.

Short-term surges in energy prices are a general phenomenon. These shocks fall well within the monetary policy time horizon and do not necessarily need to be addressed by monetary policy action. If monetary policy were to react, it would amplify the negative impact of rising energy prices on aggregate demand and output. Moreover, as monetary policy measures generally take effect in 5 to 8 quarters, they would exert downward pressure on inflation at a time when the shock is likely to have passed. Thus, temporary supply shocks tend to justify a deviation from the target in the short term, provided that price stability is restored in the medium term and inflation expectations remain anchored.

By contrast, rising energy prices in the green transition process may be *sustained* due to divergent economic policies (e.g. tax increases) and may have an impact on the definition of the monetary policy stance. The green transition involves risks, including inflation, as the gradual transition to greener energies can entail higher and more volatile prices, at least during the transition period. During the green transition, a sustained rise in inflation may occur if the expansion in the supply of alternative energy sources is too slow, and the cost of the transition can also raise prices, i.e. the shifting of demand accompanying the transition may lead to changes in prices in certain sectors (*De Galhau 2022*). The combination of insufficient production capacity of renewable energy in the short term, subdued investments in fossil fuels and rising carbon prices means that a potentially protracted transition period is expected, where energy prices are constantly rising (*Schnabel 2022a*). Several factors should be taken into account when formulating the monetary policy response to this process.

- On the one hand, given that price increases can be sustained, monetary policy cannot overlook the impact of this and must respond. As a result of the transition, persistently high energy prices could affect inflation expectations. If expectations remain above the central bank's target at the end of the monetary policy horizon, inflation could rise further. Taking the experience of the 1970s as a reference point, when the increase in energy prices triggered a damaging price-wage

spiral, strong evidence is found that the deterioration of inflation expectations significantly increases the cost of returning inflation to the target.

- On the other hand, the shock caused by the green transition differs from the traditional temporary energy price shock in another aspect. In this case, the rising prices of conventional energy sources are essentially due to the taxes levied on them. Tax revenue remains in the economy, which does not adversely affect the performance of the economy through an appropriate redistribution mechanism. This also justifies a different monetary policy response: while monetary policy measures are not justified in the case of traditional short-term shocks, the central bank cannot disregard the price increase during the green transition.

Climate change, and thus the green transition, also shapes economic and financial developments beyond the traditional monetary policy horizon ('*tragedy of the horizon*') (*ECB 2021*). Given the timeframe of the transition, it is questionable whether the current medium-term horizon of monetary policy is appropriate. There are views that, in the event of supply shocks, the long-term horizon can also mitigate output and employment losses and volatility, as well as fluctuations in exchange rates and yields. This is also valid for the supply shock under consideration (*Boneva et al. 2021*). At the same time, the creditworthiness of the central bank may be jeopardised if the time horizon extends too far into the future and the deviation of inflation from its target becomes the norm rather than the exceptional event. In order to preserve credibility, the central bank's monetary policy framework must be clear and transparent. It should contain clear guidance on the extent to which it will tolerate the deviation of inflation from its target during the transition.

4.3. Who should finance the green transition?

There is no question that significant new investments are needed to transform the economic system, i.e. to achieve low emissions in a given country. According to former Bank of England Governor *Mark Carney*, the role of the financial sector in financing the necessary investments is unavoidable. According to *Bloomberg* (*2021*), Carney estimated the necessary investments at USD 130,000 billion. The emergence of significantly restructured central bank instruments, in particular lending programmes and asset purchases, raises the question of the role that central banks can play in providing the necessary resources for the transition. As *Brunnermeier – Landau* (*2020*) put it, the increased role of central banks in the financial markets can also provide an opportunity to play a more proactive role in the fight against climate change.

Central banks can primarily contribute to green investments by reducing their funding costs. By directing financial sector actors towards sustainable lending and securities, central banks can indirectly stimulate green investments. One possible way to do this is to provide supervision measures, such as capital requirement discounts for banks in the case of green loans (*Prestedge 2021*). In addition to their incentive role, such measures can also strengthen financial stability, as they lead to the build-up of greener balance sheets, while the financial sector is currently unable to adequately price climate risks due to uncertainty about climate change and the lack of data or measurement methodologies.

In the context of bond purchases and certain central bank stimulus programmes, it has been suggested that these programmes have in many cases indirectly favoured carbon-intensive companies (*Matikainen et al. 2017*), due to the prevalence on the bond market of incumbent industries with high emissions. Therefore, central banks may also seek to correct the distortions inherent in their asset purchase programmes used so far, but may also focus on environmental sustainability. One possible way to do this is to purchase assets with a specific focus on sustainability, or to launch direct, targeted credit programmes that can help accelerate the necessary green transition. Asset purchases for green securities can also be even more effective in stimulating the economy than programmes that reflect general market ratios (*Monasterolo – Raberto 2017*). The low-emission sectors can respond more strongly to the expansion of resources in terms of employment and investment.

However, despite the above, prudent behaviour by central banks is justified, as they may face significant trade-offs in relation to their sustainability policy (*Radu – Paun 2021*). While support for incentive measures, such as green lending or the holding of green securities, by supervisory means, may be neutral from a monetary policy perspective, in the case of direct financing of investments, the central bank must also bear in mind its primary objective, which is to preserve price stability. The level of investment required for a successful transition is so significant that – although in the long run support for the transition will make an explicit contribution to achieving the objective of price stability – in the short run, more direct central bank involvement can be made possible through targeted, smaller-scale programmes.

4.4. How can a green central bank remain independent?

According to the standard approach, the ability of central banks to operate as an independent body allows them to carry out their work in a way, which affects redistribution between economic actors the least, i.e. in the most ‘market-neutral’ manner. Green activity naturally creates a new situation in this regard, since the aim of this is to make central banks committed to a process that affects economic participants differently.

As climate change is one of the biggest challenges for all aspects of policymaking today, the involvement of central banks in mitigating the economic impacts of environmental factors is increasingly being supported. Economic participants are unlikely to be able to voluntarily switch to the green economy, which may be termed as a 'market failure'. The basic assumption is that the state is responsible for correcting the market failure, while central banks, as parts or 'branches' of the state, are obliged to assist in this endeavour on the basis of the authority granted to them in their mandates. In this approach, central banks cannot avoid being involved, as climate change may lead to the accumulation of financial risks affecting financial stability at the macro level.

The proactive participation of central banks in the green transition is generally accepted by the public, but its disadvantages and possible costs should also be taken into account. Institutional independence is the basis of traditional central banking activity in the Western world. The central bank has a limited mandate, which sets clear, unchanged objectives to ensure its legitimacy. As a result, it is accountable to elected officials and resistant to political and public pressure. However, the greening of central banks may have an impact on this role. The extension of the mandate of the central bank, which includes new objectives that may be pursued by other political actors, may have disadvantages and, as we indicated at the beginning of this paper, the different mandates of the central bank may conflict with each other. Regardless of how central banks receive these new tasks (via legislative changes or a reinterpretation of the existing mandate), the assumption of 'unattainable' targets may reduce the central bank's credibility. The broader scope of rights entails greater publicity and criticism, as well as new organisational responses and possibly higher costs. Together with the new tasks, the central bank must coordinate its activities with other bodies performing related tasks, in particular the government.

Fiscal and monetary policy are, to some extent, substitutes for each other: the 'easy money policy', i.e. a loose monetary policy, is temporarily compatible with low inflation if the state has a large budget surplus. Similarly, policymakers may be tempted to use temporary fiscal and monetary measures as temporary substitutes for more painful structural adjustments. Faced with the high costs of greening the economy, elected officials may tend to transfer responsibility to an 'independent' technocratic body, i.e. the central bank (*Radu – Paun 2021*), which may lead to higher coordination costs and a deterioration of central bank independence.

5. Summary

The importance of the incentives provided by the public sector to market participants has already been highlighted by the process of managing the crises that emerged as a result of the 2008 financial crisis and the coronavirus outbreak in 2020, as well as the process of recovery from the crises. Joint action by the different policy areas is also needed during the green transition, as the integration of environmental sustainability aspects into the economic environment and the greening of the economy poses challenges for both fiscal and monetary decision-makers.

It is now increasingly clear that without active state involvement there can be no successful green transition. The energy transition should be promoted while protecting the most vulnerable in society from possible negative consequences, and the measures to achieve the latter should be designed in a way that does not reduce incentives to reduce carbon emissions.

Due to the non-linear nature of the processes, time becomes an important constraint and we need to decide as soon as possible which path to take: whether to allow climate change to take place or whether to intervene and fight it. If we opt for the latter, then it is absolutely necessary to make a directed technological change. Accordingly, state intervention through various climate protection measures will play an increasingly important role. If these measures are not taken, we can "save" the cost-side effects, but the price of this will be that the likelihood of a climate catastrophe will increase, which may have serious social impacts, in addition to economic ones.

Thus, the green transition is not an option in reality, but a necessity. It is not clear, however, who is responsible for accomplishing it. In the case of central banks, this issue is particularly acute, as central banks have considerable potential due to their power to create money, but their mandate is limited and they should in particular help to achieve price stability. The challenge is when the objectives of central banks "clash", although under central bank law the objective of price stability must take precedence. Obviously, however, this will not promote the green transition. Therefore, the best approach is that the responsible central bank always seeks to achieve and maintain price stability, while at the same time constantly looking for ways to promote the green transformation of the economy. This consensus is beginning to emerge in the world of central banks as well, but the challenges remain, in terms of market neutrality, varying time horizons, funding and independence.

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Impact of Energy Rating on House Prices and Lending Rates*

Gábor Hajnal – Alexandr Maxim Palicz – Sándor Winkler

The real estate market is a key component of the green transition, and thus it is worth examining the pricing and financing costs of modern residential buildings in Hungary. In our study, we investigate a) whether a significant price premium can be identified for green properties based on new housing projects in Budapest, and b) whether banks finance residential buildings with more advanced energy technologies at lower interest rates. Based on our regression estimation, the green price premium is clearly evident in the Budapest new housing market: on average, homes with an energy rating of BB or better are 5.1 per cent more expensive than homes with an energy rating of CC. Based on our estimate of housing loan interest rates, no significant difference can be identified in the interest rates on loans granted to finance properties with a certificate higher than CC compared to loans granted for properties with CC certificate, i.e. banks do not yet factor energy aspects into the pricing of loans.

Journal of Economic Literature (JEL) codes: C13, G21, R30

Keywords: green financing, new homes, energy rating, housing loans

1. Introduction and motivation

Energy modernisation of the residential building stock in Hungary is crucial for meeting domestic climate change targets, which would also contribute to the security of energy supply. Today, about one third of final energy consumption in Hungary is accounted for by residential buildings (*Government of Hungary 2020*), the vast majority of which are in need of energy modernisation. According to the energy performance certificates issued, environmentally sustainable new housing is gaining ground in the housing market, driven both by the increase in the number of new homes and the previously expected tightening of energy compliance rules (the expected and subsequently delayed introduction of BB or better energy

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Gábor Hajnal is an Economic Analyst at the Magyar Nemzeti Bank. Email: hajnalg@mnb.hu
Alexandr Maxim Palicz is a Senior Economic Analyst at the Magyar Nemzeti Bank. Email: palicza@mnb.hu
Sándor Winkler is a Head of Division of the Magyar Nemzeti Bank. Email: winklers@mnb.hu

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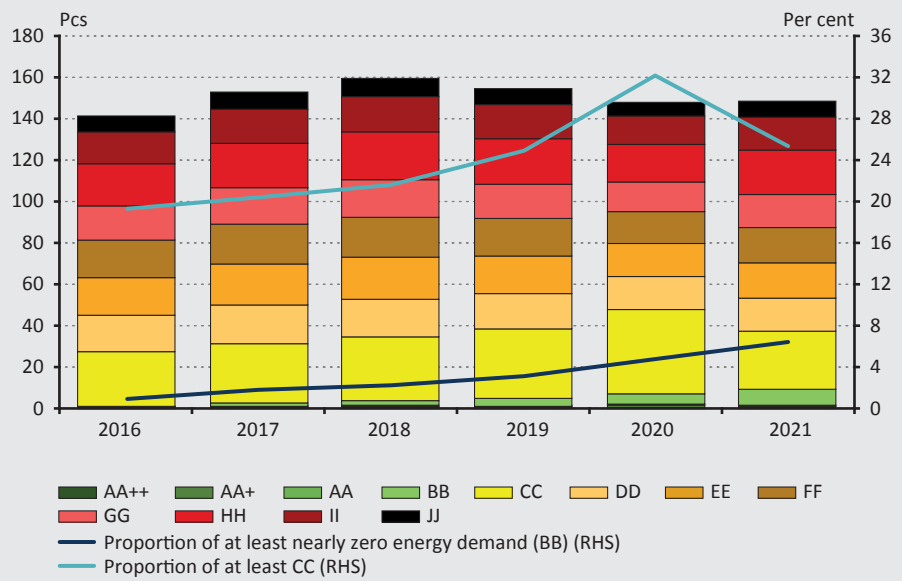
performance requirements for the occupancy of new homes). However, the poor energy performance of the housing stock as a whole is illustrated by the fact that only 3.2 per cent of energy performance certificates issued for residential buildings since 2016 have a rating of nearly zero-energy requirement (BB) or better, and 29.7 per cent have a rating of poor or worse (*Figure 1*).

Figure 1
Distribution of residential buildings with energy performance certificates issued between 2016 and 2021 by energy ratings



Source: Magyar Nemzeti Bank (MNB), e-tanusitas.eu

More energy-efficient homes may be more expensive to build, but demand for these properties may also be higher as sustainability concerns become more important. There is therefore a negative correlation between the improvement in the quality of the residential building stock and the affordability of housing. Consequently, it is important to examine the extent to which green aspects explain the price of properties in the new housing market, i.e. the premium that buyers have to pay for choosing more energy-efficient housing.

Given the increasing proportion of loan-financed home purchases, which accounted for nearly 50 per cent of all housing transactions in Hungary in 2021 (*MNB 2022*), choosing the right financing source is even more important for energetically advanced, newly built properties, the higher price of which may be associated

with higher borrowing needs. According to the so-called green hypothesis, loans collateralised by more energy-efficient residential buildings have a lower credit risk due to their long-term stable value and lower maintenance costs, which can ideally manifest in lower financing costs. In our study, we use micro-level loan and real estate statistics to test this hypothesis for the Hungarian lending market using statistical methods.

The study is structured as follows: In the *second section*, we review the theoretical background and domestic experience with green financing. In the *third section*, using data from new housing projects in Budapest, we estimate the impact of better energy ratings on prices of new homes using a regression method. In the *fourth section*, we estimate the partial effect of the energy rating on housing loan interest rates using contract-level data. Finally, we summarise our main conclusions.

2. Theoretical background and domestic experience with green financing

Climate change is one of the major challenges of the 21st century. It has an impact on society, economic activity and inflation trends, as well as on financial stability (*Zöldy et al. 2022*). Direct physical damage can reduce the value of properties and the quality of the living environment (*Kim – Peiser 2020*; *Hirsch – Hahn 2018*), which can even be reflected in loan financing costs (*Nguyen et al. 2018*) and also increase insurance premiums.[1] Over-indebted and low-income households may be particularly vulnerable to the potential economic impacts of climate change. The reason for this is that they have less financial resources for green modernisation and adaptation, and typically spend a higher share of their income on consumables such as heating or electricity that have high greenhouse gas emissions (*Zachmann et al. 2018*). Moreover, a deterioration in labour productivity as a consequence of the negative impacts of climate change may also adversely affect households' income and ability to repay loans (*Gosling et al. 2018*).

Depending on the energy performance of the property, the green transition can shape utility costs and thus property values along different possible long-term paths. It is already being suggested that, as a result of the tightening regulation required by climate policy objectives, the rising costs of fossil energy production could lead to sustained price increases and inflationary pressure (see greenflation, *Schnabel 2022*), which could be further exacerbated by geopolitical risks. By contrast, energy modernisation of real estate can already yield results in the short term, both through an immediate reduction in potential energy use and through the resulting returns from higher property prices (*Zancanella et al. 2018*).

[1] Source: https://www.ft.com/content/5d271251-973d-45e5-8982-2e28bf96f952. Downloaded: 1 March 2022.

According to the green hypothesis, residential real properties with better energy efficiency have higher and more stable values and their lower utility costs also reduce the cost of living, which can have an overall positive impact on the loss given default (LGD) and probability of default (PD). The potentially lower default probability of green mortgages may result on the one hand from the more favourable credit risk characteristics of the clients choosing such properties (higher income, more environmentally conscious buyers) and on the other hand from the higher income of the borrowers that can be used to repay the loan due to the lower maintenance costs of the properties. Looking at data from four EU countries, *Baccega et al.* (*2019*) find a robust, statistically significant negative correlation between the energy performance of financed properties and default for Belgium and the Netherlands. *Billio et al.* (*2021*) found a lower risk of default based on data from Danish mortgage transactions, while *Guin and Korhonen* (*2020*) and *Guin et al.* (*2022*) found a lower risk of default on micro data from the UK. *Schütze* (*2020*) found lower expected losses for green mortgages using data for Germany. The results suggest that the energy efficiency of buildings has significant explanatory power for the probability of default of clients, even when examining a wide range of control variables. Overall, therefore, loans financing green properties may have a lower credit risk compared to less energy-efficient properties.

The lower credit risk may justify, *ceteris paribus*, a lower risk premium, and thus lower interest rates for green housing loans. However, little empirical research has been conducted on the relationship between energy efficiency and loan pricing. *An and Pivo* (*2018*) examined the default risk and loan terms of loans for energy-certified buildings in the US office building market. They found that with regard to loans granted for buildings that were already green-certified upon loan origination, banks set interest rates that were 15 basis points lower on average than for buildings that were green-certified only after the loan was granted. According to the authors, the difference in loan pricing is not economically significant compared to their estimate that the default risk for green buildings is 34 per cent lower on average than for other office buildings. *Giraudet et al.* (*2021*) studied the impact of energy efficiency on loan pricing in the French personal loan market. In their analysis, they looked at both home renovation loans and car loans, classifying loans for improving the energy efficiency of a property as “green” in the case of the former and loans for the purchase of a new energy-efficient car in the case of the latter. They found that, on average, the interest rate on loans for green car purchases is lower than on loans requested for other vehicles, while the result for loans for home renovation was counter-intuitive: loans for improving the energy efficiency of buildings are financed more expensively on average by institutions than loans for other renovation. The authors explain the latter result by a phenomenon identified in a previous study

(*Giraudet et al. 2018*), namely that banks' pricing practices reflect the low quality of energy efficiency renovations.

The lower risk of green mortgages is also underpinned by the potentially higher stability in the value of energy-efficient properties today. Demand for green properties is rising due to lower maintenance costs, sometimes higher comfort levels, possible energy efficiency regulations (*Ferentios et al. 2021*) and the gradual incorporation of energy performance data into purchasing criteria (*Hartenberger et al. 2017*), suggesting that these properties may exhibit a green price premium (*Hyland et al. 2013*; *Cajias – Piazolo 2013*; *Stanley et al. 2015*; *Fuerst et al. 2020,* etc.). Looking at domestic studies, *Ertl et al.* (*2021*), analysing data on detached house transactions in 2019, found that there is a significant premium in the price of detached houses as a result of a higher energy rating. Compared to the FF energy rating considered as average, a discount of around 20 per cent was identified for properties with worse energy performance, while a price premium of 10–15 per cent was identified for properties with higher energy ratings. The authors also found that family houses with a BB or higher energy rating are about 13 per cent more expensive than those with a CC energy rating. This suggests that the value of green properties may remain higher even during periods of real estate market stress, and thus the green housing market may be less volatile, meaning that green mortgage collateral may offer higher returns for lenders in the event of default.

Table 1
Overview of the credit risk characteristics of green mortgage lending

Author	Sample (geographical scope)	Property value/Loss given default	Default risk
Hyun et al. (2013)	*Ireland* data on 260,000 real estate transactions	*Significant* real estate price premium	*Not examined*
Cajias – Piazolo (*2013*)	*Germany* data on 2,630 real estate transactions	*Significant* real estate price premium	*Not examined*
Stanley et al. (*2015*)	*Ireland* data on 2,792 real estate transactions in the surroundings of Dublin	*Significant* real estate price premium	*Not examined*
Fuerst et al. (*2020*)	*United Kingdom* micro-data on real estate transactions	*Significant* real estate price premium	*Not examined*
Ertl et al. (*2021*)	*Hungary* real estate transaction data for 2019 (detached houses)	*Significant* real estate price premium	*Not examined*
Baccega et al. (*2019*)	*Four EU countries* aggregate data: UK, IT microdata: BE, NL	*Not examined*	IT, UK: data suggesting lower risk BE, NL: robust negative correlation
Schütze (*2020*)	*Germany* aggregate data	*Significant* lower expected losses for modern properties	
Guin – Korhonen (*2020*)	*United Kingdom* microdata	*Not examined*	*Significant* green housing loans are less likely to default
Billio et al. (*2021*)	*Denmark* 120,000 properties period between 2014–2018	*Not examined*	*Significant* greater impact for lower income clients
Guin et al. (*2022*)	*United Kingdom* microdata	*Not examined*	*Significant* green housing loans are less likely to default

Overall, the above studies suggest that, by taking into account the energy performance of properties, lenders can make more accurate lending decisions compared to institutions that ignore these characteristics. The potentially lower credit risk of energy-efficient properties could therefore have a significant impact in the future on lenders' risk management, regulatory requirements and the potential for the use of green financing instruments. Incorporating the energy performance of real estate collateral into lending and pricing may allow for lower interest rates for more energy-efficient properties and the development of dedicated green loan products, due to the lower risk premium. However, the picture is complicated by

the fact that the studies examined (*Table 1*) only looked at relatively short time horizons and only found a correlation between energy rating and real estate price and probability of default for certain countries or sub-markets. Further research is therefore needed to provide general support for the green hypothesis, which will require the development of widespread access to energy data.

3. The link between the energy performance of residential buildings and prices

3.1. Data used for the estimation

To answer the question of how more advanced energy features affect the price of newly built homes, we use data from new housing projects in Budapest to make our statistical estimates. The database is the Budapest Housing Market Report,[2] compiled by the Eltinga Real Estate Market Research Centre, which covers new housing projects in Budapest that are larger than four residential units and are currently under development and for sale, on a quarterly basis. The database contains detailed information on the energy performance of buildings since Q1 2019, which can be either the energy performance certificate or the type of building engineering, or both.

For the period between Q1 2019 and Q4 2021, our database contains a total of 5,371 project observations, where an observation covers the characteristics of a housing project for a given quarter (e.g. construction status, planned completion, average square meter supply price). Adding up all the individual projects monitored over the three-year period, this represents some 41,501 new homes in Budapest. For 76 per cent of the project observations (4,090 observations), information on the energy performance certificate was available, and for 68 per cent (3,668 observations), the database included the average square meter supply price per vacant home, in addition to the certification information. Energy performance certificates are not yet available during the construction of buildings, as they can be issued for buildings that are already completed and awaiting occupancy permits; in many cases, however, developers already provide a projected certificate value based on the construction plans. Finally, the certificate values given in the first case of completed buildings were imputed to observations for previous quarters of the project, when the project was still pending or under construction.

[2] https://eltinga.hu/en/housing-report

The energy performance certificate shows the energy performance characteristics and efficiency of the building, as determined by a calculation method[3] according to the legislation. In Hungary, an energy performance certificate is required for the occupancy permit for new residential buildings and for the purchase of second-hand residential buildings, and is valid for 10 years afterwards. The current Hungarian system of energy performance certificates has been in place since 2016 and divides the overall energy performance of buildings according to a 12-grade scale *(Table 6 in the Annex).* In our study, we look at the impact of energy ratings and, in relation to the energy performance of buildings, the existence of renewable energy utilisation in buildings.

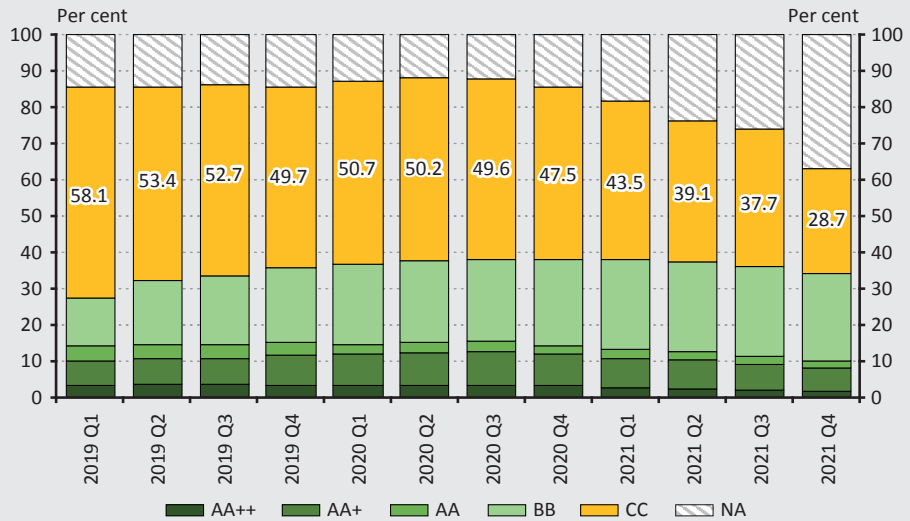
According to the requirement laid down in EU taxonomy,[4] the primary energy demand determining the energy performance of a building should be less than or equal to the threshold for nearly zero-energy demand (hereinafter "NZE") buildings set in national measures implementing Directive 2010/31/EU of the European Parliament and of the Council,[5] which in the Hungarian legislation is 100 kWh/m^2/year. The introduction of the NZE requirement for newly built residential buildings in Hungary was originally set for 1 January 2021, which the regulatory authority first postponed by half a year, then by another year, and then by two more years in the summer of 2022. Therefore, the period between 2019 and 2021 examined in our study is an appropriate period to examine the transition towards the NZE requirement in the supply of new homes and the impact of these more stringent requirements on the new housing market, because, in response to the anticipated tightening of regulations, developers have gradually adapted, and an increasing proportion of buildings have been built to meet the NZE requirement.

Based on the new housing developments in Budapest in our database, it can be seen that in 2019 the majority of residential buildings on the market (planned, under construction or completed but still with vacant units) did not yet meet the NZE requirement. In Q1 2019, 58.1 per cent of new residential units under development and for sale in Budapest had a CC energy rating, and, considering only known certificates, 68.1 per cent of homes did not meet the NZE requirement (*Figure 2*). In many cases, the database does not contain data on the energy

[3] The Hungarian certification system is set out in Government Decree No 176/2008 (VI. 30.).
[4] Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088 Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020R0852 Commission Delegated Regulation (EU) 2021/2139 of 4 June 2021 supplementing Regulation (EU) 2020/852 of the European Parliament and of the Council by establishing the technical screening criteria for determining the conditions under which an economic activity qualifies as contributing substantially to climate change mitigation or climate change adaptation and for determining whether that economic activity causes no significant harm to any of the other environmental objectives. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=PI_COM:C(2021)2800
[5] https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32010L0031&from=EN

performance certificate, but does contain data on the building engineering. The missing certificates were substituted in according with the following principle: a BB certificate was assumed if renewable energy was used in the building engineering, and a CC certificate was assumed if not, which is referred to as the estimated energy performance certificate. Our rating is based on the principle that, according to the regulations, a property can only be rated BB or higher in Hungary if it uses at least 25 per cent renewable energy.

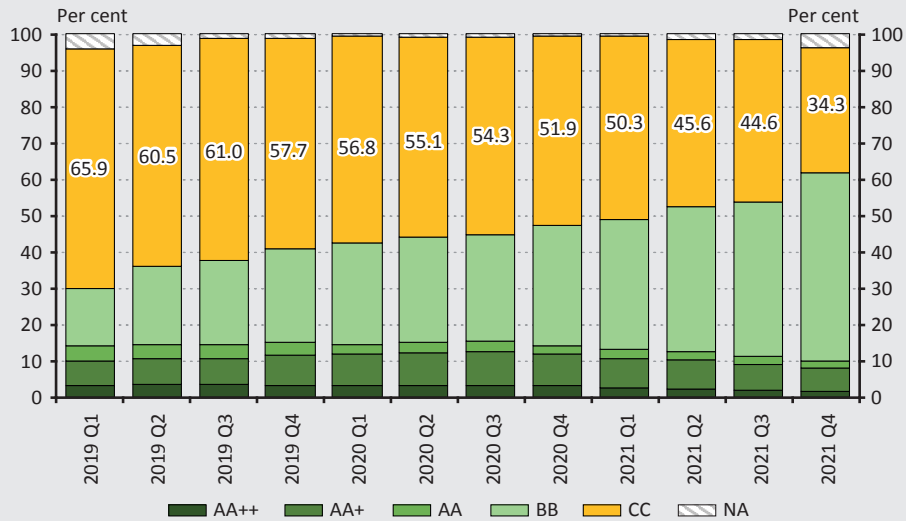
Figure 2
Distribution of the number of residential units in condominium projects under development and for sale, based on known energy ratings



Source: Calculations based on Eltinga–Housing Report data

Looking at the temporal distribution of residential units under development and for sale by estimated energy performance certificates, the "green" transition in the new housing market is clearly visible, i.e. buildings meeting the NZE requirement are gaining ground as we approach the previously expected entry into force of the NZE requirement (*Figure 3*). In Q1 2019, 65.9 per cent of the new residential unit supply in Budapest did not meet the NZE requirement (i.e. had a CC rating), which fell to 34.3 per cent by Q4 2021.

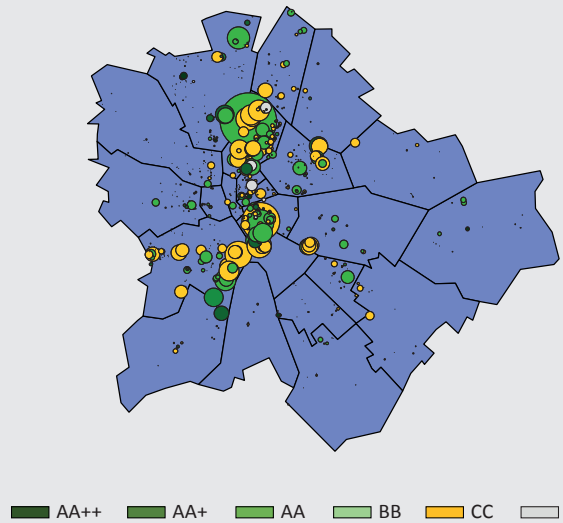
Figure 3
Distribution of the number of residential units in condominium projects under development and for sale, based on estimated energy ratings



Source: Calculations based on Eltinga–Housing Report data

The spatial distribution of new residential units on the market in the last three years is highly concentrated. 29.3 per cent of the residential units are located in one district (District 13) out of the 23 districts in Budapest (*Figure 4)*. 57.6 per cent of the residential units are located in three districts (13th, 11th and 9th) and 90.4 per cent in 11 districts. The high spatial concentration of new condominium developments is explained on the one hand by the availability of development sites and the location of marketable areas that are closer to the city centre or have good public transport connections. As shown in *Figure 4*, most of the condominium development projects are located in the central part of Budapest, along a north-south axis. The Budapest public transport network is particularly favourable in these areas, with several metro connections, which significantly increases the value of residential buildings. However, the proportion of environmentally sustainable, new homes meeting the NZE requirement is not highest where most homes are built. The share of new homes with at least a BB rating is highest in Districts 12, 17, 3 and 1 (over 80 per cent), while in District 13, where most new homes are built, only 33.9 per cent of homes met the NZE requirement between 2019 and 2021.

Figure 4
Location, number of homes and estimated energy performance certificates of new housing projects in Budapest for sale between Q1 2019 and Q4 2021

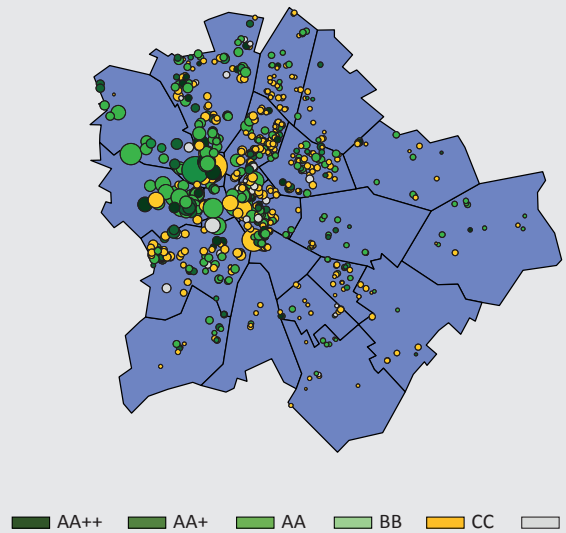


Note: Based on estimated energy performance certificates where not known; BB if renewable energy use is known, otherwise assuming a CC rating. The size of the circles in the chart is proportional to the number of homes (the largest circle represents 790 homes).

Source: Calculations based on Eltinga–Housing Report data

There is considerable variation in the average square meter supply price of housing projects. In Q4 2021, the average square meter price of a new residential unit in the most expensive building was HUF 3.9 million, while the average price of a new residential unit in the cheapest building was HUF 616,000. The average square meter supply price of a new residential unit in Budapest as a whole was HUF 1.1 million. *Figure 5* shows the importance of location in the pricing of residential buildings. The central areas of the capital and the 12th District are the most expensive in terms of average square meter price.

Figure 5
Location, average square meter price and estimated energy performance certificates of new housing in Budapest for sale between Q1 2019 and Q4 2021



Note: Based on estimated energy certificates where not known; BB if renewable energy use is known, otherwise assuming a CC rating. The size of the circles in the figure is proportional to the square meter price of the apartments (the largest circle represents 3.9 million HUF/m²).

Source: Calculations based on Eltinga–Housing Report data

The distribution of projects meeting and not meeting the NZE requirement by number of homes and square meter price differs, especially for the latter. 55 per cent of housing projects with CC energy performance certificates are condominiums of 25 units or less, while 61 per cent of homes with BB energy rating fall into this category. 31 per cent of housing projects not meeting the NZE requirement had an average square meter supply price of HUF 750,000 or less, while the same proportion for projects meeting the NZE requirement was only 13 per cent. Overall, relatively cheaper housing projects with 25–100 homes are over-represented among those with a CC energy performance certificate (*Table 2*).

Table 2
Distribution of individual projects in the database by square meter price and number of homes broken down by category of estimated energy performance certificates

	Less than 25 units	25 – 50	50 – 100	100 – 200	Over 200 units	Total
	CC					
Below HUF 0.75 mn	18.6	4.2	3.3	3.1	1.4	**30.6**
HUF 0.75 – 1.0 mn	23.9	7.2	6.9	5.0	3.1	**46.1**
HUF 1.0 – 1.25 mn	7.8	1.7	2.2	1.4	1.7	**14.7**
HUF 1.25 – 1.5 mn	2.8	0.8	0.6	0.3	1.1	**5.6**
HUF 1.5 – 1.75 mn	0.8	0.0	0.0	0.0	0.0	**0.8**
HUF 1.75 – 2.0 mn	0.0	0.0	0.3	0.0	0.0	**0.3**
Above HUF 2.0 mn	0.8	0.3	0.8	0.0	0.0	**1.9**
Total	**54.7**	**14.2**	**14.2**	**9.7**	**7.2**	**100.0**
	BB or higher					
Below HUF 0.75 mn	9.1	1.0	1.8	0.5	0.5	**13.1**
HUF 0.75 – 1.0 mn	17.8	4.7	6.3	3.9	1.6	**34.2**
HUF 1.0 – 1.25 mn	11.5	4.2	2.9	3.4	2.1	**24.0**
HUF 1.25 – 1.5 mn	8.6	0.8	1.0	0.5	0.8	**11.7**
HUF 1.5 – 1.75 mn	5.0	0.0	0.3	0.5	0.0	**5.7**
HUF 1.75 – 2.0 mn	2.6	0.3	0.3	0.8	0.0	**3.9**
Above HUF 2.0 mn	6.0	0.8	0.3	0.3	0.0	**7.3**
Total	**60.6**	**11.7**	**12.8**	**9.9**	**5.0**	**100.0**

Note: Based on the latest price information for each project.
Source: Calculations based on Eltinga–Housing Report data

3.2. Estimation results: The link between the energy performance of residential buildings and prices

In the following, we look at the impact of the buildings' energy performance certificates, i.e. their energy efficiency, on the average square meter supply price of new housing projects. We examine this using a linear regression model, where the dependent variable is the average square meter supply price of new housing projects in each quarter and the explanatory variables are the different characteristics of the projects, including their energy performance. The explanatory variables of the model include a binary variable identifying the quarter of sale, which, in addition to including other explanatory variables, essentially captures the average "pure" price variation of the housing market.[6] Location is a significant driver of property values, which we controlled for in our model using several variables. First, we divided Budapest into 19 different relatively homogeneous areas based on postal codes. These areas were delimited by means of a regression method so that each area was as homogeneous as possible in terms of, inter alia, price and property type, and the postal codes

[6] This approach is essentially in line with the hedonic regression methodology used to calculate house price indices, which is also followed inter alia by the MNB house price index. (*Banai et al. 2018*).

constituting the areas were close to each other. In terms of location, two additional variables were created using the geocodes of the projects: (i) the straight line distance of the projects from Deák Ferenc Square, as the largest downtown public transport hub in Budapest, and (ii) the straight line distance of the projects from the nearest metro station, which is intended to control for the "quality" of public transport. The price of housing in our model is thus determined, on the location side, by the neighbourhood in which it is located (less expensive or more expensive) on the one hand and by the quality of public transport in the area, on the other.

Other characteristics of the projects are captured in the modelling with the following variables: the number of units in the project, the pre-sales rate in the given quarter, the rate of housing tax and the size of the developer. The number of housing units in a project captures the complexity of the development. The pre-sale rate is a control for the fact that, during the initial period of sale, it is likely that units with smaller floor areas which are thus more marketable but with higher square meter prices will be sold quickly, and therefore, in case of a higher pre-sales rate the project is likely to cover less marketable units and therefore with lower unit prices. The VAT rate on housing changed several times during the period of our analysis, between 2019 and 2021. Developers may price in a higher tax burden into the price of residential units that can be sold at a higher VAT rate. Finally, the size of developers was determined based on whether they develop more or fewer than 250 residential units in a given quarter. Larger firms may offer buyers a more competitive price due to economies of scale, better market knowledge and longer-term contractor relationships.

We included the energy performance of housing projects in our estimates in three ways. First, with energy performance certificates known with certainty. Secondly, with energy performance certificates supplemented by estimation, where we assumed a BB certificate for the use of renewable energy in the case of certificates that are not known, and otherwise a CC certificate. In our third approach, we used exclusively the information on whether a building uses renewable energy. We expect that properties with more advanced energy systems may be more expensive compared to less advanced properties, which may be mainly due to lower maintenance costs and stability of value. The higher price may also be due to the higher cost of the engineering and building materials needed for more advanced energy systems.

The main results of our estimation are shown in *Table 3*. In our main model (Model 1), we control for the energy performance of new housing projects using the energy performance certificate data that is known with certainty; thus, our estimate is based on 3,659 observations and has an explanatory power of 74 per cent. The explanatory variables included in the main model all significantly explain our target variable. Based on the quarterly coefficients of advertising, the average square meter supply price of new homes increased significantly between Q1 2019 and Q4 2021, rising by 33.1 per cent overall and by 2.6 per cent on average per quarter, simply due to the lapse of time, i.e. such a large increase in the price of new housing can be measured in the Budapest new housing market. According to the MNB's

housing price index, housing prices in Budapest rose 21.2 per cent between Q1 2019 and Q3 2021, while the model shows that new housing prices in Budapest rose 26.6 per cent over the same period. Price indices for new and pre-owned homes from the Hungarian Central Statistical Office (HCSO) also show a similar picture, i.e. indicating higher price increases for new homes. The former rose by 31.3 per cent and the latter by 25.2 per cent over the period, but the HCSO only publishes price indices for the country as a whole, and therefore we cannot directly compare our results for the Budapest housing market with the price increases published by the HCSO.

In the model, the energy performance of the buildings was controlled for using the known energy performance certificates, where the CC-rating certificate was taken as the benchmark. Buildings with AA or better rating were aggregated into one category, due to the lower number of elements compared to CC and BB-rated buildings. Our results show that buildings with a BB energy performance certificate (compliant with the NZE requirement) have a significantly higher average square meter supply price per home, by some 5.1 per cent, compared to those with a CC certificate. The partial price effect of buildings with AA or better rating, which is more favourable than the NZE requirement, is slightly higher, at 6.1 per cent, compared to those with CC rating. The model is also estimated with the BB category as the benchmark. Based on the results of this model, there is no significant price difference between BB and AA or better rated buildings, the latter being only significantly more expensive than buildings with CC rating. Our results show that the price of new homes meeting the NZE requirement differs significantly from those with CC rating, while there is no statistically significant premium for buildings with better energy performance certificate than the NZE requirement in the metropolitan market for new residential units.

Most of the other explanatory variables in the regression have significant intuitive signs (*Table 3*). A higher number of residential units increases the average square meter supply price of the project, which is probably due to the fact that developers seek to build and sell as many residential units as possible in an area that offers better business opportunities for them. In line with our preliminary expectation, higher pre-sale rates are negatively correlated with the average square meter supply price, meaning that lower-priced residential units, such as those with larger floor areas or less favourable locations, are sold at the end of the project sales period. The distance of a project from the nearest metro station also has a significant explanatory power on the square meter price: an extra kilometre reduces the average square meter supply price by 1.4 per cent. A dummy variable defined for 19 different areas of Budapest was also found to be significant. The VAT on housing was insignificant in our estimations and was therefore not included in our final model. This is presumably also due to the fact that when the reduced housing tax was phased out at the end of 2019, the rules still allowed the majority of new homes to be sold at a 5 per cent VAT rate, and the 5 per cent housing tax returned in general from 2021. We also eventually removed the size of developers from our estimates, as the variable's inclusion no longer materially improved our model.

Table 3
Regression results showing the factors explaining the average square meter supply price of new housing projects

Dependent variable: Logarithm of the average square meter supply price of the project	Model 1		Dependent variable: Logarithm of the average square meter supply price of the project	Model 2	
	Coefficient	p-value		Coefficient	p-value
Advertising quarter			**Advertising quarter**		
2019 Q2	0.051	0.000	2019 Q2	0.056	0.000
2019 Q3	0.081	0.000	2019 Q3	0.082	0.000
2019 Q4	0.100	0.000	2019 Q4	0.102	0.000
2020 Q1	0.130	0.000	2020 Q1	0.131	0.000
2020 Q2	0.140	0.000	2020 Q2	0.146	0.000
2020 Q3	0.152	0.000	2020 Q3	0.151	0.000
2020 Q4	0.161	0.000	2020 Q4	0.166	0.000
2021 Q1	0.181	0.000	2021 Q1	0.193	0.000
2021 Q2	0.207	0.000	2021 Q2	0.221	0.000
2021 Q3	0.235	0.000	2021 Q3	0.236	0.000
2021 Q4	0.286	0.000	2021 Q4	0.295	0.000
Energy performance certificate			**Advertising quarter * use of renewable energy**		
BB	0.050	0.000	2019 Q1	0.056	0.001
AA, or higher	0.059	0.000	2019 Q2	0.051	0.001
			2019 Q3	0.062	0.000
			2019 Q4	0.057	0.000
			2020 Q1	0.065	0.000
			2020 Q2	0.055	0.000
			2020 Q3	0.067	0.000
			2020 Q4	0.052	0.001
			2021 Q1	0.044	0.004
			2021 Q2	0.053	0.001
			2021 Q3	0.077	0.000
			2021 Q4	0.067	0.000
Number of units	0.0002	0.000	**Number of units**	0.0001	0.000
Pre-sale rate	–0.114	0.000	**Pre-sale rate**	–0.109	0.000
Distance from metro	–0.014	0.000	**Distance from metro**	–0.018	0.000
Areas in Budapest	Based on postcodes, 19 homogeneous areas with significant coefficients.		**Areas in Budapest**	Based on postcodes, 19 homogeneous areas with significant coefficients.	
Constant	14.447	0.000	**Constant**	14.377	0.000
Number of observations	3,659			4,271	
R^2	74.30			75.18	
Adjusted R^2	74.06			74.92	

We tested the robustness of our model in several ways. For instance, the model calculation was performed with energy performance certificates supplemented by estimation, bringing the total number of observations to over 4,500. We obtained very similar results for the partial effect of energy performance certificates on average square meter prices. Buildings with BB certificates were on average 5.7 per cent more expensive than buildings with CC certificates, while the partial effect of AA or better certificates increased slightly to 6.5 per cent. The model estimation was also conducted including only the binary variable of whether or not the building uses renewable energy, instead of the energy performance certificates. According to our estimates, the use of renewable energy increases average square meter prices by 6.0 per cent, which is also consistent with the results of our main model. We also extended our model to include interactions between renewable energy use and sales quarters to assess whether the partial effect of more advanced energy use changed over time (*Table 3, Model 2*). Based on this estimate, the price premium for buildings using renewable energy ranged from 5.3 to 6.9 per cent until Q4 2020, declined to 4.5 per cent in Q1 2021, and then was 8.0 and 6.9 per cent in Q3 and Q4 2021, respectively. The latter value may also reflect the demand stimulus effect of the FGS Green Home Programme. Finally, as part of the robustness analysis, we estimated our model by eliminating buildings with over 250 units. This reduced the number of items in the sample by just over 100 observations, and the price premium for buildings rated BB and AA or better increased slightly by approximately one percentage point compared to those rated CC.

Overall, the results are in line with previous findings in the national and international literature, suggesting that residential buildings with more advanced energy systems exhibit a significant price premium. *Ertl et al.* (*2021*) found that detached houses with a BB or better energy rating are about 13 per cent more expensive than those with a CC energy rating, suggesting that the green price premium for detached houses in Hungary may be higher than for new-build condominium units. Comparisons with the results of the international literature are, however, complicated by the fact that the energy scales studied are diverse. Nevertheless, our results fit with the general findings whereby better energy efficiency increases the value of residential buildings (see, for example, *Hyun et al. 2013*; *Stanley et al. 2015*).

4. Identifying the impact of energy efficiency on interest rates

In the next section of our study, we use linear regression to investigate the impact of energy performance certificate on the interest rate of newly contracted housing loans, i.e. whether banks take energy efficiency into account, *ceteris paribus*, when pricing loans.

4.1. Data used and descriptive statistics

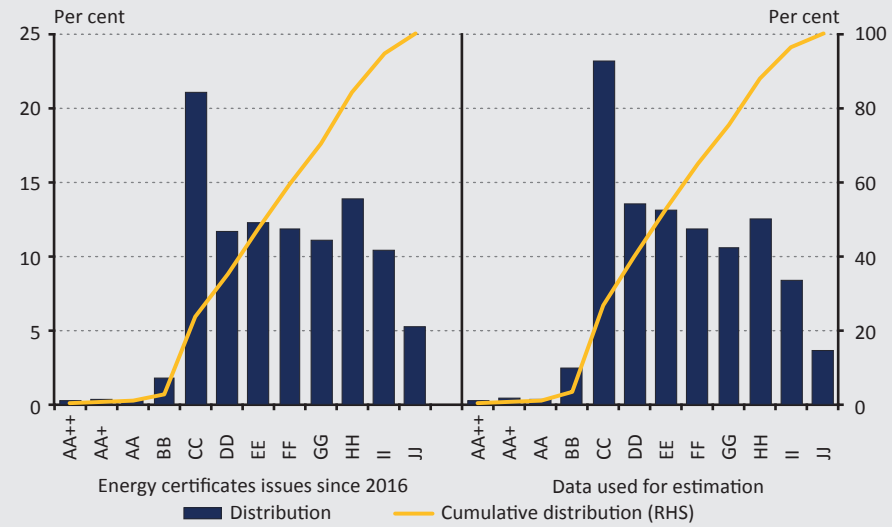
Our analysis is based on the information content of two databases:

- The central bank's credit register (HITREG) database, which contains anonymised, transaction-level data on the contractual details of retail loan contracts on the balance sheet of credit institutions;
- and the Real Estate Transaction (ING) report, which also contains anonymised, transaction-level data on the characteristics of the real estate, as the subject matter of the sale and included as collateral in the loan or lease contracts concluded during the reference period.

As the latter data set only contained data for 2021 and Q1 2022 at the time of the analysis, from the former database we only kept the observations contracted during this period, and thus the estimation results relate primarily to this period. In the HITREG database 85,165 and in the ING database 71,162 individual observations on the purchase of new or second-hand homes are available for 2021 and 2022 Q1, but for 28,326 observations from the latter population the energy performance certificate is unknown and these observations were dropped. In total, by combining the databases, we have a micro-level database containing 38,194 observations by loan contract, which anonymously contains the most important characteristics of the borrower, the loan contract and the collateral for new housing loan contracts.

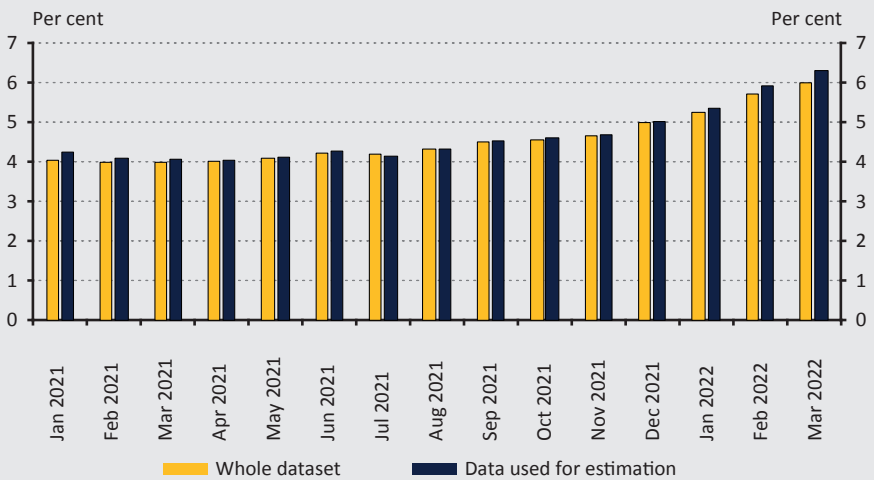
The representativeness of the data for the whole population was tested from two perspectives. On the one hand, the distribution of energy performance certificates of the properties in the database is almost identical to the distribution of energy performance certificates of the national residential building stock (*Figure 6*), indicating appropriate representativeness in terms of energy ratings. On the other hand, with respect to the average interest rates describing the dependent variable of our estimation, it can be observed that the weighted average interest rates used in the estimation are typically higher than for the whole population, but the difference does not exceed 30 basis points in any of the months considered (*Figure 7*).

Figure 6
Distribution of energy performance certificates of the properties



Note: FGS GHP-transactions were eliminated from the database.
Source: e-tanusitas.eu, calculations based on MNB data

Figure 7
Weighted average interest rate on the housing loan contracts used in the estimation



Note: FGS GHP-transactions were eliminated from the database.
Source: Calculated based on MNB data

Based on the descriptive statistics, an intuitive picture emerges with respect to the average year of construction and the average square meter price of the properties used as collateral: properties with higher energy ratings were on average built later and are more expensive (*Table 4).* As regards the distribution of average interest rates by energy performance certificate, which describes the dependent variable of our estimation, it can be observed that banks typically lend at lower average interest rates for contracts secured by properties with higher rated energy performance certificates. This leads us to conclude that institutions do take into account the energy performance of the property when pricing loans, but the difference in average interest rates may capture other characteristics strongly related to the energy performance certificate, such as the quality of the property or the riskiness of the borrower. Therefore, in the next section of our study, we use a linear regression method with control variables to examine the partial effect of energy rating on interest rates.

Table 4
Descriptive statistics of loan contracts in the database by energy rating

Energy rating	Number of observations	Average construction year	Average square meter price (HUF)	Average interest rate (%)
AA++	93	2018	816,727	4.40
AA+	140	2012	775,024	4.35
AA	120	2010	662,083	4.54
BB	933	2013	677,194	4.64
CC	8,836	1997	560,124	4.70
DD	5,154	1985	489,723	4.78
EE	5,012	1977	444,570	4.87
FF	4,517	1970	418,576	4.97
GG	4,028	1965	372,750	5.18
HH	4,786	1962	305,363	5.45
II	3,198	1961	294,425	5.63
JJ	1,377	1960	270,905	5.65

Source: Calculated based on MNB data

4.2. Estimation results: The link between energy performance certificates for residential buildings and interest rates

The methodological implementation of our analysis, which focuses on the impact of energy efficiency on interest rates, is based on the previous studies in the Hungarian literature in which the authors aimed to identify factors explaining lending rates (see, for example *Aczél et al. 2016*; *Dancsik – El-Meouch 2019*). In addition to the explanatory variables used in the literature, we also include variables controlling for the location and quality of the property, based on the ING database, in order

to accurately estimate the partial effect of the energy performance certificate. The explanatory variables used in the model are:

- Property characteristics[7]
  - Energy performance certificate of the property used as collateral
  - Square meter price, expressed as the ratio of the sale price of the property to the useful floor area of the property, in thousand HUF

- Contract characteristics
  - Age of the borrower
  - The net monthly income of the borrower, recorded at the time of the loan contract and taken into account in the debt-service-to-income ratio, expressed in thousand HUF, categorised; in the case of multiple borrowers, the variable includes the aggregated income of the debtors
  - Debt-service-to-income (PTI): the monthly repayment as a proportion of the borrower's net monthly income
  - Loan-to-value (LTV): loan amount as the proportion of the collateral value (value of property)
  - Size of the contracted loan amount, expressed in million HUF, categorised
  - Contracted length of the interest rate period, categorised

- Other, binary variables
  - HPS-loan dummy: Is the loan a subsidised housing loan under the Home Purchase Subsidy Scheme for Families (HPS)?
  - CCHL-loan dummy: Is the loan a Certified Consumer-friendly Housing Loan (CCHL)?
  - Time dummy: the month in which the housing loan contract is signed, controlled for changes in the yield curve and the funding costs
  - Bank dummy: bank disbursing the loan[8]

In our model, properties with better than BB energy performance certificate were grouped into one category, which was mainly justified by the low number of observations available in the database. In the model, properties with the largest number of observations in the database and a CC energy performance certificate were taken as the benchmark. To identify partial effects, the following linear regression (OLS) was estimated:

$$INTEREST\ RATE_i = \beta_0 + \beta_1\ PROPERTY_i + \beta_2\ CONTRACT + \beta_3\ HPS\ LOANdummy_i + \beta_4\ CCHL\ LOANdummy_i + \beta_5\ BANKdummy_i + \beta_6\ TIMEdummy_i + \varepsilon_i \quad (1)$$

[7] We included the year of construction among the explanatory variables during the model construction, but it did not prove to be significant, therefore it is not included in the model presented here.
[8] Banks with fewer than 400 observations were dropped from the estimation, reducing our database to 37,907 observations.

where *INTEREST RATE*$_i$ is the annualised interest rate on the i-th contract. *PROPERTY* is a vector containing the property characteristics, *CONTRACT* is a vector containing the contract characteristics, and dummy variables are included for *HPS*- and *CCHL*-loans, as well as for the disbursing bank and the date (month) of the contract. β_0 is a constant, β_1, β_2, β_3, β_4, β_5 and β_6 are vectors of coefficients associated with each set of variables.

Based on the R^2 statistic, the explanatory power of the model reached 75 per cent. All explanatory variables significantly explain the interest rate on housing loans at the 5 per cent significance level. For the question that is most relevant to this stage of our analysis, the model provides the following result: for properties with an energy rating of BB or better than BB, there is no negative partial effect on the contract rate, even at the 10 per cent significance level (*Table 5*). This result shows that for properties with the best energy performance, banks do not factor energy considerations into the pricing of loans. However, a significant positive effect can be measured on the pricing of loan contracts for properties with energy performance certificates significantly lower than CC, such as FF, GG, HH, II and JJ. With regard to the latter result, it is conceivable that the low energy rating, in addition to the effect captured through other control variables, captures the poor quality of the property, which banks take into account in the terms of the loan contracts.

A significant negative partial effect can be measured for the square meter price variable controlling for the quality of the property, but the magnitude of the effect is negligible. The results on the characteristics of the contract are also in line with our preliminary expectations: institutions tend to lend at increasingly lower interest rates on average to clients in the higher income category and to clients requiring higher loan amounts.[9] In addition, a longer interest period, a higher payment-to-income and loan-to-value ratio on average increase the level of the interest rate, although the latter variables have a low partial effect. We also controlled for the type of loan: the partial effect of Certified Consumer-Friendly Housing Loans is significantly negative and that of HPS loans is significantly positive.[10] Finally, we also included in the estimation the disbursing bank and the month of disbursement, controlling for different pricing behaviour of banks in the former case and for the rising yield environment in the latter.

[9] As a reflection of typical pricing practices of banks, the contract amount and income variables were included as category variables in the model.

[10] *Dancsik et al.* (*2022*) also found that banks typically price *overall* subsidised HPS-loans at a higher rate than market loans (taking into account the interest paid by the client and the interest subsidy paid by the state), which may be due to the statutory fixed client interest rate and the resulting low intensity of competition.

Table 5
Result of the estimated OLS-regression

Dependent variable: annualised interest rate of the contract	Coefficient	p-value
Energy performance certificate (compared to CC)		
higher than BB	0.009	0.832
BB	–0.008	0.742
DD	0.012	0.363
EE	0.032	0.015
FF	0.051	0.000
GG	0.072	0.000
HH	0.103	0.000
II	0.119	0.000
JJ	0.155	0.000
Square meter price	–0.000	0.003
Age	0.001	0.004
Income category (compared to an income of up to HUF 250,000, in thousand HUF)		
250–500	–0.252	0.000
500–750	–0.360	0.000
More than 750	–0.443	0.000
PTI	0.004	0.000
LTV	0.002	0.000
Contract amount category (compared to a maximum contract amount of HUF 5 million, in million HUF)		
5–10	–0.519	0.000
10–15	–0.834	0.000
15–20	–1.068	0.000
over 20	–1.491	0.000
Length of interest rate period (compared to an interest rate period of at least 1 but not more than 5 years)		
5–10 years	0.664	0.000
over 10 years	1.048	0.000
HPS-loan	1.218	0.000
CCHL-loan	–1.088	0.000

Table 5
Result of the estimated OLS-regression

	Coefficient	p-value
Date of disbursement (compared to January 2021)		
February 2021	–0.043	0.146
March 2021	–0.067	0.013
April 2021	–0.137	0.000
May 2021	0.010	0.741
June 2021	0.048	0.060
July 2021	0.223	0.000
August 2021	0.300	0.000
September 2021	0.346	0.000
October 2021	0.443	0.000
November 2021	0.592	0.000
December 2021	0.929	0.000
January 2022	1.325	0.000
February 2022	1.90	0.000
March 2022	2.196	0.000
Bank disbursing the loan	9 banks with significant coefficients	
Constant	6.077	0.000
Number of observations	36,072	
R^2	0.747	
Adjusted R^2	0.747	

Note: We also ran the regression with the elimination of HPS-loans and found no significant change in the estimated coefficients. HPS-loans are included in the sample at the full interest rate, i.e. they also include state subsidy, and thus the principles generally applied in bank pricing to the full price are valid. Moreover, we control for potential pricing discrepancies of HPS-loans with an HPS binary variable in the original regression.

Source: Calculated based on MNB data

5. Conclusions

According to the green hypothesis, residential buildings with more modern, environmentally sustainable energy performance are more stable in value and have a lower credit risk. The construction costs of homes with more advanced energy systems are higher, but the lower credit risk of home loans for these properties justifies, *ceteris paribus*, a lower interest rate, which may partly offset the higher transaction price. In our study, we used statistical methods to examine the existence of sustainability considerations in the domestic new housing and housing finance market.

One of the main conclusions of our study is that housing developers in the Budapest new housing market offer environmentally sustainable properties at significantly higher prices. We estimate that the average square meter supply price of homes in buildings with BB energy performance certificate is significantly higher, by about 5.1 per cent, compared to those with CC certificate. Furthermore, the average square meter price of buildings rated AA or better was not found to be significantly higher compared to those rated BB.

Looking at the credit market implications of the green hypothesis, we found that banks do not finance residential buildings with environmentally sustainable energy more cheaply: the interest rate on loans for properties with a BB or better energy rating is on average no different from the interest rate on loans for properties with a CC energy rating. This result shows that banks do not yet factor energy considerations into pricing of loans. In the current banking practice, amongst other things, the risk parameters of the borrower and the loan contract as well as other qualitative features of the property play a key role in determining the interest rate.

Overall, in the domestic market for new housing, developers already offer homes with more advanced energy systems at higher prices, but there is currently no bank product on the market offering better terms for the purchase of environmentally sustainable residential buildings financed by a loan. The latter finding points to the need for the uptake of green credit products, which would contribute significantly to accelerating the sustainable economic transition in the Hungarian housing market by stimulating the demand side.

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Annex

Table 6
Classification of buildings according to their overall energy performance and their relative percentages

Energy rating	Textual description of energy rating	Percentage ratio by aggregate energy indicator (%)
AA++	Minimum energy demand	<40
AA+	Outstandingly high energy efficiency	40–60
AA	Better than nearly zero-energy buildings requirements	61–80
BB	Meets the requirements for nearly zero-energy buildings	81–100
CC	Modern	101–130
DD	Nearly modern	131–160
EE	Better than average	161–200
FF	Average	201–250
GG	Close to average	251–310
HH	Poor	311–400
II	Bad	401–500
JJ	Extremely bad	500<

Source: e-tanusitas.eu

Climate Stress Test: The Impact of Carbon Price Shock on the Probability of Default in the Hungarian Banking System*

Bálint Várgedő

This study presents the methodology and results of a transition risk climate stress test carried out for credit institutions, focusing on the methodology of a sectoral module developed for the analysis. Using a sectoral network derived from an input-output table, the sectoral module distributes a price shock between activities with higher greenhouse gas emission intensity and the related sectors. Results suggest that the sectors with the largest exposure to transition are electricity and gas supply. The probability of default for these two sectors may increase by 1.5 to 2.3 percentage points compared to the baseline. The transition risks for various sectors are highly heterogeneous. Based on Monte Carlo simulations, the extent of the transition risks for Hungarian banks also varies significantly. The advantage of this methodology lies in its ability to estimate the magnitude of macroeconomic shocks and the transition differences across sectors, and its ease of integration into stress testing processes.

Journal of Economic Literature (JEL) codes: G21, G32, Q54

Keywords: climate stress test, transition risk

1. Introduction

In recent years, investigating the impact of climate change on the financial system has emerged as a new challenge for central banks, supervisors and market participants. Climate stress tests, as risk assessment tools, have again become the focus of inquiry due to the forward-looking nature of the problem, given the limited usability of methodologies based solely on historical data. Established by the Financial Stability Board, the *Task Force on Climate-related Financial Disclosures* (*TCFD 2017*) is among those recommending the use of scenario analysis and stress tests for companies and financial institutions.

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Bálint Várgedő is an Analyst at the Sustainable Finance Department at the Magyar Nemzeti Bank and a PhD student at the Corvinus University of Budapest, Doctoral School of Business and Management. Email: vargedob@mnb.hu

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In my analysis, I quantify the effect exerted by a carbon price shock on the credit risk of companies operating in different sectors, in particular on the probability of default. In terms of specific policies, carbon pricing is one of the most effective and widespread instruments applied to reduce carbon emissions (*Nordhaus 1993*; *Stern 2007*). In the European Union, carbon pricing was implemented through the Emissions Trading System (EU ETS) mechanism. A number of EU countries (e.g. Austria) plan to reduce GHG emissions by means of a carbon tax in addition to the EU ETS. Income, whether from carbon taxes or carbon quotas, can be used in different areas of the central budgets, including support for the acceleration of the transition, the reduction of taxes on labour, or targeted transfers to those in need (*IMF 2022*). Based on IMF calculations, these budgetary options can significantly reduce macroeconomic losses in the short term. However, due to the risk focus of the analysis, I disregarded those options, as such measures (e.g. accelerating the transition) do not necessarily provide relief for the sectors most exposed to transition risks.

The carbon price increase was implemented via an increase in oil prices on the world market, using the Polaris macroeconomic model (*Soós et al. 2020*). In the case of Hungary, this amounts to an increase in the input cost of fossil fuels, just like an increase in carbon prices, as Hungary is a net energy importer, with 87 per cent of its oil consumption covered by imports (*Eurostat 2022a*). Subsequently, a sectoral model is used to propagate the macroeconomic shock across sectors. The model diffuses the primary shocks proportional to the carbon emission intensity of each sector through a sectoral network, derived from input-output tables of the sectors. Finally, the corporate probability of default (PD) model by *Horváth* (*2021*) is used to calibrate the magnitude of the probability of default specific to each sector.

The novelty of this study is the assessment and quantification of the short-term transition risks of the Hungarian banking sector, especially in respect of the probability of default for corporate loan portfolios. While there are exercises reported in the international literature that analyse the short-term transition risks of climate change (*Vermeulen et al. 2018*; *Guth et al. 2021*), often these methodologies cannot be implemented in Hungary due to lack of data and the use of non-public models. Nor did these analyses examine the possible extent of variation in the level of transition risks for different banks in the banking system. I use a Monte Carlo simulation to quantify this heterogeneity for seven major Hungarian banks. In addition, the study aims to ensure that the methodology it follows can subsequently be used by credit institutions in their own climate risk analyses.

Owing to its focus on risk, the study is primarily concerned with the risks and losses arising during the transition to a low-carbon economy. It is not intended to carry out cost-benefit analyses, since due to the nature of climate change this is only possible with the help of long-term analyses. The conclusions of such studies on Hungary

suggest that the transition represents an opportunity for the Hungarian economy rather than a welfare loss (*Fazekas et al. 2021; Bokor 2022*).

In addition to climate change, the scenario examined in the study is also relevant in light of the high energy prices in 2022. The transition to a low-carbon economy and the elevated prices of fossil fuels both have a negative impact on a similar range of activities. Nevertheless, the study focuses on the assessment of transition risks.

Section 2 provides an overview of the relevant literature, with particular regard to the sectoral breakdown and time horizon. In *Section 3*, I briefly present the macroeconomic scenario, describe the methodology of the sectoral model used for the analysis and perform the calibration of the shocks. This is followed by the presentation of the data used. The results of the research are presented in *Section 4*, followed by a summary of the study in *Section 5*.

2. Overview of the literature

In recent years, a number of exercises have been elaborated internationally to model the effects of climate change on the financial system, mainly by financial supervisors and central banks. Stress tests of the bottom-up type, i.e. designed with the involvement of market participants, were carried out by both the French supervisory authority (*ACPR-BdF 2021*) and the Bank of England (*BoE 2019*). In addition, the European Central Bank (ECB) has also published its top-down exercise, conducted using mainly internal supervisory models (*Alogoskoufis et al. 2021*). One feature common to all three of these analyses is that they are long-term stress tests based on the scenarios of the Network of Central Banks and Supervisors for Greening the Financial System (NGFS). By contrast, the following three analyses, which are presented in more detail below, are more closely related to this study.

The Central Bank of Hungary (Magyar Nemzeti Bank, MNB) has produced its stress test using a 30-year time horizon to explore the long-term climate risks to the Hungarian banking system (*Bokor 2022*). The exercise focused on the evolution of non-performing loans (NPL rates) in different sectors. These rates were modelled in three climate scenarios: an orderly transition, a disorderly transition and a "hot world" trajectory. The results were dominated by transition risks in the case of the first two scenarios and by physical risks in the third. The sectoral economic trajectories were produced using the macroeconometric model Cambridge Econometrics E3ME, taking into account the governmental measures related to the narrative of each scenario (*Fazekas et al. 2021*). The surprising result of the modelling is that the Hungarian economy may follow a higher GDP trajectory in the event of an orderly transition. As regards credit risks, significant heterogeneity is observed in terms of the different sectors and the effects of the three scenarios.

In its short-term energy transition stress test for the Netherlands (*Vermeulen et al. 2018*), the Dutch central bank (DNB) examined the resilience of the financial system in four scenarios (policy, technology, both and loss of confidence). The stress test carried out in 2018 is relevant both on account of its pioneering nature and its methodological specificities related to the short time horizon. Having implemented the scenarios in the NiGEM macroeconomic model, the authors used their proprietary sectoral model to produce the sectoral impact of shocks. This was quantified by means of a so-called transition vulnerability factor, which – in parallel with the CAPM[1] beta – captures company/sector-specific sensitivity, but focuses on transition risk rather than market risk. A sector's level of transition vulnerability is based on the greenhouse gases (GHGs) emitted in the production of consumer goods manufactured by the sector. The GHG calculations for a final product in a sector are not limited to the emissions of the sector, but are based on the quantity emitted along the entire production chain. Thus, a carbon price shock is stronger for every member in the production chain of carbon-intensive goods. The GHG emissions are then prorated to the economic weight of the sector, and the resulting intensity indicators are normalised by the authors so that the average rate of the transition vulnerability factor is one. Losses incurred in the different scenarios were also quantified for the balance sheets of banks, insurers and pension funds. The results of the stress test suggest that the scenarios can cause "significant but manageable" losses to financial actors.

Another example of a short-term transition risk stress test is the exercise by the Austrian National Bank published in 2021 (*Guth et al. 2021*). In addition to measuring overall transition risks, the stress test seeks to assess the impact of the carbon tax reform that was introduced in Austria in 2021 on the financial system. The authors model the effect of two scenarios: an orderly carbon price rise trajectory, and a disorderly one. The modelling of the sectoral block used in the stress test is described in the supplement by *Königswieser et al.* (*2021*). Starting from the price-based input-output model, the modelling follows a series of steps to integrate the shock of carbon prices into the economic performance of the sectors. The complex methodology allows the authors to control, inter alia, for incomplete cost transfer, the adaptation of demand, as well as the second-round effects arising from the change in wages and employment. Based on the results of the stress test, the aggregate CET1 ratio of the Austrian banking sector may decrease by 0.7–2.7 percentage points, which represents a manageable effect according to the authors.

In addition to a study by *Bokor* (*2022*), several analyses have been published in the Hungarian literature in recent years with a focus on assessing the effects of climate change on financial markets and institutions. In her essay on the methodological considerations of climate stress tests, *Boros* (*2020*) highlights the specificities of

[1] Capital Asset Pricing Model

these exercises, the aforementioned time horizon issue and the importance of a sectoral breakdown. *Ritter* (*2022*) compared the high transition risk exposures of Hungarian credit institutions with the EU average. According to his results, Hungarian credit institutions were more exposed to the transition risks. *Bokor* (*2021*) proposed a simple carbon risk indicator that enables time-series analysis of the transition risks to the banking system as well as the identification of the institutions most exposed to the transition.

2.1. Sectoral breakdown

The use of macroeconomic models is a common practice in modelling the scenarios of traditional stress tests, assuming that the economic shock to companies affects individual sectors equally, the only difference being the sensitivity of companies. In contrast, the specificity of climate stress tests is that, as a result of the scenario narratives, the economic impacts are uneven across sectors. The most widespread scenario narrative implements the risks of the transition to a low-carbon economy through a carbon price or carbon tax hike. However, in addition to its macroeconomic effects, the rise in carbon prices weighs more heavily on certain activities involving high GHG emissions (e.g. coal-based electricity generation, steel production) than on other activities involving low emissions (including a significant part of services). Thus, in addition to the definition of macroeconomic paths, it is also essential to define economic indicators at the sector level, in order to obtain results that are more coherent with the scenario narrative. Apart from the economic sectors that are most sensitive to the shock postulated in the scenario narrative, the approach allows for the identification of credit institutions that finance these sectors more heavily and are consequently exposed to higher risks.

The first step in the common approach to producing sector-level economic indicators is to model the impact on aggregate indicators according to the results of a macroeconomic model, followed by the estimation of heterogeneous sectoral effects using a sectoral model. In their study comparing international practices of climate stress tests, *Baudino – Svoronos* (*2021*) use the term 'macroeconomic block' in reference to the step of quantifying climate risks in aggregated indicators at the macroeconomic level. Analogously, the breakdown of macroeconomic indicators into sectoral levels can be described as a sectoral block.

2.2. Long-term and short-term exercises

Based on international practices, two approaches appear to emerge in climate stress tests: short-term exercises and long-term exercises. Short-term stress tests typically cover periods of 2 to 3 to 5 years, while long-term stress tests typically quantify financial and economic impacts in scenarios with time horizons of 20–30 years. The specificities of climate stress tests and the time horizon issue, as well as the importance of a sectoral breakdown are highlighted in *Boros* (*2020*).

The unquestionable advantage of long-term analyses is that they can adequately address the physical risks of climate change, which are only expected to occur in the longer term. In addition, transition risks are expected to materialise fully over the horizon (*Baudino – Svoronos 2021*). In contrast, short-term exercises can handle a specific scenario, and thus they are only suitable for quantifying limited or special physical risks, which may realistically occur in the near future. Furthermore, it is not certain that transition risks will materialise over the time horizon being examined, but this poses a minor problem as they can be assumed to occur in the narrative of a severe but credible scenario.

However, in compiling the scenarios of long-term stress tests, a number of assumptions must be made, which may have a negative impact on the robustness of the results. For example, where the objective is to determine institution-level results in a supervisory top-down exercise, in the case of a 30 year scenario one frequently applied balance sheet assumption is that the composition will remain unchanged (static balance sheet assumption) and this may result in limited interpretability of the results. In addition, long-term scenarios are often based on complex economic models: in such cases, there is a possibility of using "black box" models, where the effects of different modelling decisions are difficult or impossible to distinguish. Moreover, if the assumptions are not properly documented, the explainability of the results will decrease, reducing the scope for use. *Stern et al.* (*2022*) expresses similar criticism for long-term integrated assessment models, on which stress tests are often based, highlighting very significant uncertainties in relation to physical risks. This uncertainty may stem from possible extreme risks, as well as from tipping points such as disintegration of the Greenland ice sheet.

However, with short-term stress tests, the difficulties listed above that need to be resolved are less relevant and easier to deal with. Their time horizons also fit better into the framework of business models, which are relatively short-term by climate change standards. In addition, they are better suited to established stress testing frameworks, as a result of which they can be modelled with lower resource requirements, and as such they can also serve as starting points for market participants.

In summary, long-term stress tests are more suitable for complex strategic decisions and cost-benefit analyses, as well as for examining the sustainability of financial institutions' business models. In contrast, short-term exercises can be useful for identifying institution-specific transition risks and as part of general micro-prudential supervision, and can provide guidance for market participants to manage their climate risks. Thus, the two approaches arguably complement rather than exclude each other.

3. Methodology

This Section describes the methodology of the study, detailing the framework of the macroeconomic scenario and the methodology of the sectoral block. First, I present the methodology of the primary effect of the transition shock, then the construction of a network that diffuses sectoral shocks, and with the help of these, the process of calculating the propagated shocks to each sector. Finally, I use the sectoral distribution of bank exposures and macroeconomic stress scenarios to calibrate PD effects on individual sectors.

3.1. Macroeconomic scenario

As short-term stress tests are primarily suitable for quantifying transition risks, those risks are also the focus of the stress test discussed in this study. In defining the scenario, the ease of implementation into widespread macroeconomic models has also been taken into account.

The narrative of the scenario is the large-scale introduction of carbon pricing, the most common policy instrument for the transition to a low-carbon economy. Carbon pricing is also recommended for decision-makers by *Nordhaus* (*1993*) and *Stern* (*2007*), being one of the tools best suited to curb GHG emissions, in addition to (and supporting, see *Acemoglu et al. 2012a*) technological development. In the scenario, a sudden and significant introduction is assumed, covering all sectors. The technical issue of the exact form of pricing, i.e. whether a carbon quota trading mechanism is introduced or a carbon tax is levied, is not of primary importance for modelling. Indeed, other emission abatement measures, such as restrictions on the production of internal combustion engines or the introduction of stricter energy criteria for newly built dwellings, can be perceived as carbon pricing by means of a carbon pricing equivalent, allowing any such measure to be matched by a carbon price increase which would have a similar abatement effect.

The economic stimulus of using the revenues from pricing is not part of the narrative of the scenario, similarly to the stress test by *Vermeulen et al.* (*2018*), and can therefore be considered conservative. The macroeconomic model integrates carbon prices through a 100 per cent increase in oil prices on the world market.

Both the scenario and the baseline were implemented using Polaris, a macroeconometric model by *Soós et al.* (*2020*). The advantage of the model is that it provides for an accurate fit with past behaviour patterns of the Hungarian economy, and that, as an error correction model, it takes into account both shorter and longer-term economic contexts. Polaris can be used to model a wide range of economic indicators at the national level.

In the scenario, several methodologies can be used to determine the extent of the shock. A common transition narrative is the introduction or increase of carbon prices, and the relevant literature may be useful in determining the magnitude of the carbon price increase required for the transition. For the policy scenario, the stress test by *Vermeulen et al.* (*2018*) modelled the effects of introducing a carbon price of 100 USD/tonne in the Dutch economy and financial system. In *Guth et al.* (*2021*), the effective carbon price in the Austrian economy increases gradually to 130 EUR in the orderly transition scenario over 5 years, and to 260 EUR in the disorderly transition scenario. Carbon prices may be conveniently implemented in macroeconomic models by means of oil price increases, a relatively common component of these models. According to a simple calculation by *Vermeulen et al.* (*2018*) burning a barrel of petroleum will produce 432 kg of CO_2 emissions, and thus an increase of 100 USD/tonne is equivalent to an oil price increase of 43.2 USD. Where gas, coal or energy prices are also included in the macroeconomic model, they can be calculated analogously by reference to the corresponding GHG intensities. To determine the magnitude of the shock, another common alternative in stress testing exercises is to rely on the extremes of the historical/modelled distribution of the shocked variable, for example, where the distribution function takes values of 95, 99 or 99.9 per cent. The doubling of the global oil price we are looking at corresponds to an oil price increase of 75 USD, which translates into an increase of 175 USD per tonne in the carbon price. From this perspective, the size of the modelled shock falls between the carbon price increases applied in the two exercises discussed above.

3.2. Sectoral block

In the sectoral model, sectoral heterogeneity is incorporated into the corporate probability of default through a sectoral deviation by deflecting PDs for macroeconomic stress paths by sector. Probabilities of default are defined as the chance of default as understood in banking, not the occurrence of bankruptcy or liquidation. When looking at the entire banking system, the deflections are neutral and the sum of the deflections (weighted by exposure) is zero. In other words, the aggregate results for the banking system are determined by the macroeconomic paths, with the deviations being responsible for the heterogeneity of the institutions financing different sectors with varying intensities. This allows us to identify institutions that are more sensitive to the given climate shock, but the magnitude of the overall impact will be consistent with the macroeconomic and PD models. In other words, the relationships observed in the past for economic and financial indicators will hold.

The modelling of the sectoral block can be divided into three parts: identifying the primary shock, modelling the propagation of shocks, and calibration.

3.2.1. Primary shock

The scenario narrative allows for the identification of the sectors that will be primarily affected by the shock. In the case of a carbon price increase, the extent of the primary shock can be well approximated by the GHG intensity of the sector, where the higher the carbon equivalent emissions per unit of added value, the more exposed the sector. The GHG intensity of each sector is available from the Eurostat database (*Eurostat 2022b*), broken down into 64 sectors.

The fundamentals of a company may be negatively impacted via multiple channels if it operates in a sector whose end product is subject to an extra tax. Where the company is unable to pass on to consumers all or nearly all of the higher costs due to the tax, its profitability may deteriorate sharply, accompanied by a fall in demand for the expensive product, depending on the price elasticity of the good. Thus, the lower volume sold in the new equilibrium represents lower sales for the company. According to the principles of economics, both effects increase the probability of default for the company.

3.2.2. Shock propagation

As can be seen from the above considerations, the shocks caused by the measures may have an impact on all actors in the production chain, which will apply to both cost transfer and falling demand. This requires modelling the relationships between sectors and exploring the network of economic activities. The basis for this is provided by the input-output table, which describes the production relations and supplier networks of sectors in the national economy. The role of the network of economic sectors has already been addressed by a number of researchers in relation to the propagation of idiosyncratic shocks to individual sectors (*Horvath 2000; Acemoglu et al. 2012b*). The methodology is thus partly based on those studies.

Before analysing the network of sectors, a formal definition of network needs to be provided. Each node in the network (i, j =1, 2, …n) is a sector of the economy, of which 64 are covered by the analysis (n=64). The edges of the network are determined by the strength of the link between the sectors. The network of economic sectors is best described by means of directed weighted edges, given that the individual sectors are suppliers and customers of one another (directed network), and even where they are interconnected, the strength of their links can be heterogeneous (weighted network).

The edge from sector i to sector j is determined by direct expenditure (Hungarian Central Statistical Office, *HCSO 2005*). This is the value of the goods used in production by sector j from the output of sector i, corresponding to item j in row i in the direct expenditure matrix T, $T[i, j]$. Normalising direct expenditures $T[i, j]$ by the total output (x_j) of sector j will produce technical coefficients (A_{ij}). The technical

coefficients serve as the weighted edges of the network. The technical coefficient A_{ij} shows the number of units of output from sector *i* required for a single unit of output from sector *j*. The same applies with matrix operations, introducing matrix *A* ($A[i,j]=A_{ij}$) and the itemised inverse ($\frac{1}{x}[j] = \frac{1}{x_j}$) of total output vector *x*, along with identity matrix *I*, with *n* dimensions:

$$A = T \cdot I \cdot \frac{1}{x} \tag{1}$$

The resulting matrix *A* is therefore the adjacency matrix describing the edges of the network, whereby $A[i,j]$ will be equivalent to the weight of the edge pointing from sector *i* to sector *j*. Note that in the case of technical coefficients (as with direct inputs), in production the output of sector *i* may be used to produce the final output of sector *i*. For example, the food industry may take input from the output of the same industry. This means that the diagonal of the adjacency matrix does not only contain zeros, i.e. there are self-loops.

The adjacency matrix shows the most important suppliers in each sector (the edges with the largest weights directed into the given sector) along with the most important recipients of the products of the given sector apart from end use (the edges with the largest weights directed out of the given sector). The sum of the former is the 'in' degree, while that of the latter is the 'out' degree, being two versions of degree resulting from the specific nature of directed networks. Degree is also a simple centrality indicator, where the higher the degree of a sector, the higher the number of sectors a shock to it can propagate to.

The adjacency matrix provides a more accurate picture of the propagation of an individual stress to a sector. Let $s_i^{(0)}$ indicate the initial individual shock to sector *i*. In the first round, according to the model it will spill over to sectors *j*=1, 2, …n to extent $s_j^{(1)} = s_i^{(0)} \cdot A_{ij}$. Analogously, shocks propagated in the first round will continue to propagate, in the second round also potentially from several nodes of the network $s_j^{(2)} = \sum_{i=1}^{n} s_i^{(1)} \cdot A_{ij}$. Note that the propagation of shocks can be well captured by means of matrix notation, even where several sectors are affected by the initial shock. Let vector *s* be introduced to indicate the initial shock, with item *i* being $s_i^{(0)}$. This allows formulating propagation in rounds 1, 2, ... k as follows:

$$\begin{gathered} s^{(1)} = A \cdot s \\ s^{(2)} = A \cdot s^{(1)} = A \cdot (A \cdot s) = A^2 \cdot s \\ \dots \\ s^{(k)} = A^k \cdot s \end{gathered} \tag{2}$$

Summarising the shocks in rounds 0, 1, 2, ... k, the following relationship is obtained for the sum of the shocks in the first k rounds $S^{(k)}$:

$$S^{(k)} = s + s^{(1)} + s^{(2)} + \cdots + s^{(k)} = s + A \cdot s + A^2 \cdot s + \cdots + A^k \cdot s \qquad (3)$$

Introducing the notation $S = \lim_{k\to\infty} S^{(k)}$ for the magnitude of a shock that has run its full course in the economic system, the sum on the right will accommodate the relationship known as the Neumann series, similar to the geometric series:[2]

$$S = \lim_{k\to\infty} S^{(k)} = \sum_{l=0}^{k} A^l \cdot s = (I - A)^{-1} \qquad (4)$$

The total shock thus obtained therefore shows the impact, in different parts of the economy, of a specific shock to a single sector of the economy or a subset of the sectors once it has propagated across sectors. It can be seen from the deduction that the shock will primarily impact the affected sectors as well as those in their immediate and indirect neighbourhoods, although the more indirect the relationship, the more moderate that impact will be. The method can also be used to identify the nodes of the network considered to be the most central based on its eigenvector centrality (*Anufriev – Panchenko 2015*). These sectors are the ones that will diffuse the shocks they receive to the greatest extent. A sector with lower eigenvector centrality will diffuse shocks less, which will consequently remain within the sector to a relatively higher extent.

The term $(I - A)^{-1}$ on the right side of the equation is the Leontief inverse commonly used in input-output modelling. Its other interpretation is how the demand shock per unit of a given industry affects the output of the whole economy as a result of the spill-over of the effects. Using the Leontief inverse thus allows us to quantify the full course of any initial shock for all sectors, providing for easy application in calculating multiple scenarios. Therefore, these properties meet the expectations for the sectoral block of a climate stress test.

There are several possible ways to integrate the sectoral results obtained into the scenario. One is that the sectoral block is used both to determine the extent of the shock to the macroeconomy and to model distribution across sectors. In this case, the macroeconomic block is also part of the sectoral block. An example is provided in *Guth et al.* (*2021*). The other option is that only the relative relevance of the sectors to one another is determined by the sector block, and the macro block is responsible for calibrating the average impact (for example, *Vermeulen et al. 2018*). In our methodology, we take the latter approach, so that the sectoral block is responsible only for the relative performance of the sectors.

[2] The eigenvalues of vector A must also satisfy the technical assumptions.

3.3. Calibration

The sectoral block was integrated into the stress testing process in accordance with the established stress testing methodology. The following two conditions can be used to clearly determine the PD changes in each sector, together with the desired coherence:

- Macroeconomic coherence: the average PD in the economy at the level is indicated by the macroeconomic paths of stress scenarios;
- Sectoral coherence: the relative size of *S* total shocks determines the PD increment of sector *i* compared to sector *j* relative to the baseline during the stress scenario.

The basic idea of the deduction is that for each sector, the total PD effect (dPD^i) is obtained as the sum of the PD effects of macroeconomic stress (dPD_{macro}) and the sectoral deflection ($dPD^i_{deflect}$). Macroeconomic stress is an effect of the difference between the stress path and the baseline, since the baseline does not involve any shock to the economy. Formally:

$$for\ \forall i\ sector\colon dPD_{macro} + dPD^i_{deflect} = dPD^i \tag{5}$$

dPD_{macro} can be estimated with the help of the point-in-time PD model, where $dPD^i_{deflect}$ is the variable sought and dPD^i is an indicator that is easy to interpret in economic terms, allowing sectoral results to be formulated. Once the two coherence constraints have been formalised and dPD_{macro} (not sector-dependent) has been estimated, the equation system can be solved for each sector. Introducing w^i to indicate the lending weight of sector *i*, the two constraints take the following form:

- Macroeconomic coherence:

$$\sum_i w_i\, dPD^i_{deflect} = 0$$

- Sectoral coherence:

$$for\ \forall i\ sector\colon \frac{dPD^i}{dPD^1} = \frac{dPD_{macro} + dPD^i_{deflect}}{dPD_{macro} + dPD^i_{deflect}} = \frac{S_i}{S_1}$$

The equations system is solved as follows:

$$\begin{aligned} for\ \forall i\ sector\colon\ dPD^i_{deflect} &= dPD_{macro}\left(\frac{S_i}{\sum_j w_j\, S_j} - 1\right) \\ for\ \forall i\ sector\colon\ dPD^i &= dPD_{macro}\frac{S_i}{\sum_j w_j\, S_j} \end{aligned} \tag{6}$$

The result can be interpreted in such a way that the PD deflection of a given sector depends on the ratio of the total shock to the sector indicated by the macro model and the total shock to the average sector, and the magnitude of the deflection is

calibrated by the macro PD shock. However, it follows from the definition that the constraints formulated for the total PD effect are still easier to interpret, deflection being only one component therein. The right-hand term of the equation, $\left(\frac{S_i}{\sum_j w_j S_j} - 1\right)$ is analogous to the transition vulnerability factor used in the Dutch stress test (*Vermeulen et al. 2018*).

The macroeconomic PD shock can be estimated by reference to the difference between the point-in-time PD model used in the stress test and the macroeconomic indicators. The macroeconomic variables included in the PD model in *Horváth* (*2021*) are disposable household income, along with the current period and lagged values of inflation and employment. The PD effect can be approximated linearly by using the average marginal effects (β_j) describing the sensitivity of the explanatory variables of the logit model. The macroeconomic PD effect only determines the amplitude of deflections, making minor inaccuracies due to linear approximation less problematic. Thus, only the deviation in macroeconomic variables is required. Per definition, dPD_{macro} is the PD effect resulting from the macroeconomic environment of the baseline and the stress path; consequently, the deviation sought will be obtained as the difference of the economic indicators between the predicted stress path (X_j^{stress}) and the baseline (X_j^{base}).

$$dPD_{macro} = \beta_1(X_1^{stress} - X_1^{base}) + \cdots + \beta_k(X_k^{stress} - X_k^{base}) \tag{7}$$

Table 1
Average partial probability coefficients of the significant macroeconomic variables in the *Horváth PD model*

Dependent variable: 'Default'	
Households' disposable income (dlnhhinc)	–0.1108*** (0.0229)
Inflation (dcpi)	–0.0008* (0.0004)
Employment lagged by one year (l1_demp)	–0.00005*** (0.0000)
Households' income lagged by one year (l1_dlnhhinc)	–0.1007*** (0.0259)
Imports lagged by one year (l1_dlnim)	0.0211*** (0.0001)

*Note: *p<0.1; **p<0.01; ***p<0.001; robust standard errors in brackets.*
Source: Horváth (2021): Table 2

The significant macroeconomic variables and their coefficients used in the corporate PD model are presented in *Table 1*. The default definition used in the model was defined on the basis of the banking analyses of eight large Hungarian banks, which were collected by the MNB as part of its supervisory activities between 2007 and 2017.

In this way, instead of liquidation procedures and other approximation techniques, the model is based on real bank default events, which were included in the database in annual terms at the customer level. The exact form of the explanatory variables of the model and the interpretation of the coefficients permit the following to be stated: *"The results show that a 1 per cent decline in household income (dlnhhinc) raises the probability of default by 11 basis points in the year of the shock, and – as a carry-over effect – nearly to the same degree in the following year as well. The labour market exerts its impact on the default rate through the change taking place in private sector employment* (*100,000 job losers raise the probability of bankruptcy by 50 basis points within a year*). *In addition to all of these factors, the role of the inflation environment is another determinant."* (*Horváth 2021:p. 58*)

Thus, the identification of primary shocks can be performed by Leontief inverse after modelling the shocks spreading to the economic sectors, and subsequently PD deflections per sector can be generated, using the macroeconomic impact estimated during calibration. Adding these to the results of the point-in-time PD model produces PD values that reflect macroeconomic fundamentals along with the fundamentals of both the sector and the company.

3.4. Data

The range of data used is essentially based on three different sources. One is GHG intensity broken down into 64 NACE 2-digit sectors as reported in *Eurostat* (*2022b*), which determines the extent of the primary shock to companies in the sectors. In the rest of the study, I refer to NACE 2-digit sectors as subsectors and NACE 1-digit sectors as main sectors. For the establishment of the sectoral network, an input-output table is also incorporated; this is managed and updated at 5-year intervals by the HCSO. For the calibration and the quantification of the effects on bank losses, the exposure data from the MNB's HITREG database are required. In the analysis, I used the exposures of seven major Hungarian banks, which I constructed on the basis of the 'gross book value' field in HITREG. The exposure data were aggregated by sector in the calculation of deflections, more granularly in simulations, broken down by borrower and credit institution.

4. Results

4.1. Macroeconomic scenario results

Table 2 shows the impact on the macroeconomic indicators of the carbon price increase scenario implemented through an oil price increase using the Polaris model. GDP growth in the scenario falls significantly short of the baseline, especially in 2022, when the shortfall is more than one percentage point. This year also sees the largest shortfall compared to the baseline in terms of inflation, imports and household incomes. For the most part, the effect of labour market developments will be felt by 2023. Overall, however, the scenario is not extreme, and the results outline a less severe scenario compared to the regular stress path of the MNB.

Table 2
Deviation in macroeconomic indicators between the stress path and the baseline over a three-year time horizon

	GDP	Unemployment rate	Inflation	Disposable household income	Private sector employment	Imports
	annual change (%)	*annual average (%)*	*annual average (%)*	*annual change (%)*	*annual change (%)*	*annual change (%)*
2021	–0.40	0.03	1.42	–1.42	–0.04	–0.52
2022	–1.23	0.32	2.28	–2.59	–0.42	–1.82
2023	–0.79	0.49	0.60	–1.27	–0.23	–0.83

Note: The table shows the percentage differences between GDP, disposable household income, employment in the private sector and the annual growth rate of imports. For the unemployment rate and inflation, percentage differences between annual averages are shown.

The PD deviations estimated from the deviations of the stressed macroeconomic paths are reported with their components in *Table 3*. In the carbon price scenario, the estimated probability of default increases by 24 and 39 basis points in the second and third years, respectively; in the first year, the effect is close to zero.

Therefore, the probability of default appears to increase gradually over the time horizon. One reason is that in the economic indicators the largest deviation from the baseline occurs in the second year. On the other hand, in the estimated PD model emphasis is placed on the historical values of the economic variables. Thus, in the third year, spill-over effects from the previous year also increase the estimated PD difference. The higher PD in the stress path is mainly due to a decrease in disposable household income (its value lagged by one year). The effect is dampened by the rise in inflation, which, according to the model, reduces the probability of default for companies. The fall in employment only leads to a significant increase in the default rate at the end of the time horizon, and even then its extent falls short of the increase in disposable income.

Table 3
PD effects of economic indicators compared to the baseline

	Disposable household income	Inflation	Imports	Disposable household income lag	Private sector employment lag	Total PD effect
	percentage point					
2021	0.16	–0.11	0.00	0.00	0.00	0.04
2022	0.29	–0.18	–0.01	0.14	0.01	0.24
2023	0.14	–0.05	–0.04	0.26	0.07	0.39

Note: PD effects of economic indicators implied by the macroeconomic scenario, expressed in percentage points, and the overall PD effect in different years.

According to the methodology, in the case of a carbon price shock, the macroeconomic PD shock used for calibration is 4, 24 and 39 basis points, respectively, over the three years of the time horizon. In order to calculate the shocks to each sector, it is necessary to calculate the total shocks that affect them and propagate across the network of sectors.

4.2. Sectoral shocks

The GHG intensities of the individual sectors are shown in *Table 4*. As in the rest of the study, for the sake of transparency, I presented the results averaged by main sectors of the economy; accordingly, the figures show the results broken down by 21 main sectors, instead of the 64 subsectors. In the calculation of the average, I used lending to individual sectors as a weight. In this way, the result for the given main sector is not biased by subsectors less relevant from a lending perspective. Obviously, only the ratio of the sectors to one another matters when determining the primary shocks. It can be identified that certain parts of the economy are more affected by the measure. Sectors primarily affected on account of their high GHG intensity include Sector D, which also involves electricity and gas supply, Sector B (mining), and Sector E (operation of utilities).

Table 4
Sectors of the national economy and their GHG intensity

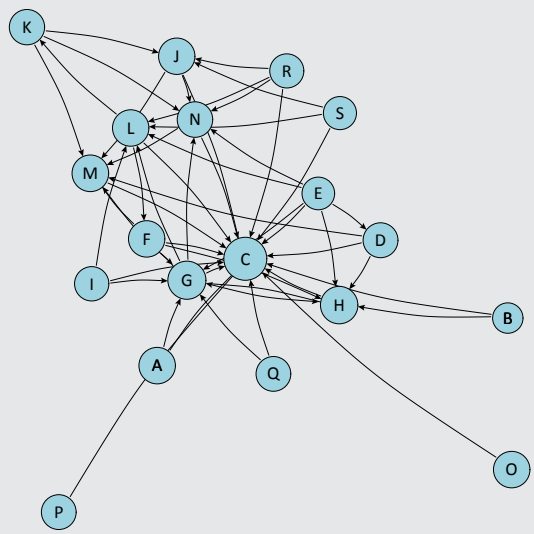
Economic sector	GHG intensity (g/EUR)
Agriculture, forestry, fishing (A)	1,987.7
Mining and quarrying (B)	1,624.3
Manufacturing (C)	471.6
Electricity, gas, steam and air conditioning supply (D)	5,789.3
Water supply, sewerage collection and treatment, waste management and remediation activities (E)	3,889.0
Construction industry (f)	166.0
Trade and repair of vehicles (G)	182.6
Transportation and storage (H)	902.2
Accommodation and food service activities (I)	81.9
Information and communication (J)	49.0
Financial and insurance activities (K)	42.2
Real estate activities (L)	38.9
Professional, scientific and technical activities (M)	46.6
Administrative and support service activities (N)	175.1
Public administration and defence, compulsory social security (O)	80.3
Education (P)	39.3
Human health and social work activities (Q)	66.7
Arts, entertainment and recreation (R)	42.3
Other services (S)	49.9
Activities of households as employers of domestic personnel; goods- and service-producing activities of private households for own use (T)	35.7
Extraterritorial organisation (U)	

Note: The intensity indicator is constructed on the basis of the value added.
Source: Eurostat (2022b); HCSO

Figure 1 is a representation of the network constructed as per *Subsection 3.2.*2, using the matrix of technical coefficients produced based on the method described in the same subsection. The figure shows the network that, according to the model, propagates the initial shock received by one or several sectors in the network to the sectors linked to them. The adjacency matrix of the network is the matrix of the technical coefficients. Thus, the size of the edge from node *i* to node *j* is equal to the number of units of output *i* required to produce a unit of good *j*, that is, the amount of shock to sector *j* caused by a shock to sector *i*. For the sake of transparency, the only edges shown are those assigned with weights of more than 0.03, implying relatively strong shock transmission. For similar reasons, instead of the more granular sectoral breakdown (subsector), the network of main sectors is displayed, but the precise calculations were made using the more detailed breakdown.

Among the national economy sectors of primary importance for the analysis, in the first step shocks are transmitted by Sector D mainly to Sector C (Manufacturing) and Sector H (Transportation, warehousing). Sector B also has strong links to Sector H and Sector M (Professional, scientific and technical activities), while shocks are transmitted from Sector E to nodes D, C and L (Real estate activities).

Figure 1
Sectoral network of the Hungarian economy



Note: Representation of the network of Hungarian national economy sectors constructed on the basis of technical coefficients. The nodes indicate the individual national economy sectors, and the directed edges indicate the links between them, weighted by the magnitude of the technical coefficients. Self-loops and edges assigned with technical coefficients below 0.03 are not shown. The size of each node is proportional to the total output of that sector. The location of network nodes was determined according to the Fruchterman–Reingold algorithm. The calculation of the technical coefficients was carried out as described in the text, on the basis of the HCSO's symmetrical entity-to-entity input-output table for 2015.

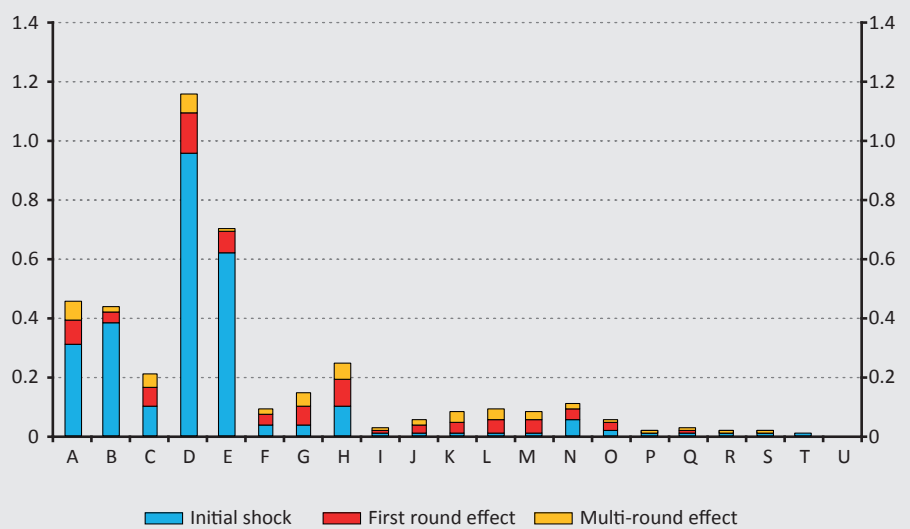
Source: Calculated based on HCSO data

The initial shocks are shown in *Figure 2*, along with the shocks propagated across the network, both after the first propagation round and the equilibrium total shock. Obviously, as a result of the propagation, the shock after the first round is always greater than the initial shock, and then a higher value will be shown by the shock that has run its full course. It can also be observed that network propagation distributes the shocks, and the initially concentrated shocks show a slightly more homogeneous picture having run their course, although the extent of the shock varies considerably across sectors.

Even after propagation in the first and subsequent rounds, the largest shocks are still received by Sectors A, B, D and E, which were originally affected the most. Although initially not affected significantly, Sector H suffers significant shocks from the related sectors. The same applies to Sectors G and C. Despite their low GHG emissions, Sectors L, K (Financial and insurance activities) and M also become affected as a result of propagation, but not strongly.

Whether and how national economy sectors are affected in relation to one another in the context of a PD increase is determined by the total equilibrium shocks reviewed. The PD effect sought can be determined by reference to the exposure distribution of bank portfolios, broken down by national economy sector.

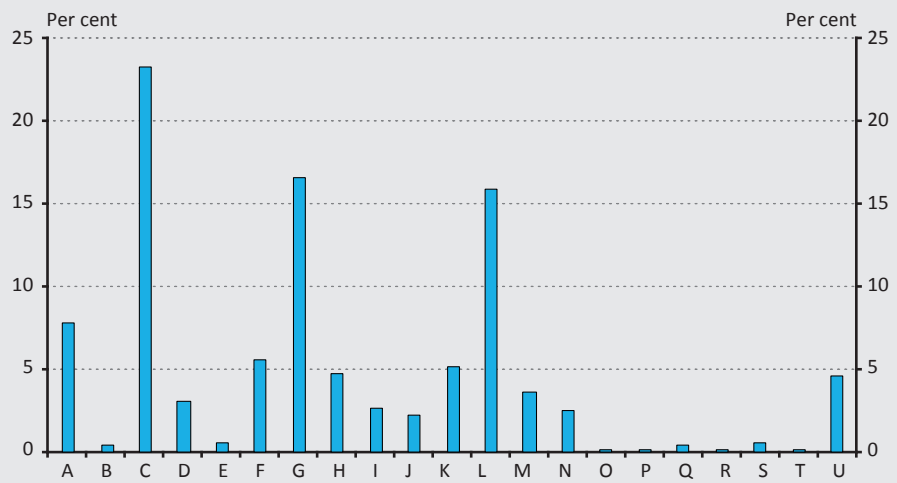
Figure 2
Result of shock propagation in the sectoral network by national economy sector



Note: Information is carried by the relative magnitude of the shocks.

The exposures of Hungarian credit institutions to sectors of the national economy are shown in *Figure 3*. Based on exposure, about one quarter of lending is directed to the manufacturing industry (C), but trade (G) and real estate (L) each also account for more than 15 per cent of the portfolio. Loans to agriculture account for 7.8 per cent of the total, with Sector D representing a mere 3 per cent. The lending ratio of Sector B, which has a high GHG intensity, is also very low at 0.4 per cent.

Figure 3
Distribution of bank credit exposures broken down by national economy sectors in mid-2021



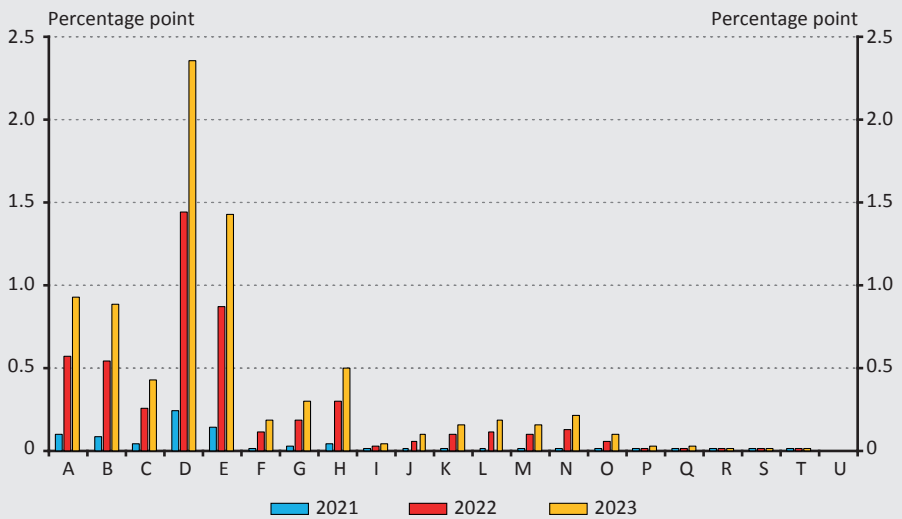
Note: Calculated on gross book value
Source: MNB: HITREG

The PD impact of climate shocks for each sector can be calculated as outlined in *Section 3* by means of the estimated macroeconomic PD effect, the relative size of the total shocks to sectors, and the distribution of exposures (*Figure 4*). The sector-specific PD effect varies from year to year, as the PD effect estimated for each year also varies. As a result, differences between the individual years are only found in this calibration term, and the extent to which the sectors are affected is stable over the years. In line with the evolution of the macroeconomic PD effect over time, the PD effect increases year on year over the time horizon for both scenarios.

The largest PD effect in the case of the carbon scenario is the PD deviation of Sector D from the baseline in 2023, by 2.35 percentage points. The value calculated for 2022 is 1.44 percentage points. A similar value is 1.42 percentage point for Sector E in 2023. In that year, Sectors A and B both suffer a significant PD effect according to the modelling, at slightly below 1 percentage point. The PD effect for Sector H

peaks at 0.5 percentage points in 2023, followed by Sector C at 0.42 percentage points. It can be said that a number of national economy sectors are not affected by the shock even through spill-over effects, and consequently no meaningful PD effect is produced in the modelled scenarios. These are the activities in Sectors I (Accommodation), P (Education), Q (Health) and R (Arts).

Figure 4
Modelled PD increment of the stress scenario compared to the baseline, by national economy sector

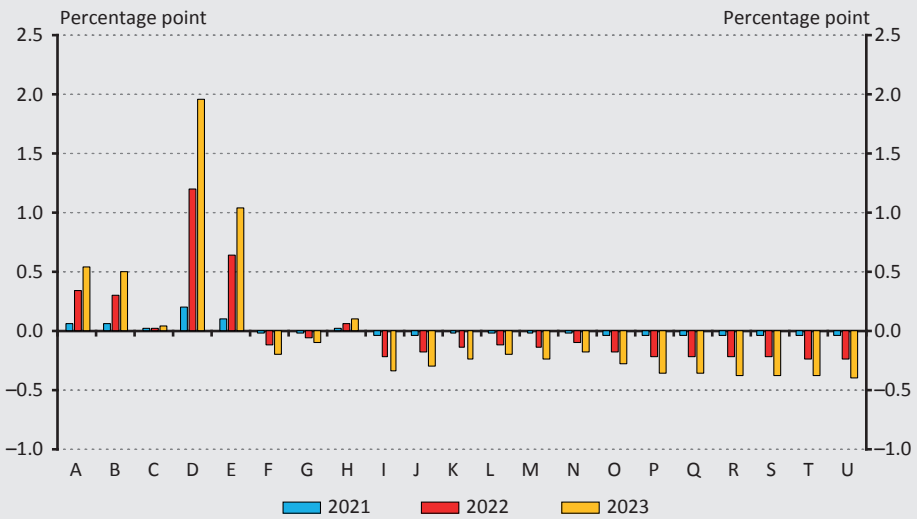


Aggregation at the level of main sectors as shown in the figures has benefits in terms of interpretability and transparency, but raises the question of how much granular information it conceals about the heterogeneity of the subsectors. The answer to this question can be given by examining the variance of PD effects. The total variance can be disaggregated into the variance within each main sector and the variance across main sector averages. According to my calculations, the variance occurring within national economy main sectors accounts for 21.9 per cent of the total variance, with the remaining 78.1 per cent resulting from the difference between the main sectors. Granular sectoral analyses can therefore lead to materially more accurate results in practice. Consequently, where possible, a granular breakdown should be used when analysing transition risks.

Also of interest from a modelling perspective is the extent of PD deflections, which can be determined as outlined in *Section 3*. PD deflections help determine the extent to which the results of a standard corporate PD model based on macroeconomic

variables in each sector need to be increased or decreased in order to obtain results that are consistent with the scenario. PD deflections are shown in *Figure 5*. According to the results of the carbon price scenario, the PD results of Sectors A, B, D, E and H are to be increased. According to the modelling, the remaining sectors are less affected by the carbon price increase than would otherwise be inferred from the macroeconomic indicators.

Figure 5
Extent of the modelled PD deflections of national economy sectors

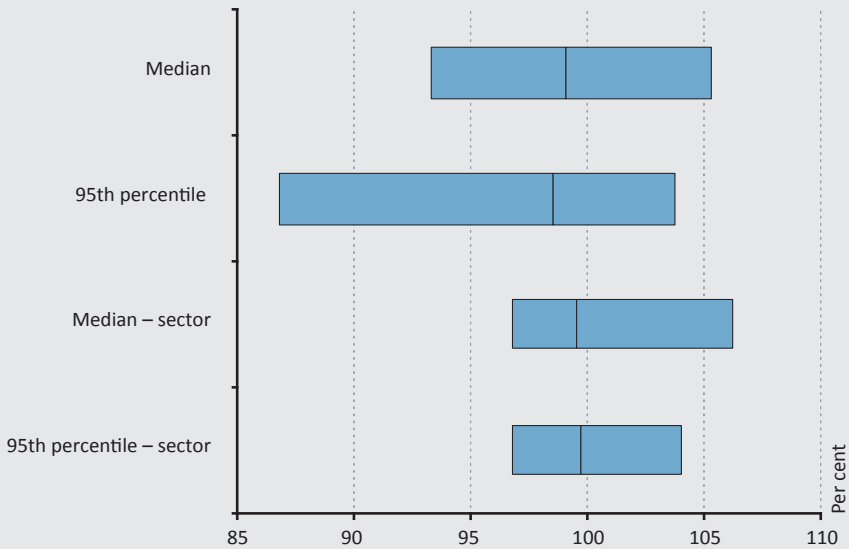


Using the deflections, a Monte Carlo simulation can be produced for the corporate loan portfolios of banks, assessing the impact of deflections on banks. This allows us to identify the banks whose credit risk is negatively affected by the sectoral heterogeneity of transition risks. For simulation purposes, probability of default was assumed to be homogeneous within each sector, whereby the probabilities specifically represent the risk differences resulting from the sectoral composition of bank portfolios. The simulations were based on the corporate credit exposures of seven Hungarian banks participating in the exercise. For simulation purposes, all loans of a company with a given bank are assumed to become non-performing or remain performing collectively. Thanks to the 5,000 simulations run, the 95th percentile of the default rates' distribution can be estimated robustly.

The sectoral default rates used were determined according to two methods. First, I aggregated the historical sector-level default rates published by *Horváth* (*2021*), and second, I kept the breakdown by main sector. Then, I uniformly increased these

initial rates with the macroeconomic PD effect of the scenarios, and then added the PD deflections calculated for 2023. The results are similar for the deflections calculated for the other years, with possible differences only in the amplitude of the effects detected; consequently, no separate calculation was produced for the other years.

Figure 6
Band of loss ratio of banks with and without PD deflections



Note: The relative values represent the ratio of losses for each bank, simulated at the 50th and 95th percentiles with and without the 2023 PD deflection. The figure shows the band of these values for each bank. The left edge of each band indicates the minimum value, the middle line the median, and the right edge the maximum value observed for the banks. The first and second rows show the results for the aggregated historical PD, and the third and fourth the results obtained using a sectoral breakdown of historical PDs.

Figure 6 shows the results of the simulations, both the median of the simulations per bank and the 95th percentile, for both historical default rates determined as above. For aggregated historical PDs, the median – the median of the bank's relative losses – is 99 per cent, indicating a slightly lower loss with deflections than without them. In the case of the most exposed bank, this ratio is 105 per cent. When sector-level default rates are used (Row 3), the relative ratio may be as high as 106 per cent. The largest relative loss ratio difference between banks belonging to the minimum and the maximum is observed for the aggregate default rate and the 95th percentile. Apparently, individual banks are characterised by significant differences, with losses varying by up to 17 per cent for a given risk. These differences between banks may be higher in the case of a scenario that is more severe in terms of transition risks.

The methodology presented here can also be implemented by banks with minor changes. One option, for example, is to implement the effect of the carbon price shock they seek to analyse in their own macroeconomic models through a variable that captures energy prices. Subsequently, using the sectoral methodology outlined, with Equation (6) they can disaggregate the effect for the companies operating in each sector. For some steps, they may also find the partial results of this study helpful.

5. Conclusion

This study presents the methodology and results of a climate stress test carried out for credit institutions, focusing on the methodology of the sectoral module developed for the analysis. The sectoral module diffuses the consequences of the energy price shock caused by carbon pricing between activities with higher GHG intensity and related sectors. The transition shock is diffused across the economy by a sectoral network formed on the basis of the input-output table. The purpose of modelling is to measure the transition risks and not to perform a cost-benefit analysis; accordingly, the positive effects of the transition, occurring mainly in the longer term, are not reflected in the model. Due to the risk focus, the economic stimulus effect of the revenues from carbon pricing were disregarded: despite their ability to significantly mitigate the negative impact on the macro-economy in the short term, their impact on the activities more exposed to transition risks is uncertain.

According to the results of the macroeconomic model, the introduction of carbon prices, modelled as a 100 per cent energy price increase, would, in the short term, cause a 1.2–0.8 per cent GDP decrease compared to the baseline. Based on this, the transition scenario implies a PD increment of 0.2–0.4 percentage points in the short term. According to the results of the sectoral module, the national economy sectors with the highest exposure to transition are those of electricity and gas supply (D), utilities (E), agriculture (A) and mining (B). In addition, the manufacturing (C) and logistics (H) sectors are considered to be vulnerable and have significant bank credit exposures. According to the results of the modelling, the electricity and gas supply sector may suffer the largest PD effect of 1.5–2.3 percentage points compared to the baseline, and the model quantifies a PD effect of 0.3–0.5 percentage points for agriculture, which accounts for 8 per cent of the corporate credit exposure. Given that the transition risks for the sectors are specifically heterogeneous, the transition represents a lower PD increment for many sectors than would otherwise result from a lower GDP path. The credit losses of individual banks also vary depending on the sector to which a particular institution has a higher exposure. According to the simulation used in the research, depending on the calculation method, there

may be a 7–17 per cent difference between the banks in terms of the impact of the introduction of transition risks at the sectoral level.

The advantage of the methodology presented lies in its ability, on the one hand, to capture the magnitude of macroeconomic shocks and the fundamental transition differences across sectors, and, on the other, its ease of integration into stress testing processes. As a result of the sectoral module, credit institutions with higher exposures and more vulnerable holdings in sectors exposed to transition risk can also be identified. In addition to the micro-prudential field of use, the methodology can also be used to assess the banks' own risks with minor modifications.

The aim of the short-term exercise is therefore not to carry out a cost-benefit analysis of economic policy responses to climate change, but to examine the stability of the financial system and individual credit institutions in the event of a transition scenario. In the future, the practice can be further developed by incorporating sectoral as well as enterprise-level data when available. Similarly to the sectoral heterogeneity observed in the sectors for transition risks, there may be significant differences between the risks of individual companies within the sectors. For some companies, it is easy to conceive of positive effects from the transition that are currently not adequately handled by the model. Another enhancement option is to refine the network diffusing the primary shocks, for example by using the more detailed corporate-level network of *Borsos – Stancsics* (*2020*).

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Carbon Intensity of Banks' Loan Portfolio – A Good Basis for Comparison in Case of Low-Income Countries?*

Gábor Szigel

In recent years, more and more credit institutions have been publishing the financed carbon footprint of their loan portfolio, enabling comparisons across institutions, for which investors and supervisors tend to use the carbon intensity of portfolios expressed as a proportion of the financed carbon footprint-to-total loan volumes. In this article, it is argued that such comparisons are unfair to low-income countries with low price levels, as they show the same activity as being more "carbon-intensive" in a low-income country than in a high-income country. The magnitude of such distortions can be significant, amounting to as much as 3 to 7-fold just within the European Union itself. As differences resulting from price levels do not actually represent differences in the carbon intensity of individual countries' real economy and are also not an "own choice" of these countries (but rather a consequence of the Balassa-Samuelson effect), it is argued that the comparison of carbon intensity of different banks' loan portfolios should be conducted using purchasing power parity adjustments – if not necessarily for investors, at least in the practice of financial supervisory authorities.

Journal of Economic Literature (JEL) codes: G21, M41, Q56, Q51, L52, F37, C81, C82

Keywords: carbon accounting, carbon footprint of banks, purchasing power parity

1. Introduction

In recent years, there has been more and more focus on the quantification of the financed carbon footprint of banks' loan portfolios in the financial sector. While there are no binding legal requirements for the quantification of banks' financed carbon footprint in force in the European Union or in any other developed economy, many credit institutions estimate and publish these figures on a voluntary basis as a sign of commitment to fighting climate change and/or under pressure from

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Gábor Szigel is a Senior Advisor of OTP Bank. Email: Gabor.Tamas.Szigel@otpbank.hu

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investors, supervisors or other stakeholders. Additionally, supervisory authorities have started to conduct comparisons of the carbon intensity of banks' loan portfolios, as the European Central Bank (ECB) did in its 2022 bottom-up climate change stress testing exercise (*ECB 2022a*).

The ability to compare the carbon intensity of individual banks' loan portfolios by putting them next to each other, however, does not necessarily mean that these comparisons provide meaningful information on which institutions are responsible for more pollution. One possible reason for this is that the underlying estimation methodologies are complex and heterogenous, i.e. there is inherent modelling risk stemming from the underlying quantification techniques.

Moreover, there may also be other systemic reasons that distort the comparison of the carbon intensity of loan portfolios across the financial systems of different countries, including factors such as the difference in nominal income and price levels of countries, structural differences in the depth of financial integration, etc. Such systemic distortions lie beyond the performance and choices of banks' managements, authorities and governments ("no fault of their own"), but may cause large differences in the carbon intensity of banks' loan portfolios. Such distortions are problematic, as they distort the "level playing field" across countries and institutions, while not reflecting any real differences in carbon emissions, and thus do not support the fight against climate change.

This article identifies such systemic distortions that are independent of actual pollution intensity and attempts to assess their impact.

The article is structured as follows: first, the context and basic methodology applied in the quantification of banks' financed carbon emissions are reviewed. Potential sources of systemic distortions that may impair comparability across institutions and financial systems are then discussed, and countries' different price levels are identified as the most important source of distortion. This impact is also illustrated using examples. Finally, the mechanism of the Penn effect and Balassa-Samuelson effect responsible for this distortion are briefly introduced and subsequently it is also demonstrated that the distortions stemming from the different price levels can be material, based on the example of EU countries. The article ends with a presentation of the conclusions.

2. Concept and role of banks' financed carbon footprint

2.1. Context and measurement of banks' carbon footprint

As the reduction of greenhouse gases (hereinafter: GHG) is a key front of the battle against climate change, one of the basic prerequisites for these efforts is the ability to measure GHG emissions. This is not only crucial for establishing and

monitoring GHG reduction targets, but also for prudential reasons, as banks with more exposure to carbon-intensive borrowers also face higher transition risk.[1] The evaluation of loan portfolios based on their underlying carbon intensity is becoming an increasingly integral component of the risk assessment exercises conducted by central banks and financial supervisory authorities (for more on the domestic practice of the MNB, see *Bokor 2021; Kolozsi et al. 2022*; *Ritter 2022; or* from abroad, e.g. Banca d'Italia: *Faiella – Lavecchia 2022*).

In light of the foregoing, the GHG accounting methodology has undergone serious development in the last decade. According to the most widespread standard, the GHG Protocol (*World Resources Institute 2004*), all corporations (including banks) must distinguish the following levels of carbon emissions:

- *Scope 1 emissions*: direct GHG emissions of the corporation (e.g. from gas boilers, own vehicles, etc.);
- *Scope 2 emissions*: GHG emissions attributed to the energy (e.g. electricity, heat energy) utilised by the corporation; and
- *Scope 3 emissions*: all GHG emissions that arise in the value chain of the corporation.

The GHG emissions attributed to banks' loan portfolios are obviously part of banks' Scope 3 emissions. (However, it should be noted here that the GHG Protocol treats credit institutions in a somewhat exceptional manner, as it does not require the quantification of Scope 3 emissions for certain activities – such as the collection of deposits and financial transaction services – in banks' value chain). To quantify the Scope 3 emissions of banks' loan portfolios, a new global initiative was introduced in 2020: the PCAF (Partnership for Carbon Accounting Financials) methodology (*PCAF 2020*), which is presented briefly in the next section.

As of August 2022, no country in the world had a legally binding requirement for banks to calculate and publish the GHG emissions attributed to their loan portfolios. There are, however, "soft requirements"; for instance, in its Guide on climate-related and environmental risks, the ECB expressed its expectation that banks make their Scope 3 emissions publicly available (*ECB 2020a*). The MNB's so-called Green Recommendations also encourage domestic credit institutions to prepare estimations on their Scope 3 emissions in Point 40 (*MNB 2021a*) and maintained this during the 2022 update of the recommendation (point 51) (*MNB 2022*).

[1] A bank's transition risk is the risk of loan losses attributed to borrowers which will belong to the "losers" of the transition to a carbon-free economy, as their carbon-intensive business models can no longer be maintained.

Right now, only a fraction of banks publishes Scope 3 emissions of their loan portfolios: out of 112 credit institutions supervised directly by the ECB, only 15 per cent made such reports publicly available (*ECB 2022b*). However, in light of the existing supervisory pressure, it seems inevitable that more and more institutions will be publishing their Scope 3 emissions in the near future, paving the way for the more extensive use and comparability of such data.

2.2. Comparability of banks' carbon footprint based on carbon intensity in proportion to loan volume

Of course, the emissions of individual institutions expressed in terms of absolute volumes (in CO_2 equivalent) do not tell us much about how polluting an institution's business activity is, because it does not take into account the differences in the institutions' size. This limits the comparability of carbon footprints.

Therefore, in practice, the GHG emissions of institutions are often compared in proportion to some monetised or economic value, creating indicators for carbon intensity. Such indicators may be the carbon footprint related to invested amounts or carbon efficiency (emissions / revenues) and the weighted averages of thereof (weighted average carbon intensity, WACI).

In the case of credit institutions, the absolute carbon footprint of their loan portfolios is typically compared *to the financed loan volume* – in the rest of this analysis, this is referred to as the *carbon intensity of loan portfolios*.

3. Methodology to calculate banks' financed carbon emissions

To calculate the carbon intensity of banks' loan portfolios, it is necessary to estimate the borrowers' GHG emissions and then determine a mechanism to allocate "its share to the bank". The PCAF methodology determines the rules of this process, according to which the carbon footprint of the banks' loans is the borrower's total GHG emissions multiplied by the so-called attribution factor, which serves for the purposes of this allocation. However, the exact mechanism differs by loan product types.

3.1. Calculating the emissions of business loans

In case of the corporate loans, the basis is the total GHG emissions of the borrower:

Financed emissions of business loans =
*Emissions of the borrower * Attribution factor* (1)

The attribution factor is calculated as the ratio of the loan volume provided to the borrower by the bank to the total assets of the borrower (or, in the case of publicly traded companies whose market capitalisation can be calculated, to the borrower's enterprise value, EV):

$$\textit{Attribution factor} = \textit{Loans provided by bank} / \textit{Borrower's total assets} \quad \text{or} \quad \textit{Loans provided by bank} / (\textit{Borrower's market cap} + \textit{Borrower's liabilities} - \textit{cash}) \tag{2}$$

In Equation (1), the total GHG emissions of the borrower can be determined based on several approaches: with the more sophisticated methodologies, the emissions are estimated from indicators of physical activities of the borrower (e.g. used energy in kWh, produced steel in tonnes, etc.), but this approach requires a great deal of data and measurements. Therefore, there are simpler approaches – especially for smaller, less sophisticated businesses – to estimate the borrower's emissions from its economic indicators by means of the environmentally extended input-output (EEIO) tables (for more details, see *Huppes et al. 2011*). (The practical application of the EEIO tables is presented in some articles such as *Teubler – Kühlert 2020*, as well as in the academic literature). This approach basically relies on industry averages as suggested by Equation (3). In 2022, the PCAF methodology requires the Scope 1 and 2 emissions of borrowers to be included in the estimation of banks' Scope 3 emissions for most corporations (with some exceptions), but borrowers' Scope 3 emissions will have to be gradually included into banks' carbon footprint by 2026 for all enterprises and industries.

$$\textit{Emissions of the borrower} (\textit{simple approach}) = \textit{Borrower's revenue} * (\textit{Industry emissions} / \textit{Industry output}) \tag{3}$$

Replacing Equations (2) and (3) in Equation (1), it becomes obvious that the – recently most widespread, EEIO-based – simple approach estimates the emissions attributed to a loan basically as the product of the financing ratio of the company by the bank, the weight of the company within its (statistical) industry and the total GHG emissions of the given industry.

$$\textit{Financed emissions of business loans} = (\textit{Loan provided by the bank} / \textit{Borrower's total assets}) * \textit{Industry emissions} * (\textit{Borrower's revenue} / \textit{Industry output} (\textit{revenue})) \tag{4}$$

3.2. Calculating the emissions of mortgages

In the case of (residential) mortgage loans, the formula differs from that of business loans in such a way that the basis of calculation is the financed property's carbon footprint, not that of the borrower (see Equation (5)) and the attribution factor is the loan-to-value ratio of the transaction (see Equation (6)).

Financed emissions of mortgage loans =
*Attribution factor * Emissions of the property* (5)

Attribution factor = Loan provided by the bank / Property's value at origination = LTV (6)

*Emissions of the property = Energy consumption of the property * Emissions factors* (7)

Replacing Equations (6) and (7) in Equation (5) shows that the financed emissions of mortgage loans basically depend on the LTV, the energy consumption of the property and the emissions intensity of energy used by the household sector, i.e. from the composition and efficiency of the local energy mix.

Financed emissions of mortgage loans =
*LTV * Energy consumption of the property * Emissions factors* (8)

3.3. Other loans

PCAF defines approaches for another four asset classes, which are the following: listed equity and corporate bonds, project finance, commercial real estate finance and motor vehicle loans. These approaches are similar[2] to the two introduced above, at least at a level which is important for the subject of this paper. Consequently, they are not described in detail here.

4. Factors distorting comparability across countries

The previous section presented the calculation of borrowers' carbon emissions and the allocation of the proper share of such to the financing banks. The estimated GHG emissions attributed to banks' loan portfolios are often divided by the loan volume, in order to capture the carbon intensity per monetary unit. This section assesses systemic factors (which do not result from the banks' business strategy and cannot be changed or influenced by their management) that may distort the comparability of these carbon intensity measurements. As the carbon intensity is a ratio, the potential distorting factors can be related to the nominator or/and the denominator, and thus they result from:

- the estimated carbon emissions themselves, or/and
- the value of the total loan volume.

[2] For equities, bonds and project finance, the calculation method is similar to that of business loans, whereas the approach for commercial real estates and car financing is more like that of mortgage loans.

4.1. Factors distorting the comparability of carbon emissions in the case of corporate loans

Looking at corporate loans, the emissions attributed to different loan portfolios according to PCAF can differ from each other, basically for two possible reasons:

- *Corporate emissions*: estimated emissions will obviously be higher for more polluting companies. In this case, factors distorting comparability in a systemic manner may be connected to the different economic structures in different countries or their place in the international supply chains. Although the argument of "no fault of their own" could be considered here as well, showing more polluting regions or corporates as being indeed more polluting than others is appropriate, as their direct contribution to climate change is in fact larger and thus must be addressed.

- *General finance ratio* (*corporate leverage*): PCAF will show the carbon footprint of banks and financial systems which accept corporate borrowers with higher leverage as being larger than others. This would result in higher carbon footprints for banks in countries where corporate leverage is *ceteris paribus* higher than elsewhere. Although such differences might indeed reflect a higher share of responsibility of banks in carbon emissions, they could also be consequences of local characteristics such as the level of development of local financial markets, the capital accumulation ability of local corporates, etc. Indeed, there are some differences in average corporate leverage across EU countries, but these do not tend to be dramatic (see *Annex*).

An additional source of distortion could be the application of different estimation approaches across the banking industry. If corporate-level estimations are based on indicators of physical activity (according to the more sophisticated methods), rather than based on economic indicators (simpler methods), and these estimations differ from each other, that would not represent a source of distortion in itself, because the different results might only reflect the fact that the given company differs from its industry average. However, there is no evidence whether these approaches (the ones based on EEIO tables and the ones based on physical activity) would lead to the same results at the level of a whole industry; ultimately, this depends on how well the EEIO tables (which are also estimates) reflect reality. There is also no evidence on the consistency and reliability of corporates' own physical activity based GHG emissions, regardless of whether these are prepared or audited by independent third parties or not, but this goes beyond the scope of this paper. It must be noted, however, that some analyses (*Szigeti and Tóth 2016*) suggest that even estimations of GHG emissions based on similar approaches but performed by different actors for the same company may lead to inconsistent results.

Finally, another additional source of distortion could arise from the fact that PCAF allows the replacement of total assets by enterprise value in Equation (2), despite the fact that the latter is usually higher for companies with good future growth prospects. As a consequence, the carbon intensity of a loan provided to a non-listed company will be *ceteris paribus* higher than that of a listed company, giving an unfair advantage to fast-growing listed companies (as the carbon footprint allocated to the bank will be lower even if both companies conduct an equally polluting activity) and vice versa for slow-growing companies. However, it can be assumed that this distortion of comparability is not systemic across countries and financial systems.

4.2. Factors distorting the comparability of carbon emissions in the case of mortgage loans

Looking at mortgage loans, the emissions attributed to different loan portfolios according to PCAF can differ from each other, basically for two possible reasons:

- *Emissions of properties*: estimated emissions will be obviously higher for properties which consume more energy and/or from a more polluting energy mix. This can be attributed to the general conditions of buildings, to climate conditions or to physical/geographical limitations with regard to the local energy mix in different countries. Although all these reasons could be assessed as systemic and not alterable on the short run by economic actors, these differences reflect real differences in pollution and in the contribution of a given country to climate change. Therefore, such differences should remain reflected in the comparison of carbon intensity of banks' loan portfolios.

- *Typical LTV ratio*: this has a similar impact as the corporate leverage ratio above. In countries and financial systems where LTV ratios tend to be higher, the carbon footprint of mortgage portfolios will also be higher. Typical LTV ratios can differ significantly from country to country, which can be partially explained by regulatory factors (e.g. introduction or existence of LTV limits), but also by structural differences (such as borrowers' ability and/or willingness to accumulate savings). In fact, there are substantial differences between the average LTV ratios of mortgages across the member states of the euro area (LTV ranged between 53–87 per cent in 2016–2018) as published by the ECB (*ECB 2020b*). However, as in the case of the corporate leverage ratio, dividing the carbon footprint of mortgage loans by the loan volume, i.e. focusing on carbon intensity instead of the carbon footprint itself, eliminates the impact of this distorting factor.

Overall, the picture is very similar to that seen in the case of business loans: the differences in the carbon footprint of different banks' loan portfolios calculated according to PCAF mostly reflect real differences in the emissions of the underlying properties, and it is not possible to identify any factors that would clearly, materially

and systematically distort the comparability of these measures across countries and financial systems.

4.3. Factors distorting the comparability of carbon intensity of portfolios: the effect of different price levels

As mentioned earlier, investors and supervisors do not compare the carbon footprints of different banks' loan portfolios directly to each other, but as a proportion to the total loan volume (expressed e.g. in emitted tonnes of CO_2 equivalent / euro), i.e. they compare carbon intensities rather than the carbon footprints themselves:

$$\textit{Carbon intensity of loan portfolio} = \textit{Financed emissions of loans / Total outstanding loan volume} \quad (9)$$

The above indicator will be distorted by the differences in general price and wage levels of different countries through the value of the total outstanding loan volume, completely independently of the real level of pollution of the underlying activities. The mechanisms through which this occurs are illustrated by two examples in the next section.

5. Impact of different price levels on carbon intensity

5.1. A business loan

Let us assume there are two entrepreneurs: Entrepreneur_A operates in Country_A, while Entrepreneur_B operates in Country_B. Each entrepreneur builds a house which is completely identical and constructed using the exact same technology from the exact same input materials. For the sake of simplicity, let us assume that all input materials are bought from abroad at the same price and quality (and obviously, the same carbon footprint) and all the energy needed for the construction (e.g. electricity, etc.) is produced from these input materials as well (i.e. the building process only has Scope 1 GHG emissions, while the Scope 2 emissions are zero). Finally, the entrepreneurs sell the finished houses to buyers.

Let us further assume that Country_A is a high-income, high-price level country, while Country_B is a low-income, low-price level country: price and wage levels in Country_A are approximately twice as high as in Country_B. Therefore, both the price of the finished house and the wages of the construction workers will be more or less two times higher for Entrepreneur_A than for Entrepreneur_B. Consequently, the rough financials of the two entrepreneurs will look as presented in *Table 1*.

Table 1
Financials of the two entrepreneurs and the carbon intensity of the loan provided by the financing banks

	Entrepreneur A	Entrepreneur B
Profit and loss		
Revenue (from selling the house)	100	55
Input materials	–10	–10
Labour costs	–60	–30
Profits of the entrepreneurs	30	15
Funding		
Loan borrowed from banks (financing ratio = 100%)	70	40
Carbon emissions of the project		
Total GHG emissions (in CO_2-equivalents)	x	x
Carbon intensity of the loan provided by the financing bank		
Scope 3 emissions of the loan	x/70	x/40

It is assumed that both entrepreneurs funded 100 per cent of the project from a loan borrowed from a bank (their equity was zero), i.e. $Entrepreneur_A$ borrowed 70 units, whereas $Entrepreneur_B$ borrowed only 40 units. As the construction activity of the entrepreneurs produced the exact same amount of GHG emissions (this is denoted by x), the carbon intensity of the loans (Scope 3 emissions / total loan volume) in case of $Entrepreneur_A$ will amount to x/70, whereas it will be x/40 in case of $Entrepreneur_B$. Thus, the carbon intensity of these two different loan portfolios will differ by a factor of almost two, despite the fact that the underlying financed activity was equally polluting.

5.2. A mortgage loan

Now, let us assume that the two houses above are bought by two different private persons in $Country_A$ and in $Country_B$. They both take out a mortgage loan with an LTV of 60 per cent from their banks, i.e. the buyer in $Country_A$ borrows 60 units, whereas buyer in $Country_B$ borrows 33 units. Let us also assume that the energy consumption of the two buildings is identical, meaning that the underlying energy mix of the two countries is also identical (expressed, for example, in terms of CO_2-equivalents / kWh). Let y denote the annual GHG emissions of the two buildings.

In this case, the GHG emissions of these mortgage loans allocated to the financing banks according PCAF will be y/60 and y/33 in $Country_A$ and in $Country_B$, respectively. In this case again, the carbon intensity of the different mortgage loans in $Country_A$ and in $Country_B$ will be different by a factor of two, despite the underlying activity (asset) being equally polluting here as well.

The above examples illustrate how different price and wage levels in different countries necessarily cause a distortion in the comparison of carbon intensities of loan portfolios.

6. Reasons for different price levels across countries and their magnitude in the EU

The above distortions have a significant negative impact on the comparability of carbon intensities if there is indeed a major difference between countries' price levels that is non-random and independent of the real level of pollution. This section demonstrates that these differences do indeed exist and that they are systemic in nature as they can be explained by development levels. Therefore, they cannot be influenced by the decisions of banks in the short run and probably not even in the longer run either.

Although the purchasing power parity (PPP) theory of classical economics assumed an eventual convergence in the prices of different countries, in reality this has never occurred since the early 1950s, as documented by the so-called "Penn studies" (e.g. *Kravis et al. 1978*), which also established the practical fundamentals of the PPP-correction for international income data. A phenomenon – called the "Penn effect" based on these papers – was observed, according to which high-income countries also tend to have higher price and wage levels.

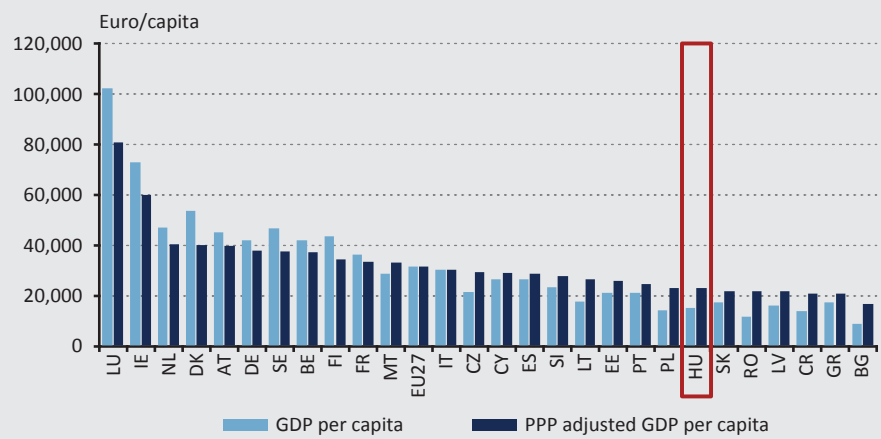
The reason for this phenomenon is explained mostly by the "Balassa-Samuelson effect" which can be briefly summarised as follows: all countries produce tradeable goods, which can be sold anywhere in the world economy, and non-tradeable goods, which can be sold only locally. The tradeable goods (e.g. a mobile phone) tend to have a single price which is more or less the same everywhere around the world (otherwise arbitrage would be possible by buying them where they are cheap and selling them where they are expensive), whereas the non-tradeable goods (e.g. a haircut) have prices which can differ across countries. In more developed countries, the productivity of labour is higher for tradeable goods, and therefore the wages of workers employed in the tradeable sectors will also tend to be higher. This, however, would not be sufficient to explain the differences in price level across countries. It is also necessary that wages in the non-tradeable sector also be higher in more developed countries, even though the labour productivity of non-tradeable workers might be the same everywhere (hairdressers are more or less equally productive in developed and developing countries). This can have many reasons: for example, the higher demand (purchasing power) from workers employed in the tradeable sector, the potential substitution of labour between the tradeable and the non-tradeable sector, etc.

Analysing the impact channels of the Balassa-Samuelson effect is beyond the scope of this paper, but a good summary can be found in the introductory chapter of

Pancaro's paper (*Pancaro 2011*) for example. Actually, for the purposes of this study, it is irrelevant what exactly explains the Penn effect. What is important is that it exists and it is material, as is demonstrated for the countries of the European Union below.

To filter out the distortions caused by Penn effect in income data such as GDP, a purchasing power parity (PPP) adjustment is applied in order to remove the impact of different price levels from the economic performance of different countries and enhance their comparability. As price levels correlate with the level of development, PPP-adjusted GDP data show a smaller difference in the real economic performance of countries: for instance, in the EU, differences between Member States based on *nominal* GDP per capita are in a range of up to 12 times between the poorest and the richest, but after PPP adjustment the differences diminish to a magnitude of "only" five times (*Figure 1*).

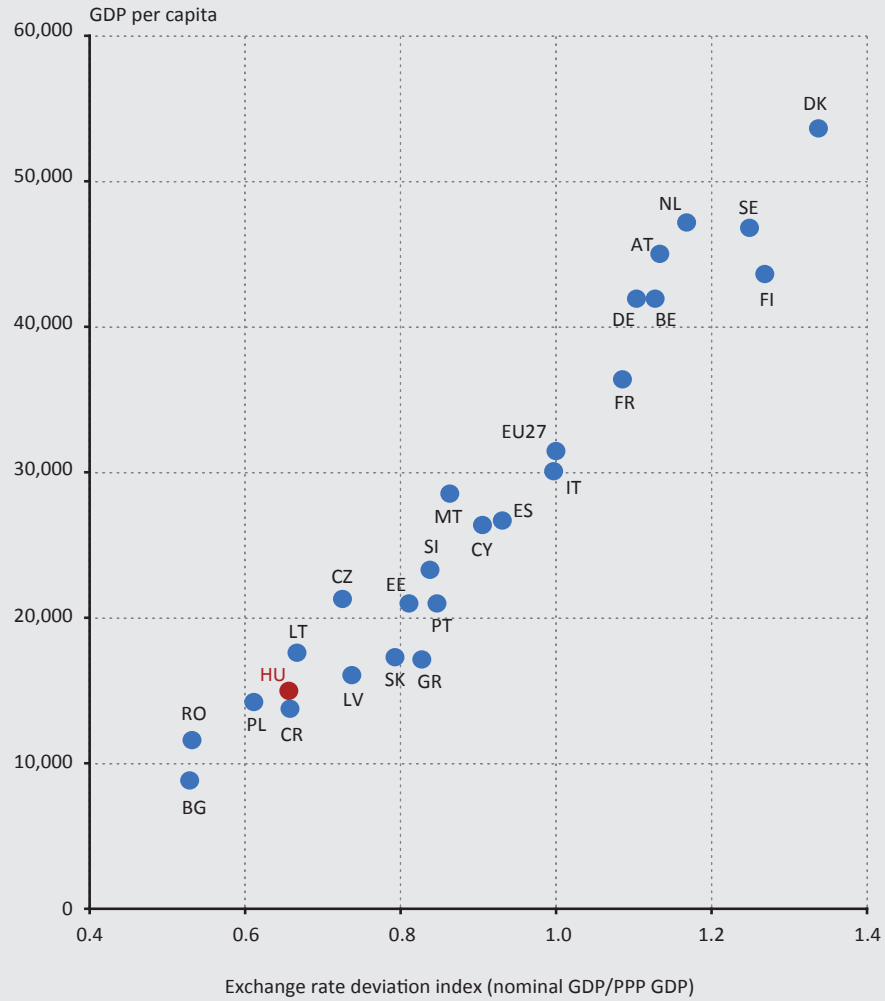
Figure 1
Per capita GDP based on nominal GDP and PPP-adjusted GDP data in EU countries, 2019



Source: Eurostat

Figure 2 also illustrates that differences in price levels across countries are non-random: correlation between the level of development and the necessary PPP-adjustment factors is strong for EU countries, as the correlation coefficient between these two is 0.84. PPP-adjustment factors in this chart reflect the relative price levels showing a significant difference between countries: for example, the differences between Bulgaria and Denmark have a magnitude of 2.5 times, meaning that on average the same good costs 2.5 times more in Denmark than in Bulgaria.

Figure 2
PPP-adjustment factor (exchange rate deviation index) and nominal GDP per capita in EU countries

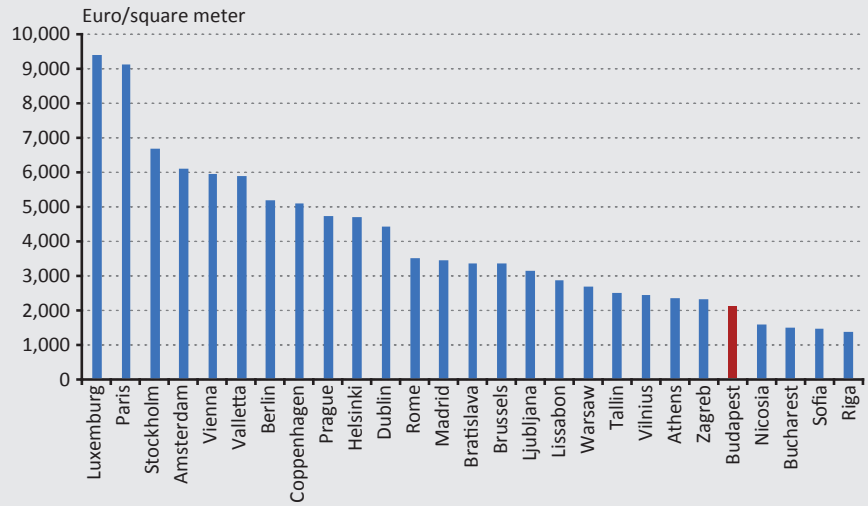


Notes: All data for 2019; data for Ireland and Luxembourg were omitted as these countries have extreme values in terms of nominal GDP for several reasons. However, the omission of these two countries does not change the correlation between the PPP-adjustment factor and the level of development of the EU countries.

Source: Calculations based on Eurostat data

Furthermore, differences in price levels may be even bigger than above in certain subsegments of the economy: e.g. real prices across countries of the EU can differ even by 6–7 times between certain regions of the EU (*Figure 3*), although these differences may also be due to non-systemic, unalterable factors, other than differences in economic development (e.g. local regulations, interest rate environment, etc.).

Figure 3
Real estate prices in selected European cities



Note: The indicated property prices are "Price per Square Meter to Buy Apartment Outside of Centre" as defined by numbeo.com. As the data at numbeo.com are not compiled based on a representative sample, they should be treated with utmost caution.

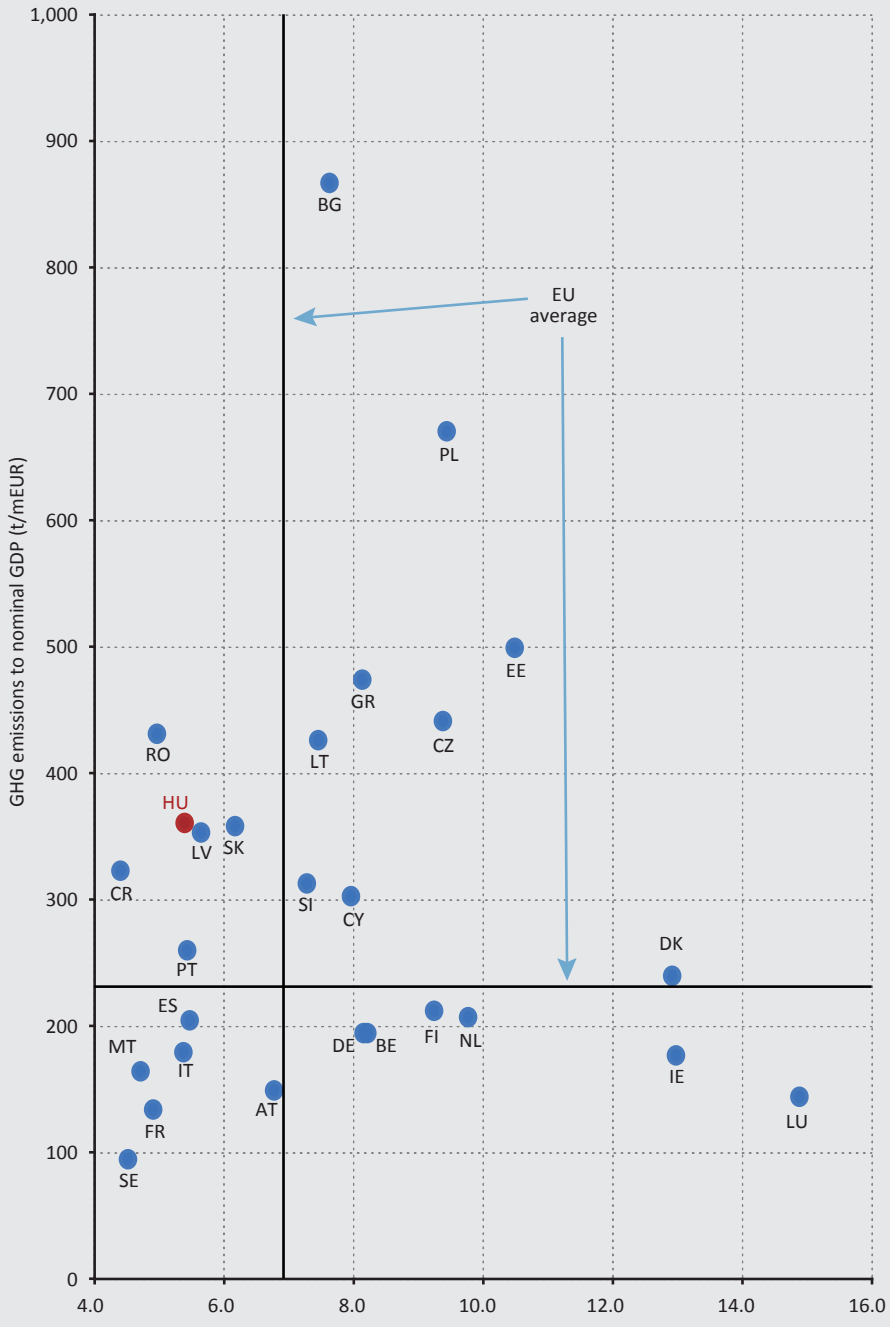
Source: numbeo.com, prices downloaded in June 2022

Adjustment with PPP is also not completely unknown in the case of environmental sustainability statistics: the World Bank, for example, publishes country-level GHG emissions as a proportion to PPP-adjusted GDP data among its World Development Indicators (*World Bank 2022*). The MNB also published a regional comparison of CO_2 emissions of Hungary based on PPP-adjusted data in its Sustainability Report (*MNB 2021b: p. 23*). However, this approach is not yet widespread, as already noted with regard to the 2022 bottom-up stress test of the ECB.

7. Magnitude of the distorting effect of different price levels in comparisons of carbon intensity within the EU

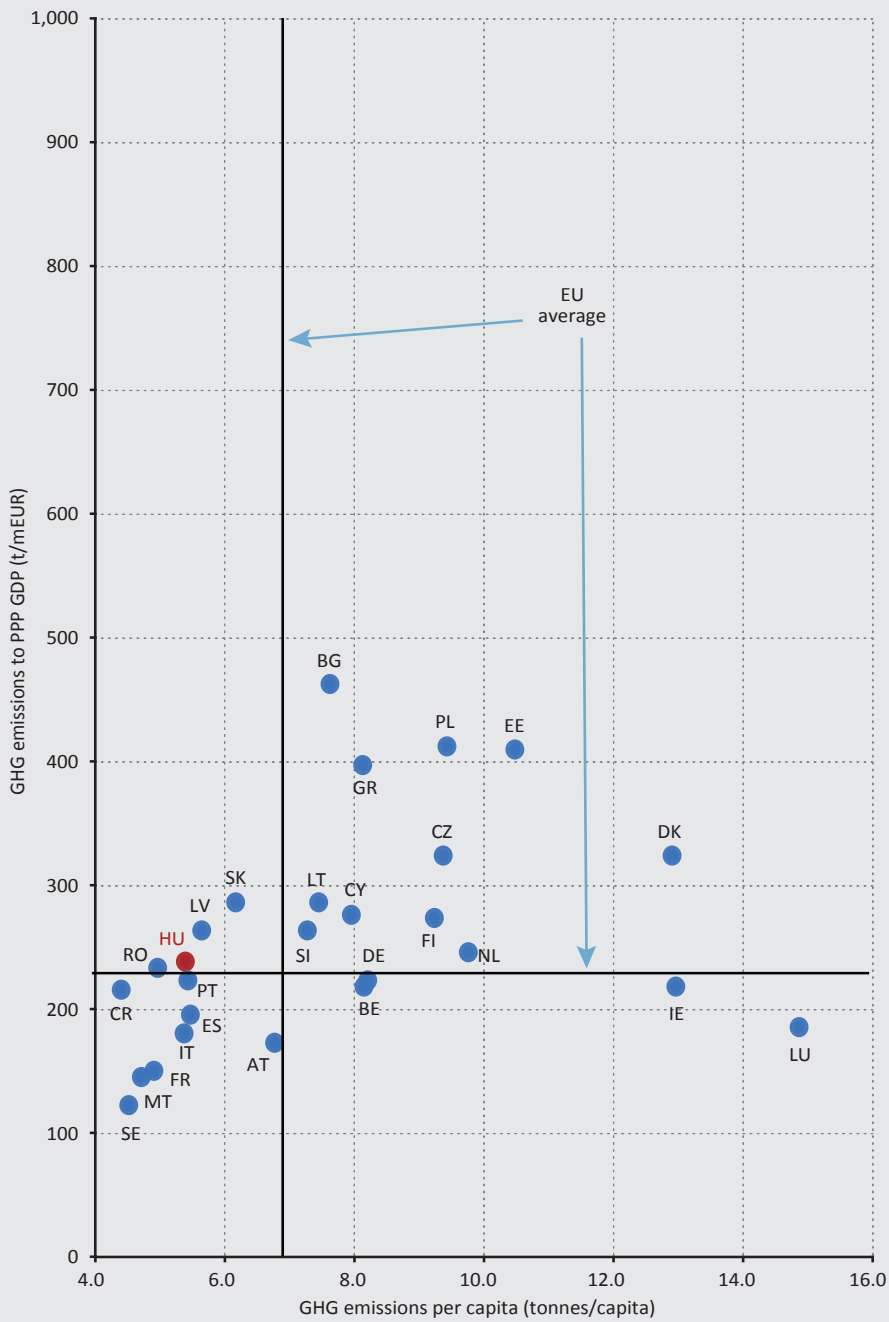
How different price levels – if not adjusted – could impact the comparison of the carbon intensity of banks' loan portfolios in different countries can be estimated by comparing GHG emissions data of different countries in proportion to their nominal and PPP-adjusted GDP. *Figure 4* shows EU countries' GHG emissions related to their nominal, non-PPP-adjusted GDP. *Figure 5* shows the same, but with PPP-adjusted GDP. The per capita GHG emissions of the countries are added to both charts for the sake of comparison.

Figure 4
GHG emissions of EU countries in proportion to their population and nominal GDP (in tonnes of CO_2-equivalent), 2019



Source: Eurostat

Figure 5
GHG emissions of EU countries in proportion to their population and PPP-adjusted GDP (in tonnes of CO_2-equivalent), 2019



Note: GHG emissions in CO_2-equivalent
Source: Eurostat

Figures 4 and *5* show that differences in GHG intensity of the economies of EU Member States – if not corrected for different price level – can be even in the magnitude of 9 times (between Bulgaria and Sweden). Once the data are adjusted for price level differences, the difference between the most-polluting and least-polluting economies diminishes to a magnitude of "only" 4 times. The two charts also show that the PPP-adjusted carbon emissions intensities are more in line with the per capita-based GHG emissions values (although the two differing from each other does not reflect distortion in itself, as it only shows that there are differences in the level of real economic activity across countries as well).

8. Conclusions

The analysis shows that the carbon intensities of banks' loan portfolios as expressed in proportion to total outstanding loan volume can be very different from each other merely because of the different price and wage levels of countries. Such differences do not reflect any real difference in the pollution level of economic activities, and therefore they can be interpreted as a factor distorting the comparability of loan portfolios' carbon intensities across countries. As differences in price and wage levels vary non-randomly across countries and are rather the inevitable consequences of the different income and productivity levels of countries (due to the Penn or Balassa-Samuelson effect), this distortion will make equally-polluting real economic activities in low-income countries look *ceteris paribus* systematically more polluting.

How to treat the consequences of this distortion depends also on the point of view of economic actors and the purposes of their decisions.

From investors' point of view, taking into account this distorting impact might not be necessary. If investors seek to minimalise or at least limit the carbon footprint related to their investments, then adjusting their portfolio's carbon intensity for the different price levels would be unjustified. After all, the investment of 1 million euro will "buy more pollution" in a low-income country, than in a high-income country, because it can fund more real economic activity.

However, from the point of view of economic policy or banking supervision – especially in the EU's single market – not considering this distortion effect violates the principle of a "level playing field". If bank supervisors penalise credit institutions, loan portfolios and economic activities based on the *absolute* value of carbon intensity without adjusting it for different price levels, it causes a competitive disadvantage for low-income countries and their financial systems. Such an approach would raise questions with regard to fairness and social justice, as it would penalise polluting activities in high-income countries less, just because they are high-income countries. Therefore, for the purposes of economic policy and banking supervision, this paper finds that the carbon intensity of loan portfolios should be adjusted by purchasing power parity.

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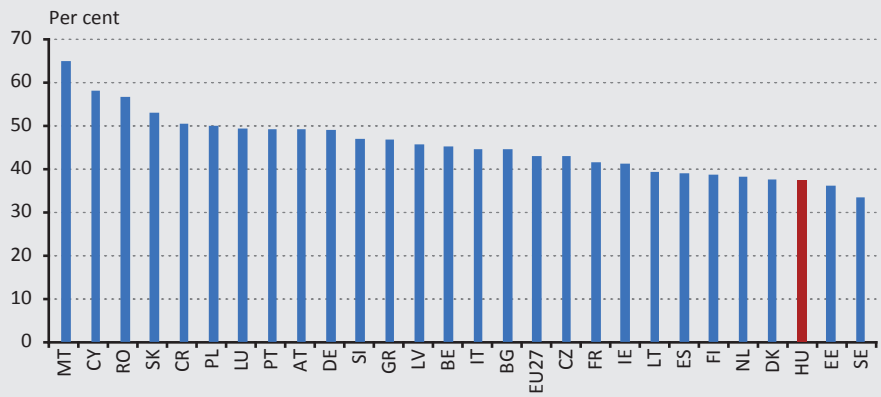
Annex: Dependence on external financing of non-financial corporates in EU countries

Figure 6
External liabilities / (all liabilities + equity) of non-financial companies in EU countries, 2019



Note: Consolidated data

Source: Eurostat, financial accounts

Sustainable Investments in the Insurance Sector*

Viktória Deák – Nikolett Tőrös-Barczel – Norbert Holczinger – Ferenc Szebelédi

Achieving global environmental and climate agreements requires the efforts of not only supranational organisations and states, but also the financial sector, including the insurance sector. In addition to the core business of insurance companies, i.e. the undertaking of risk, their investments also play a key role. Recent years have seen an increasing number of unit-linked products that seek to contribute to some sustainability goal. However, the sustainability approaches and investor disclosures of collective investment undertakings and unit-linked asset funds have not been uniform, warranting regulation on account of the growing risk of greenwashing. New EU legislation has created the opportunity, inter alia, to distinguish collective investment undertakings and asset funds in terms of sustainability and to ensure greater transparency for investors. While there is no doubt about the need for regulation, at this stage it poses a number of challenges for institutions.

Journal of Economic Literature (JEL) codes: G22, G32, K29, Q56

Keywords: unit linked insurance, ESG, transparency, SFDR, climate change

1. Introduction

Today, in all walks of life our encounters with sustainability are becoming ever more frequent. This is no different in the financial sector as well, where the issue appears in a number of aspects. These include, on the one hand, the risks posed by climate change to the operation of various financial institutions (*NGFS 2019, 2020, 2022; BIS–BDF 2020*), and on the other hand, the means and extent to which the financial system itself can influence climate risks and how it can participate in mitigating climate change and its consequences.

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* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Viktória Deák is a Junior Analyst at the Magyar Nemzeti Bank. Email: deakvi@mnb.hu
Nikolett Tőrös-Barczel is an Analyst at the Magyar Nemzeti Bank. Email: torosbarczen@mnb.hu
Norbert Holczinger is a Head of Department at the Magyar Nemzeti Bank. Email: holczingern@mnb.hu
Ferenc Szebelédi is a Head of Department at the Magyar Nemzeti Bank. Email: szebeledif@mnb.hu

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Along with central banks and supervisory authorities, regulators play a key role in greening the financial sector, as exemplified by the European Union's actions in recent years (*UN Environment Inquiry 2018; Dikau – Volz 2019; Matolcsy 2022*). Following the EU's ratification of the UN Paris Climate Agreement in 2016, a High-level Expert Group (*HLEG*) was created the same year to prepare comprehensive reforms. The Group identified two avenues: to enhance the role of the financial sector in sustainable growth and addressing climate risks, and to strengthen financial stability with environmental, social and corporate governance aspects[1] in mind (*HLEG 2017*). The Sustainable Finance Action Plan published in 2018 sets three objectives: to steer capital flows towards sustainable investments, to address financial risks arising from climate change and to increase transparency (*DG FISMA 2018, Veerle 2020*).

Sustainability challenges may also open up business opportunities for financial market participants, including the insurance sector, which have the ability to reallocate, through their investments, capital from high-emissions economic activity to low-emissions, climate-friendly projects, helping to achieve the environmental goals in the process. According to a recent IMF analysis, the achievement of the objectives set out in the global climate agreement would require an annual USD 3–6 trillion globally up to 2050, which cannot be covered by resources from public finances alone; therefore, the financial sector is needed to finance sustainable investments and economic activities (*Prasad et al. 2022*).

Among financial market participants, insurers can be seen as being in a special situation also on account of their multifaceted exposure to sustainability risks: as undertakings, as risk-takers, as risk managers and as investors (*UNEPFI 2012*). This is especially true in the case of climate risks, which, in our experience, have recently gained prominence among such risks. In itself, the management of environmental risks is not new to the insurance sector, as a significant part of insurance risks are covered to offer protection against negative environmental impacts (e.g. storms, floods, droughts, etc.). The issue of financial risks arising from climate change was already actively addressed at the international level by the insurance sector (as well as by reinsurance, with an even larger information base) the late 2000s, and thus later on the first climate models were set up mainly relying on data from insurers (*Pandurics – Szalai 2017*).

The International Association of Insurance Supervisors (IAIS) has addressed the relationship between insurers and ESG risks (especially climate risks) in several publications (*IAIS 2018, 2020*). Based on these studies, and on the presentation of impacts in the UK (*BoE 2015*) and those potentially occurring in Hungary (*Pandurics – Szalai 2017*), it can be concluded that the insurance sector is exposed to both

[1] ESG.

physical and transition risks, which are accompanied by liability risks. In addition to their impact on the assets and property insured, physical risks can also affect mortality and demographic trends, and may thus occur in the case of both life and non-life insurance. They may also be sources of investment risk, as changing climate or specific natural events may have a negative impact on the value of insurer assets. Transition risks primarily involve an investment risk, whereas a good example of liability risks is the potential loss resulting from business operations that ignore climate risks.

Looking at these risks from a different perspective, it can be established that insurers' risk-taking (i.e. what the institution does or does not cover) and their investment activity are both highly exposed to sustainability risks. In view of the broad scope of the subject, our study is only concerned with investment aspects, with a particular focus on unit-linked insurance. Investment activity can be divided into several parts, with a distinction being made between assets in terms of whether investment risk is primarily taken by the insurer or by customers. The former category includes, amongst other things, assets covering the reserves of traditional life insurance products,[2] while the latter essentially comprises unit-linked life insurance, where the customer can determine where their savings are to be invested by choosing from the asset funds offered by the insurer. Due to the nature of the plan, the number and characteristics of investment options available during the decision-making process are decisive, i.e. the options provided by the insurer and the amount of information available on the asset funds offered. The latter may also be referred to as a transparency criterion, which already played a prominent role in Hungary as part of regulating ethical life insurance, primarily by increasing the transparency of costs (*Mátyás et al. 2017*). The transparency of the sustainability characteristics of investments is provided for by recently issued EU legislation.

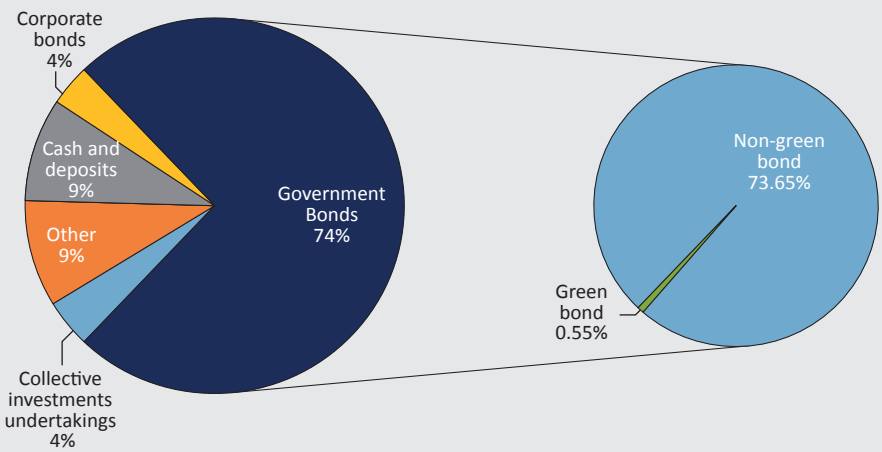
This paper examines the impact of European legislation on sustainability disclosures. For that purpose, we first review the characteristics of the investments of Hungarian insurers and then present the Hungarian sustainable asset funds, with a special reference to the possible difference on the cost side compared to 'traditional' asset funds. After presenting the main points of EU regulations, we examine practical issues as well, with a particular focus on the tasks related to the product management system.

[2] In the case of traditional savings life insurance products, due to the return of excess return, the service of the insurer also depends on the return on investment, whereby the customer also bears an investment risk.

2. Overview of Hungarian insurers' investments

To a large degree, insurers can exert their impact on climate change through their investments. The analysis of asset composition is a possible method for determining the commitment of the insurance sector to sustainability. Insurer assets can be divided into two large groups according to whether the primary risk-bearer is the customer (unit-linked) or the insurer (non-unit-linked). Non-unit-linked assets include own assets, collateral for non-life reserves and collateral for life insurance reserves (excluding unit-linked). In turn, unit-linked assets comprise unit-linked reserves, with approximately one half of the assets falling into each of the two groups (*MNB 2022b*). While the latter is explored in detail in the subsequent sections, the following paragraphs provide an overview of non-unit-linked assets.

Figure 1
Neither unit-linked nor index-linked investments by asset classes and the composition of government bonds, as of 30 June 2022



Source: Edited based on MNB (2022b) data

Approximately three quarters of the non-unit-linked assets of Hungarian insurers are government bonds (*Figure 1*), comprised predominantly of Hungarian and, to a lesser extent, other European Union exposures. It is worth examining the proportion of green government bonds among these. Providing finance for green projects, green government securities have a dynamically developing market all over the world (*Banga 2018*). This is no different in Hungary, where they represent one of the sources of climate neutrality, to be achieved by 2050 (*Government Debt Management Agency 2020*). In contrast to the high proportion of Hungarian government securities, Hungarian green government bonds represent a mere 0.55 per cent of all non-unit-linked assets. A similar result is obtained by examining the

proportion of Hungarian green securities only among long-term government bonds: of all government bonds maturing between 2032 and 2051, only 3.57 per cent are green. The most important reason for this low presence is that in Hungary, green government securities were first issued in June 2020, denominated in EUR, and were only followed by a HUF-based issue in April 2021. Thus, up to the reference date of our analysis (30 June 2022), insurers only had a short period of time to purchase these instruments. Another reason is that green government bonds are only available for three maturities (2032, 2035 and 2051), which significantly reduces the investment opportunities.

In addition to green government securities, insurers also hold green corporate bonds in their portfolios. While their aggregate share of non-unit-linked assets is less than 0.1 per cent, it is worth adding that corporate bonds also account for only 4 per cent of the total. Overall, therefore, the presence of green and sustainable assets within non-unit-linked assets is minimal, even for insurers with a higher share of unit-linked assets in their sustainable investment asset funds.

3. The emergence of sustainable asset funds and the analysis of empirical data from Hungary

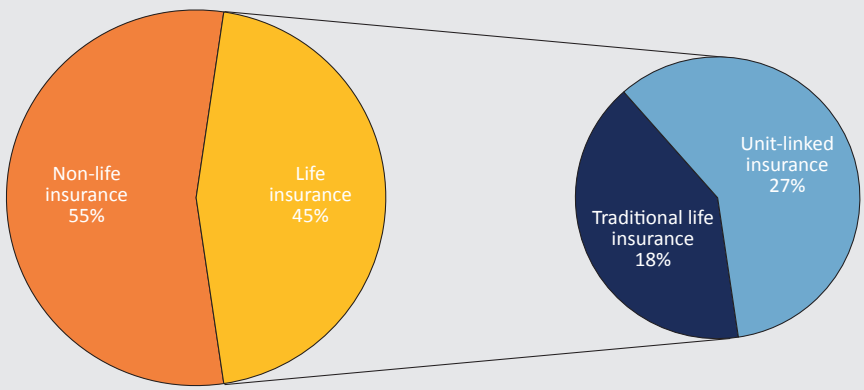
As noted above, the insurance sector has a significant role to play in supporting the transition to a sustainable economy. It is an often-mentioned fact that resources from public finances alone cannot provide the funds required for the investments to achieve the environmental and climate objectives, and therefore the involvement of the financial sector, such as banks, insurers, fund managers, investment firms and funds, is essential for the transition to a low-carbon economy (*DG Trésor 2017*). The insurance sector also plays an important role in channelling capital towards sustainable investments via insurance-based investment products (IBIPs). Of these, unit-linked insurance products are examined in detail, which combine the services offered by life insurance and collective investment undertakings, so that the amount of payments due on maturity or in the event of death is determined by the return of the investment funds selected by the customer. In addition to their goals to drive returns, the asset funds associated with insurance products have recently incorporated sustainability criteria as well. Accordingly, the amount paid by the policyholder can be transferred, at their request, to a fund that indirectly provides financing for climate-friendly or other sustainable investments.

On the European stage, collective investment undertakings contributing to sustainability and green goals emerged from the early 2010s. *Morningstar* (*2020*) reports on the exponential growth of European sustainable funds and notes that in 2020, despite the coronavirus pandemic, sustainable investment funds worth a record amount of more than one trillion EUR were available in the European

capital market, reflecting a 52 per cent increase in assets compared to the previous year. One of the reasons for this may be that, in addition to the increasing sustainability needs of investors, ESG investments were regarded by many as a safe haven (*Singh 2020*). Another possible contribution may have been the abundance of money that was characteristic of the period, owing in part to the involuntary savings caused by the pandemic and in part to the availability of state income transfers. However, due to data availability problems, it is not possible to determine exactly how much of the value of the funds can be associated with unit-linked insurance products. The survey does note though that sustainable investment funds cover a very broad universe, with multiple shades of 'sustainability' along a wide range of investment strategies. Depending on the approach followed, a distinction can therefore be made e.g. between so-called ESG, SDG,[3] green, climate, sustainable, thematic and impact investments (*Morningstar 2020*). This warrants attention also because the different methodologies may assume very different effects in terms of their contribution to sustainability goals.

However, as regards the Hungarian insurance sector today we have a more accurate picture of the size and context of the assets managed in the unit-linked insurance products marketed in Hungary.

Figure 2
Premium received by insurance companies (except for small insurance unions), by product group (2021)



Source: Edited based on MNB (2022b) data

[3] Sustainable Development Goals – sets out the UN's Sustainable Development Goals.

Unit-linked insurance products account for more than half of the share of life products, representing a sizeable slice within the range of insurance products. In 2021, the premium income of insurance companies from unit-linked insurance exceeded HUF 356 billion, which is 27 per cent (*Figure 2*) of the total premium income of insurers (life and non-life combined). As in developed international markets – although much later, around 2018 – Hungary also saw the emergence of unit-linked insurance products where some of the underlying investment options concerned environmental and social objectives. Their value exceeded HUF 22 billion by the end of 2020, a minute share amounting to a mere 1.7 per cent[4] of the total assets of Hungarian unit-linked funds. In addition, only HUF 1.3 billion worth of the assets managed in sustainable asset funds were allocated to Hungarian collective investment undertakings (*MNB 2021*).

In the absence of an official classification and definition set, before 2021 Hungarian sustainable asset funds could only be identified using keyword searches in fund names. The question immediately arises as to the extent to which, in the absence of appropriate and uniform regulation, the ESG or sustainable investment products based on self-qualification meet the sustainability goals promoted in their names and investment objectives, and contribute effectively to the promotion of environmental goals. As these financial instruments were not certified for a long time by any independent third party, the risk of 'greenwashing' also arose in the capital markets. The term essentially refers to situations where a company develops an environmentally friendly image without meaningful activity in that regard[5] (*Cambridge Dictionary 2022*).

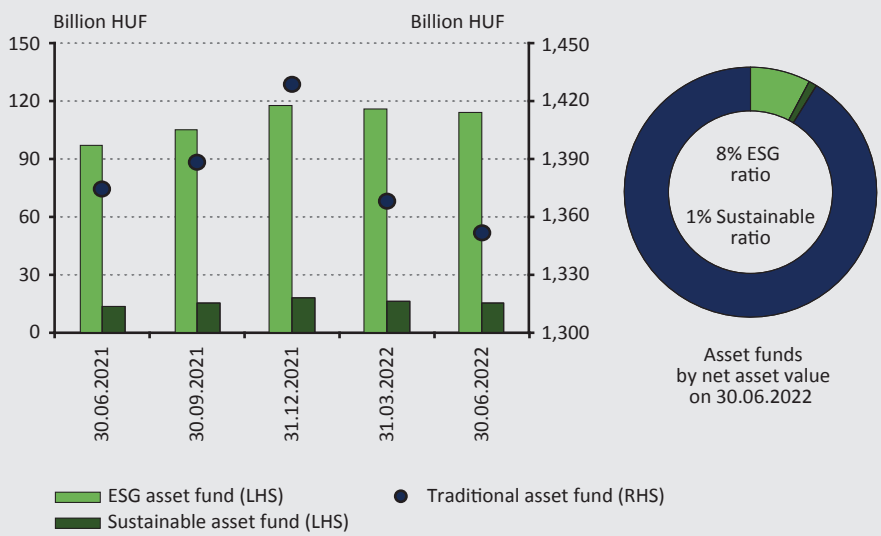
Recognising the need for regulation, the European Union's Sustainable Finance Disclosures Regulation (SFDR)[6] for investment service providers entered into force in March 2021, which not only helps investors and consumers to make their investments as transparent as possible, but also enables financial products to be 'categorised'[7] according to the depth of the sustainability goals. In this context, a distinction can be made between three types of collective investment undertaking, or, in this case, asset fund: (a) products complying only with Article 6 of the SFDR, which do not have a sustainability objective and can therefore be considered as traditional investments; (b) products complying with Article 8 of the SFDR, which aim to promote environmental and social aspects while following good corporate governance practices (ESG); and (c) products complying with Article 9 of the SFDR,

[4] In Hungary, the investments underlying unit-linked insurance products are essentially asset funds, which are typically composed of the Hungarian and foreign investment funds of the related institutions, and, in contrast with international practices, do not make individual direct investments (*MNB 2021*).
[5] Cambridge Dictionary (2022): Meaning of greenwashing in English. https://dictionary.cambridge.org/dictionary/english/greenwashing. Downloaded: 15 September 2022.
[6] *Regulation (EU) 2019/2088 of the European Parliament and of the Council of 27 November 2019 on sustainability-related disclosures in the financial services sector*
[7] Although SFDR is primarily a disclosures regulation, it is useful for a better understanding of the main differences between products.

which aim to achieve sustainable investments. The uniform classification has created a more accurate picture of the sustainability of EU and Hungarian investments, and can serve as a reference point for customers to choose, from the given repertoire, the asset fund that is appropriate for their sustainability preference.

After the entry into force of the Regulation, the stock of assets managed in the asset funds complying with SFDR Articles 8 and 9 increased compared to the earlier estimated HUF 22 billion, indicating, among other things, the launch of new asset funds around sustainable themes, in addition to the asset funds previously self-styled as ESG, green, sustainable, etc. (*Figure 3*). That said, some of them may not have pursued a sustainability goal before, but changed direction by rethinking their investment strategies, and had themselves reclassified into one of the SFDR categories in accordance with the Regulation. Based on data from the MNB, by the end of the first half of 2022, of the asset funds underlying unit-linked insurance products available to clients, 56 integrated environmental and social aspects and 7 contributed to sustainability goals. Their combined net asset value exceeded HUF 130 billion, which is 9 per cent of the assets held in the Hungarian multi-asset portfolio.

Figure 3
Hungarian ESG and sustainable asset funds by assets under management



Source: Edited based on MNB (2022a) data

In almost a year and a half, therefore, the assets of ESG or unit-linked asset funds identified in Hungary have increased more than fivefold. This may be due in part to previous estimation constraints along with the entry into force of the SFDR Regulation, which enabled the visibility of investment products that had already

existed and followed a sustainability policy, and in part to the recognition of increased investor demand, social demand and sustainability risks, and thus the integration of management methods in investment decision-making.

The popularity of asset funds complying with SFDR Articles 8 and 9 depends on a number of factors: on the one hand, the risk preference of the counterparty must meet the degree of risk associated with the fund, and on the other hand, the expected return must also be delivered. Although it is currently difficult to draw far-reaching conclusions on the performance of sustainable investments, which are mostly influenced by the markets, the insurer may also influence it through cost reductions, whereby the cost indicator provides the means of a financial comparison between ESG funds and traditional asset funds.

Under the *Insurance Act*[8] and the *MNB decree on the calculation and publication of the annual cost indicator*[9], insurers are required to publish the annual cost indicator (ACR) associated with each savings life insurance product. This will help consumers, for whom the cost of insurance offered by different insurers will become transparent. The ACR shows the approximate amount of return the insurer draws from the customer compared to the cost-free state, subject to predefined parameters. Its primary objective is to inform customers and ensure the comparability of insurance products. The ACR incorporates all costs incurred in connection with the product, including asset management costs for unit-linked insurance. Accordingly, for the same unit-linked insurance product, selecting different asset funds may cause variations in the ACR due to the different asset management fees.

Table 1
Average ACR for asset funds complying with SFDR Articles 8 and 9, and average ACR within the same product for a term of 20 years

	Average ACR for asset funds complying with SFDR Articles 8 and 9 (%)	Average ACR per product (%)
Insurer A	3.32	3.10
Insurer B	3.50	3.41
Insurer C	3.17	3.21
Insurer D	3.37	3.20
Insurer E	2.09	1.76
Insurer F	3.17	3.17
Insurer G	3.25	2.84

Source: Edited on the basis of MNB data

[8] *Act LXXXVIII of 2014 on the Insurance Business* [Insurance Act]
[9] *MNB Decree No 55/2015 (XII. 22.) on the definition, calculation and publication of the annual cost indicator*

The Hungarian market shows variations in the asset management costs associated with asset funds (*Table 1*), which, incorporated into the ACR, reduce the return on the asset funds, effectively drawing returns away from customers. On average, most Hungarian insurers charge higher asset management costs for asset funds complying with SFDR Articles 8 and 9 (see *Table 1*). However, there are rather large differences between individual insurers, with ACRs on ESG asset funds an average 5–6 per cent higher than the average cost indicator of the same product, which could translate into a difference of 15–25 basis points. In some cases, the cost indicator is up to 14–19 per cent higher, possibly resulting in a difference of 30–40 basis points. Trends for unit-linked insurance are different in the EU, where it is generally accepted that the RIY indicator[10] (which is similar to the ACR) is the same as the cost indicator for ESG-rated asset funds (*EIOPA 2022*).

Naturally, this does not mean that the above claim would apply to all asset funds, as averaging conceals asset funds that the client chooses to obtain a lower ACR compared to the rest of the asset funds.

Overall, in the majority of cases, the ACR (i.e. the cost of asset management) is higher for ESG funds, which can be attributed to the following factors: Compiling an ESG asset fund essentially requires more research work, since in addition to the 'usual' parameters, so-called sustainability strategies also tend to get thrown into the mix and must be taken into account when selecting assets. Moreover, a new asset fund needs time to become popular and increase its net asset value along the way, which, especially at the beginning, makes it a more costly project that requires more attention. It should be noted, however, this mainly concerns asset funds complying with SFDR Article 9, whereas in the case of SFDR Article 8, which provides for a more relaxed set of conditions, less effort is required to transform an existing fund into a more sustainable one, allowing initial difficulties to be overcome. Furthermore, the insurer may also price in the increased interest in the product, i.e. higher demand may in itself be a driver of higher ACR.

That said, the extra expenses incurred on the fund manager's side may also be accompanied by a higher distribution budget. The person distributing and recommending the asset fund must be adequately prepared, as many customers are new to ESG and unaware of its advantages and disadvantages, and the promotion of such may warrant additional advertising costs.

These elements are relatively easy to quantify, but there may also be factors without any actual underlying activity, such as the customer's commitment. More dedicated customers may be willing to pay more for a product solely on the grounds that it better fits their preferences. In addition, climate change is now a very important

[10] Reduction in Yield

issue that concerns many people, so even the increased interest that it has attracted may lead to a specific price increase.

In any case, it can be clearly seen that as fund managers are adding new ESG-like and sustainable funds to their range that also comply with the SFDR, within the insurance sector prominence is being given to more sustainable asset funds available within the limits of unit-linked insurance.

4. Significance of the entry into force of the SFDR and its implementation into the operation of investment units linked to life insurance

As mentioned above, in the past decade a number of financial solutions have emerged that represented varying levels of sustainability or environmental goals. In the investment services sector, however, the sustainability approaches to this type of financial instrument, but in particular the disclosures addressed to investors, were not standardised, as this area had not previously been subject to harmonised requirements. Inconsistent disclosure standards, on the other hand, make the comparability of different financial instruments more difficult, may imply an unlevel playing field, and may confuse investors' decisions. In addition, the adverse impacts of intensifying climate change and other environmental and social problems constitute a new type of risk, not only to the economy, but also to the financial sector. This is the sustainability risk mentioned above, which, if ignored, could negatively affect financial market participants. In response to the major inconsistencies in established disclosure practices and in order to incorporate sustainability risks into the investment decision-making process, the first-level rules[11] of the SFDR entered into force in March 2021. The Regulation applies to collective investment undertakings, insurance asset funds and pension funds, among other vehicles. The main objectives of the SFDR are to ensure:

– that financial market participants and financial advisers integrate sustainability risks into investment decision-making policies,

– that financial products take into account adverse impacts in terms of sustainability,

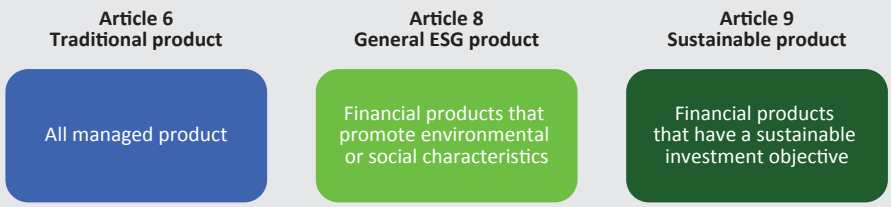
– an increase in transparency in relation to the sustainability features of financial products, curbing the risk of greenwashing activities and fostering the development of responsible and sustainable investments.

The Regulation therefore helps to provide broader access to information for investment decisions and allows a distinction to be made (*Figure 4*) between

[11] The Regulation can be interpreted at two levels, with basic requirements set at the first level, for which the technical and formal criteria are provided by second-level rules (*Commission Delegated Regulation (EU) No 2022/1288 – SFDR RTS*). The SFDR RTS will apply from 1 January 2023.

investments that promote environmental or social characteristics (SFDR Article 8 products) and those designed to make a positive impact on the environment and society (SFDR Article 9 products).

Figure 4
Product categories under SFDR classifications



Source: Edited based on the Morningstar's (2022a) figure

The higher the sustainability ambition of an investment product, the more detailed and accurate disclosure is required of statements on financial instruments such as investment funds or asset funds. In general, all investment products covered by the Regulation are required to integrate sustainability risks into investment decision-making, which is therefore a minimum that should be met regardless of the level of sustainability ambitions. However, for ESG-like and sustainable financial products, in this case asset funds, additional information is required under the Regulation, which essentially ensures that such investments actually fulfil the environmental and social goals promoted in their names and stated objectives. In practice, a number of methods have been developed to promote sustainability characteristics and to manage adverse impacts on sustainability factors, which will be explained below.

4.1. Integrating sustainability risks into investment decision-making

Sustainability risk is defined in *Regulation (EU) 2019/2088* as "*an environmental, social or governance event or condition that, if it occurs, could cause an actual or a potential material negative impact on the value of the investment*". Sustainability risks have not been part of risk management in the past, but recent research has convinced financial sector participants that such risks, resulting e.g. from adaptation procedures towards a low-carbon economy, can indeed be important for investment performance (*BoE 2018*). Such developments may also result from the European Union's increasingly tight climate policy (introduction of a carbon tax) or from social expectations (investor demand for environmentally friendly companies). Sustainability risks therefore jeopardise the stability of the capital market, making their implementation in the risk management system indispensable for financial

market participants, which, therefore, definitely affects the insurance sector as well (*Gatzert et al. 2020*).

In order to comply with the requirements of the Regulation on the integration of sustainability risks, investment units linked to insurance must have a defined methodology according to which they are taken into account in investment decisions. On the other hand, investment service providers should provide information on the effect of such risks on the return on investment. According to the Regulation, where sustainability risk is not considered relevant by financial market participants, they should provide a clear explanation of the reasons for this. While Hungarian practice has no example to offer for investment where sustainability risks are not relevant, several ways have emerged of integrating them since the Regulation entered into force.

Regardless of the product category, risk management approaches frequently exclude from the investment universe companies that are heavily polluting or gravely violate human rights. The fund manager therefore establishes a so-called exclusion policy, which is taken into account when selecting investments. Exclusion or disqualification may be based on social expectations, but may also be underpinned by scientifically defined criteria. There may also be cases where the fund manager scores the issuers of the securities included in the investment scope against ESG criteria, e.g. their impact on these factors. It then ranks candidates to consider the risk of the given company from a sustainability perspective. However, this approach alone will not lead to the exclusion of specific investments, as it only involves the identification and inventory of risky investments. Although the SFDR requires that sustainability risks be taken into account, doing so will not always be followed up by action. Therefore, it is important to point out that risk mitigation methods must be used in order to avoid the negative impact of sustainability risks and thus to ensure the stable operation of financial products.

4.2. Disclosure of sustainability information

As explained earlier, the greater the sustainability ambition of an investment unit, the more detailed information must be disclosed to investors in order to ensure transparency and an appropriate investment decision. The SFDR sets out a separate requirement for investments aimed at promoting environmental and social characteristics and for those having an explicit objective of contributing effectively to a sustainability goal.

In the case of unit-linked asset funds that are intended to promote environmental and/or social characteristics and the companies selected for investment purposes follow good governance practices, the information required under Article 8 of the SFDR must be shared with investors. The method and details of this will

be determined by the SFDR RTS from 1 January 2023. The Regulation requires a description of how these aspects are implemented. In practice, therefore, financial service providers are required to define a transparent sustainability strategy at the product level to ensure that the objectives set are met. In its report, the *MNB* (*2022a*) presents the sustainability strategies most commonly applied by Hungarian institutions based on experience to date. These include, amongst others, negative and positive screening, ESG integration, and ESG index tracking,[12] which are presented in more detail in *Table 2*.

Asset funds seeking to implement sustainable investment must share with investors the information required by Article 9 of the SFDR, which will also be set out in the RTS from the beginning of 2023. In this case again, the Regulation requires a description of how that objective is to be achieved, but also requires additional and more specific and concrete information to be disclosed; for example, where a fund seeks to reduce CO_2 emissions, in addition to how this is accomplished the reduction target to be met must also be provided in alignment with the achievement of the long-term objectives related to global warming as set out in the Paris Agreement. Asset funds implementing sustainable investments must also have a sustainability strategy, which can be based on the approaches mentioned above, but requires much more stringent terms, as such financial solutions can only deliver sustainable investments. According to Regulation (EU) No 2019/2088, a sustainable investment may be "*an investment in an economic activity that contributes to an environmental objective"* (e.g. activities related to renewable energy, water management, waste management, greenhouse gas emissions or biodiversity), or *"an investment in an economic activity that contributes to a social objective"* (e.g. an investment that contributes to tackling inequality or that fosters labour relations, or an investment in human capital or economically or socially disadvantaged communities). Sustainable investments should also fulfil additional criteria, i.e. such investments must not significantly harm any of the objectives listed in the Regulation, and the investee companies must follow good governance practices.

[12] The list is not exhaustive.

Table 2
Most frequently used sustainability strategies by SFDR compliant product category

Sustainable strategies	Short description	Article 6	Article 8	Article 9
Negative screening/ Exclusion policy	Aimed at avoiding emitters or entire industries that are harmful to the environment and society, primarily on a standard basis.	X	X	X
ESG integration	Incorporation of ESG criteria in analyses and decision-making processes. Uses a scoring method to measure the ESG performance of issuers in the investment universe.	X	X	X
Positive screening	Positively discriminates socially responsible and environmentally sustainable companies when selecting investments.		X	X
ESG screening (Positive/ negative)	Ranks companies based on their ESG scores, then excludes the assets of the companies with the poorest ESG scores, promoting the best-performing companies, even on a best-in-class basis.		X	X
Green/ESG index tracking	Essentially tracks the index basket partly or fully.		X	X
Thematic investment	Invests in companies whose activities cover an area of sustainable development (e.g. entities performing various activities related to sustainable water management).			X
Impact investment	Invests in companies that, through their activities, have a positive impact on the environment and society (e.g. renewable energy, electromobility, sustainable agriculture).			X

Note: When scoring, the financial market participant evaluates the extent to which the company enforces or influences certain environmental, social and governance factors in its operations (MNB 2022a).

Source: Edited based on MNB (2022a)

In general, fund managers in Hungary use more than one of these strategies at the same time, which can be considered as a good practice to ensure the achievement of the set objectives and meet investors' sustainability preferences. The more strategies financial market participants use, the more certainly the investment will promote environmental or social characteristics and avoid greenwashing (*MNB 2022a*).

As regards investment funds, only one product has been created in Hungary to date that is sustainable within the meaning of the Regulation, i.e. falls into a category under Article 9; however, some of the current unit-linked asset funds can already be classified as sustainable financial products, since the underlying foreign investment funds in which they invest meet the standards.

The main difference between the two categories is therefore that the ESG funds encourage the responsible operations of issuing companies (e.g. improving energy efficiency in the production line, employee treatment) by comparing the impact of organisations on the environment and society. Ultimately, by doing so they indirectly help to achieve environmental and social objectives, whereas sustainable funds contribute more directly to climate change mitigation, for example, through sustainable investments (e.g. solar power plant investment, circular resource management). Obviously, the Regulation allows SFDR Article 8 compliant products to implement sustainable investments, enhancing the differentiation of financial products on a 'sustainability scale'. This is made possible by the EU Taxonomy Regulation,[13] which complements the SFDR by defining environmentally sustainable economic activities. The precise information and ratios relating to these should be made clear in disclosures to investors.

4.3. Consideration of adverse impacts on sustainability factors

Another important provision of the SFDR, irrespective of the investment objective, encourages the investment services sector to consider, in terms of the return on their investments, not only sustainability risks but also the extent to which the operation of a fund may indirectly adversely affect certain environmental and social factors (e.g. biodiversity). Although below a certain number of employees the Regulation does not require a focus on adverse sustainability effects, an inventory of adverse impacts must nevertheless specify for investors the way in which such negative effects are considered. Similarly to the management of sustainability risks, when inventory is taken of adverse impacts, the adoption of an exclusion policy may be a good practice, since the exclusion of an environmentally harmful emitter from the investment scope could reduce environmental pollution. While they should not be confused, the two concepts are interrelated, given that a company with a significant adverse impact will have its operations more exposed e.g. to stricter environmental policy regulations, fines and consumer disengagement, i.e. a major sustainability risk. The adverse impact on sustainability factors can be measured through a number of indicators, which will also need to be applied and made public by financial actors in the near future, and will better highlight the sustainability of investments.

[13] *Regulation (EU) 2020/852 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation (EU) 2019/2088*

5. Relationship between SFDR and product oversight and governance requirements

In addition to the publication of the SFDR Regulation, there have also been other important changes in EU legislation concerning the characteristics of the insurance sector and the threefold objective of the action plan mentioned in the introduction. First, the Delegated Regulation accompanying the Solvency II Directive, which includes the prudential and capital requirements for insurers, has been revised[14] to define the concepts of sustainability risk, factors and preferences and, in relation to investments, requires that the risks arising from sustainability should also be identified and addressed. Insurers are required to assess how their investments are affected by climate risks. Second, the Insurance Distribution Directive (IDD) and the related regulation have been amended.[15] Essentially, these two acts take a customer-side approach to addressing essentially the same two aspects: how individuals' investments are affected by sustainability risk, and how they can enforce their sustainability preferences. It is in the context of savings life insurance that these questions are really relevant. Regulations on distribution are based on the definitions contained in the disclosure regulations. In the distribution process, needs assessment and suitability testing are key elements. In 2018, the EU Commission conducted a market consultation in which it assessed how the question of sustainability appears in suitability tests. Findings clearly showed that the investment objectives of clients were still generally related to financial objectives, while non-financial aspects (or those with only an indirect or longer-term financial impact), such as sustainability, were not present. A small group of customers proactively referred to sustainability as a preference (*Veerle 2020*). This may seem contradictory with the rise of green financial instruments, such as green bonds, but the latter's market is dominated by institutional investors, who base their investment decisions on a different set of criteria compared to retail investors.

The SFDR, which regulates the disclosure of sustainability information, combined with the Taxonomy Regulation, which sets out the classification criteria, allow investors, including buyers of insurance, to measure and understand the compliance of individual investments with ESG criteria.

Based on these, the new regulations require customers' sustainability preferences to be identified during needs assessment and suitability testing, and should also be taken into account during the distribution process of the products offered to them. The question of how financial and sustainability preferences are related emerged in

[14] *Commission Delegated Regulation (EU) 2015/35*, the amendment applies from 2 August 2022
[15] *Directive (EU) 2016/97 on insurance distribution, and Commission Delegated Regulation (EU) 2017/2359*

the context of capital market investments, which are subject to similar regulations. An ESG or sustainable product may also be suitable for a customer who does not otherwise have such a preference, but the opposite is not true. If the customer has indicated that criteria of ESG or greater sustainability are important to them, a product disregarding these will not be suitable. However, this does not mean that the customer has no return reference, that is, that they would be ready to forego higher returns in order to maximise their sustainability preferences.

The IDD introduced product oversight and governance arrangements in the field of insurance as well. This can be summarised briefly in the requirement for insurers to take into account customers' needs and interests during the development of their products and throughout their life cycle. Accordingly, they are required to identify the target group of the product, perform product testing based on scenario analysis with qualitative and quantitative elements before its launch, with subsequent reviews at appropriate intervals on the basis of actual performance. In 2021, in line with the trend referred to above, issues of sustainability also emerged in regulations for product governance arrangements. Consequently, sustainability criteria cannot be disregarded in product development and the necessary expertise must be ensured. At the same time, not all customers have sustainability preferences, and regulations do not make it impossible to meet such needs either. Participants in insurance distribution are obliged to notify the insurer in the same way as with other factors if the product no longer complies with the ESG criterion initially set.

6. Challenges for the insurance sector in the application of the SFDR

Although the main objective of the European Union's Sustainable Finance Disclosures Regulation was to increase the transparency and predictability of investment products traded on the EU capital market in order to eliminate 'greenwashing' and to ensure that the sustainability risks associated with these investments are taken into account, practical application has revealed numerous shortcomings and difficulties of the Regulation.

Basically, there are three types of challenges in terms of the regulations: functional challenges that arise when the regulations fail to deliver on their intended purpose, operational ones that concern challenges in its application, and ones that stem from the valuation methodology.

In terms of function, one shortcoming involves the development of sustainability strategies, which is not specified by the legislation itself. Thus, the most frequently used exclusion policy and ESG ranking often fails to fully screen out activities with harmful sustainability effects and selects e.g. only environmentally friendly and socially responsible investment assets to promote these characteristics. The

effectiveness of the exclusion strategy also depends on the width and depth of the segments it covers. For example, the environmental nature of negative screening that excludes from the investment universe only emitters involved in coal but not oil companies, is questionable.

One of the most critical points is the ESG classification of assets, i.e. the lack of a mature valuation methodology, and thus the regulations built on this already rest on a precarious footing. The essence of ESG ranking as a method for promoting sustainability criteria is to encourage companies to improve their environmental and social performance. In practice, however, the method is controversial, since the ESG score of financial instruments, i.e. the determination of how sustainable companies are on a given scale, may vary across reporting entities. This is explained by the fact that the weighting of each criterion is not known, and by the absence of a uniform ESG rating methodology that could clearly determine the level of sustainability of a company. This may give rise to a situation where various ESG rating companies award significantly different ratings to the same company, which reduces the credibility of the sustainability strategy based on this.

A survey by the European Securities and Markets Authority (ESMA) examined the situation of ESG data providers in the European Union and found, in addition to the above, that almost one half of the issuing companies cooperate with MSCI, ISS ESG and Morningstar Sustainalytics. Respondents also pointed out a number of shortcomings with regard to ratings, such as the lack of industry coverage or data granularity, while the use of ratings is fundamentally expensive, especially for smaller firms. From an ethical point of view, it is questionable that the company pays the rating company directly for the rating, and it can also request services from several rating institutions, which gives it the opportunity to choose the most preferred rating (*ESMA 2022*).

With ESG ratings, it is also important that investors who are committed to mitigating climate change consider the same thing to be sustainable as that underlying the assessment of the given company. This may raise the question of whether an oil company can be awarded a favourable ESG rating if, in addition to its clearly polluting core business, it also pursues ancillary activities that are socially beneficial and sustainable. In other words, can a single number capture the degree of sustainability along with environmental, social and government criteria?

The ESG rating should be unambiguous and, above all, uniform so that investors can place investment products on an objective sustainability scale. Regulation of the activity is therefore becoming increasingly urgent in order to ensure equal competition and protect investors, in particular against the risk of greenwashing. For the future, the plans are to make transparent and structured ESG databases

available, but in the meantime financial institutions will have to cope with initial difficulties.

Further valuation difficulties arise when instead of purchasing the securities of a single company, the customer seeks to invest in an asset fund which may comply with SFDR Article 8 or 9, or a traditional fund where no sustainability impact is involved, but these three categories do not specify the degree of sustainability of the asset fund as a whole. In an SFDR Article 8 asset fund, 80 per cent of the securities may promote environmental and social considerations, but that ratio may be as low as 10 per cent, and there is a huge gap between the two despite sharing the same name. It would be appropriate to indicate the precise extent to which an asset fund serves general ESG objectives (publication of which is expected to become compulsory from 1 January 2023). This is also important because a related amendment of the EU IDD provisions (from August 2022) has introduced the requirement to explicitly ask customers about their sustainability preferences and adapt the offer accordingly. In this way, the distribution process will also allow the customer to become familiar with the concepts and differences related to ESG and sustainability, which can further support their decision. In this sense, financial service providers, including insurers, also then fulfil an educational role.

Thus, one of the most important objectives of the SFDR remains to ensure transparency about sustainability characteristics and to eliminate 'greenwashing', which, based on what is seen in practice, is currently an increasing risk because regulations are incomplete or entirely absent. Greenwashing scandals not only jeopardise a company's existence, but can also undermine confidence in the industry and its financiers.

From the point of view of operational challenges, the depth of integration of sustainability risks raises a number of questions, since the regulation does not in itself set a minimum requirement for the way in which the risks are integrated; accordingly, it cannot be ruled out that, although an investment service takes into account the sustainability risks, the policy applied in the course of investment decision-making is not effectively enforced. With regard to domestic investments, it can also be observed that if the given fund does not have objectives that promote ESG criteria or achieve sustainable investments, the method of integrating sustainability risks is less detailed than an investment with a sustainable objective. In practice, however, it is precisely those investments that will be most vulnerable to sustainability risks that will invest in the securities of companies whose activities are fundamentally polluting, such as those that are more exposed to increasing environmental policy regulations. Thus, logically, the more strategies promoting environmental and social objectives are incorporated into decision-making policy, the less the return on the asset base will be negatively affected by sustainability risk.

These concerns will be somewhat mitigated by the entry into force of the regulations on sustainable finance that are forthcoming or being amended (e.g. the Corporate Sustainability Reporting Directive (CSRD)[16]) and the entry into force of the supplementary regulatory technical standards (SFDR RTS) next year, so that, starting from 1 January 2023, financial services providers will be obliged to determine, for example, the proportion of investments they make in assets promoting environmental and social aspects and, where appropriate, the proportion of investments that are sustainable. This will provide investors with a more accurate picture of the sustainability level of certain funds compared to the current classification. At the same time, they will be obliged to measure the extent to which they can promote environmental and social characteristics year by year by using sustainability key performance indicators (KPIs). Where the adverse impacts on sustainability factors are also taken into account by the insurer, the measurement of these negative impacts must be presented annually, using predetermined KPIs. Examples of such KPIs include the carbon footprint of the operations, the greenhouse gas intensity of investee companies, the share of renewable energy consumption and production, or the exposure of energy-efficient real estate assets.

However, the greatest challenge to this is the collection of raw data, which, although it can be considered as a particularly good element of regulation, is still a problem for institutions. As this information is not yet fully available in the vast majority of cases, often only estimates can be relied on, which may introduce a significant bias relative to the actual situation. Furthermore, the methodology for calculating such performance indicators has not been specified or clarified, and internal resources are also needed to process this information. Mention must also be made of the fact that the IT developments needed to meet the legal requirements are costly and mostly time-consuming.

At this stage of the legislative package, insurers face the same challenges as other financial service providers, due to the horizontal nature of the regulations. It is a complex package of legislation that is even more intricate in its structure and language than the 'usual' EU legislation, and its interpretation poses challenges for the markets. The individual legislative elements are also not aligned with one another in terms of temporal scope, while the 'staged' completion of the regulatory package is also a problem.

[16] *Directive of the European Parliament and of the Council amending Directive 2013/34/EU, Directive 2004/109/EC, Directive 2006/43/EC and Regulation (EU) No 537/2014, as regards corporate sustainability reporting*

The presence of these shortcomings is natural in view of the fact that the SFDR is being phased in progressively and is currently at an early stage. At the same time, it is essential that insurers recognise the potential of ESG products in due time, which, in addition to the SFDR, will hopefully be effectively supported against the risk of 'greenwashing' by the detailed definition system of the Taxonomy Regulation.

Insurers anticipate an increasing trend in the proportion of sustainable products, accompanied by an increase in consumer awareness in the longer term. Customers may develop new target market needs, to which insurers must respond with new solutions. 'More sustainable' business solutions may have a greater customer appeal, and the integration of environmental and social aspects into corporate governance practices may increase the satisfaction of the insurer's employees and customers.

7. Summary

The issue of sustainability in the insurance sector is reflected in the regulations both at the level of institutions and for customers. This will enable buyers of unit-linked insurance to identify, interpret and assess sustainability risks (in a manner equivalent to the risk associated with other investments) and to manage their investments on this basis. In addition, customers will be able to express their ESG preference and facilitate the transfer of capital towards sustainable enterprises, taking into account these considerations in their investment decisions. The primary objective of the SFDR is to assist customers in obtaining transparent, unambiguous information on the sustainability characteristics of investments.

The classification of investments is also of paramount importance from the point of view of analysis, as it provides an opportunity to examine sustainable investment products. Regarding asset funds available in Hungary, in most cases, the annual cost indicator of ESG funds, representing the cost of asset management, is higher compared to the equivalent indicator for non-ESG funds. There may be several reasons for this; accordingly, in addition to higher costs, increasing customer interest may also be factored into pricing.

While the regulations are essentially timely and necessary, they will be applied in progressive stages over time; in addition, some of the regulations promoting further sustainable financing in the EU have not yet come into force, whereby in the present circumstances the SFDR alone is not sufficient to address the challenges identified. Therefore, one of the primary tasks for regulators is to facilitate the adaptation and sustainability turnaround of financial market participants, in this case insurance companies, as much as possible during the transitional period.

Thus, the legislation is not sufficient in its current state, but its existence is absolutely necessary. As regulation evolves and over time, the concerns identified are expected to be overcome and, ultimately, ensure that capital market resources actually flow towards a sustainable economic transition.

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Media Attention to Environmental Issues and ESG Investing*

Balázs J. Csillag – Marcell P. Granát – Gábor Neszveda

We analyse how ESG scores affect future returns when environmental issues receive higher media coverage. Investors might take environmental aspects into account if they are confronted with the issue of global warming more frequently in the press. We assess the prevalence of environmental issues in the media with a machine learning-based Structural Topic Modelling (STM) methodology, using a news archive published in the USA. Running Fama-MacBeth regressions, we find that in periods when the media actively report on environmental issues, ESG scores have a significant negative impact on future returns, whereas, in months when fewer such articles are published, investors do not take sustainability measures into account, and ESG scores have no explanatory power.

Journal of Economic Literature (JEL) codes: C55, G12

Keywords: ESG, environmental issues, investors' attention, Structural Topic Model, Fama-MacBeth regression

1. Introduction

The study of investments that ensure environmentally responsible and sustainable development is becoming an increasingly relevant research topic in the field of empirical asset pricing. Corporate managers also appear to increasingly recognise the importance of environmental and sustainability issues (*Flammer 2013*). Environmental, Sustainability and Governance (ESG) scores are a popular and commonly used indicator to measure the commitment of a firm to addressing environmental and social issues (*Townsend 2020*). ESG scores attempt to measure compliance with these three criteria and offer a proxy for overall company

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Balázs J. Csillag is a Student at John von Neumann University. Email: csillagb3@gmail.com
Marcell P. Granát is an Education and Research Expert at the Magyar Nemzeti Bank, Directorate for International Monetary Policy Analysis and Training of Economic Sciences; and an Assistant Lecturer at John von Neumann University. Email: granatm@mnb.hu
Gábor Neszveda is a Senior Educational and Research Expert at the Magyar Nemzeti Bank, Directorate for International Monetary Policy Analysis and Training of Economic Sciences; and an Associate Professor at John von Neumann University; Deputy Head of MNB Institute. Email: neszvedag@mnb.hu

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sustainability. Although numerous competing measures have been proposed, *Talan and Sharma* (*2019*) and others find that ESG scores are one of the most effective and widely-used indicators.

Being environmentally and socially responsible might be beneficial for a company. Past research provides evidence of a lower cost of capital for companies with higher ESG scores (*Kotsantonis – Serafeim 2019*). Sustainable operations may also lead to higher efficiency (*Gillan et al. 2010*) and positively affect the return on firm equity or the return on assets (*Buallay 2019*). As a result, investors may prefer firms with "sustainable" management, which should be reflected in a positive correlation between ESG scores, stock prices and future returns. On the other hand, if attempts to increase ESG scores distract a company from their primary responsibility to customers and shareholders, this could reduce profits, resulting in a negative correlation between ESG scores and future returns.

Previous research also presents contradictory results. *Sahut and Pasquini-Descomps* (*2015*) investigate the relationship between ESG scores and stock returns in the US, UK and Swiss markets in the period 2007–2011 and find that ESG scores significantly impact returns negatively only for the United Kingdom. Meanwhile, other sector-specific research (*Buallay 2019*) finds that higher ESG scores among US banks had a significant positive impact on returns between 2007 and 2016. The results suggest there may be country-specific differences in investors' preferences for ESG investing. Conversely, no significant impact appears at an industry level in the US and Asia-Pacific regions, while investors in Europe appear to be willing to pay a premium for so-called "green stocks" (*Auer – Schuhmacher 2016*). Applying different approaches, several authors (*Jain et al. 2019*; *Naffa – Fain 2020*; *Naffa – Fain 2022*) obtain mixed results on the impact of ESG scores on expected returns.

These contradictory results have led to numerous studies on what drives the perceptions and actions of investors with respect to the importance of environmental issues. Due to the limited awareness of people (*Hirshleifer – Teoh 2003*; *Neszveda 2018*), they are more likely to pay attention to environmental issues if they are confronted with them more frequently or if they experience extreme weather events. Studies (*Li et al. 2011*; *Akerlof et al. 2013*) report that personal experiences matter a great deal and find that recent experience with global warming (such as extreme weather or natural disasters) increases the perception of climate risk in the United States. *Choi et al.* (*2020*) determine that retail investors sell carbon-intensive firms in the case of abnormal weather experienced in their surroundings. Recently, extreme weather events appear to trigger more intensive media coverage of environmental issues. *Schmidt* (*2015*) shows that media attention to climate change increases more in record-breaking warm years than in "normal" years.

In this paper, we analyse how the effect of ESG scores on future returns changes when environmental issues receive relatively high media coverage. People may be more likely to pay attention and react to information that they see more frequently. Various studies have documented that the attention of investors is also limited (*DellaVigna – Pollet 2009*; *Hirshleifer – Teoh 2003*), and thus they may only take environmental issues into account if they are confronted with the problem of global warming more frequently. Seeing more news on the topic may change their perceptions about the importance of sustainability and cause them to choose or modify their investments accordingly.

Based on these observations, we hypothesise that in periods when the media actively reports on environmental issues ESG scores have a significant impact on future returns. Conversely, in months when fewer such articles are published investors do not take sustainability measures into account, and therefore ESG scores have little or no explanatory power.

We assess the importance of environmental issues in the media applying a *Structural Topic Modelling* (STM) methodology and using a publicly available news archive, which consists of a collection of news reports published on investing.com. The model identifies environmental topics and determines their relative prevalence in news articles.

In our analysis, we run Fama-MacBeth regressions (*Fama – MacBeth 1973*) using observations in months when environmental issues received higher (lower) than average media coverage. These months are referred to as intensive (non-intensive) periods.

However, we find that in periods of intensive environmental media coverage the *Social* and *Governance Scores in ESG* do significantly affect future returns, while in low-intensity periods they have no explanatory power. These findings are robust to different definitions of intensive and non-intensive periods. Moreover, we find that, using the median as a threshold to define high media-intensity periods, each individual ESG score has significant explanatory power in predicting future returns. These results imply that investors pay more attention to ESG scores when environmental issues receive high media coverage. Conversely, in months when investors are less confronted with environmental problems in the press, they do not take these issues into account to the same extent in their investment decisions.

The study is organised as follows: Section 2 describes the data used in the analysis, data cleaning methods, and provides summary statistics. Section 3 describes the Structural Topic Modelling method and the Fama-MacBeth regression methodology. Section 4 presents our results, while Section 5 summarises our conclusions along with their limitations.

2. Data

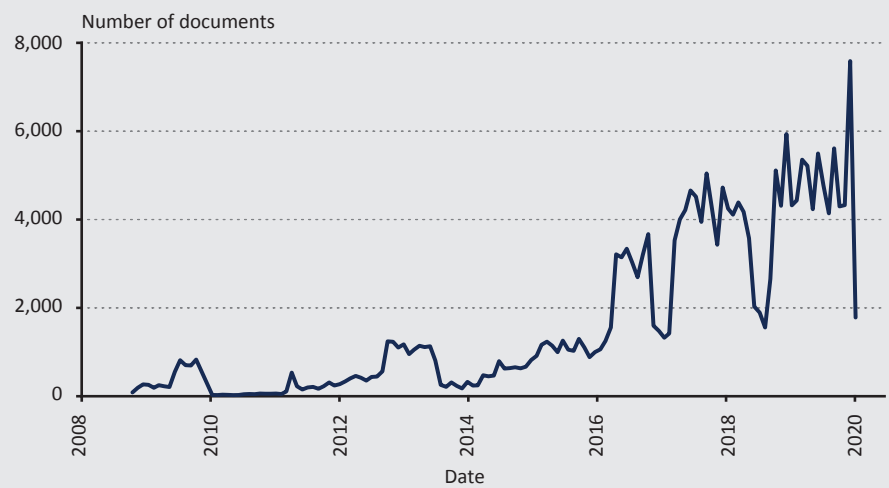
In this section, we present in detail the databases used in the analysis. First, we describe stock news data, and then data on company information and stocks' performance. In the last subsection, we provide some key descriptive statistics.

2.1. Stock news data

In addition to the financial data, we need corresponding text data in order to quantify the intensity of the environmental (green) issues in the news at any given time. Therefore, we use a publicly available news archive, which consists of a collection of new reports published on the investing.com website. The data are available at: https://www.kaggle.com/datasets/gennadiyr/us-equities-news-data.

Although the dataset contains news from 2008, it is only complete without interruption from 2010 and ends in 2020 (see *Figure 1*). The news is related to US equities which are publicly traded on NYSE/NASDAQ and maintained a price above USD 10 per share through 2020.

Figure 1
Number of documents by month in the news archive



In the analysis, we use the daily frequency to generate the prevalence of topics, but then aggregate the intensity of environmental (green) topics present in the articles to a monthly level.

2.2. Stock and company data

We use monthly data on stocks traded on the New York Stock Exchange (NYSE) and the National Association of Securities Dealers Automated Quotations (NASDAQ) stock exchanges. The Refinitiv Datastream (formerly Thomson Reuters Datastream, TDS) was used, instead of the most common Center for Research in Security Prices database (CSRP). *Ince – Porter* (*2006*) report that after cleaning the inferences drawn from TDS data are similar to those drawn from CRSP.

Our data consist of active and inactive primary equities. To avoid delisting bias (or survival bias) inactive stocks are also included (*Shumway 1997*). One-month US Treasury Bills are used as risk-free returns.[1]

The following variables were obtained through TDS:

- *Price*: unadjusted price quoted on the first day of the respective month, data in USD (Datastream database);
- *Total Return Index*: following the literature, we use the total return index as a performance measure, as it adjusts for price movements due to stock splits and dividend payments (Datastream database);
- *Turnover by Volume*: number of stocks traded in the respective month, data in thousands (Datastream database);
- *Common Shares Outstanding*: number of common shares outstanding at the end of the year (Worldscope database);
- *Book Value per Share*: book value per share at the end of the respective fiscal year, data in USD (Worldscope database);
- *Environment Pillar Score* (*ES*):[2] Refinitiv's Environment Pillar Score is the weighted average relative rating of a company based on the reported environmental information and the resulting three environmental category scores;
- *Social Pillar Score* (*SS*): Refinitiv's Social Pillar Score is the weighted average relative rating of a company based on the reported social information and the resulting four social category scores;
- *Governance Pillar Score* (*GS*): Refinitiv's Governance Pillar Score is the weighted average relative rating of a company based on the reported governance information and the resulting three governance category scores.

[1] Downloaded from Stambaugh's website (https://finance.wharton.upenn.edu/stambaug) on 10 March 2022.
[2] The research uses Refinitiv's own ESG scores as one of the first and most trusted ESG agencies available. However, there may be significant variation in the ESG ratings of different agencies. For this reason, one may obtain different results using other ESG scores.

Using these variables, the following factors were created as these are widely used in asset pricing literature (*Carhart 1997*):

- *Market beta*: systematic risk. Beta was estimated by running the following OLS regression model on our data. (Using a 36-month rolling window, requiring at least 30 observations per month.)

$$r_{i,t} - r_{f,t} = \alpha + \beta_{i,t}(r_{m,t} - r_{f,t}) + \varepsilon_{i,t} \quad (1)$$

Where $r_{i,t}$ is the return on asset *i* in period *t*; $r_{f,t}$ is the risk-free return in period *t*; $r_{m,t}$ is the market return in period *t*; α is the intercept of the model; $\beta_{i,t}$ is the market beta of asset *i* in period *t*; and $\varepsilon_{i,t}$ is the error term in period *t*.

- *Market value* (*MV*): the market capitalisation of the stock *i* in month *t*

$$MV_{i,t} = ln(N_{i,t}P_{i,t}) \quad (2)$$

where $N_{i,t}$ is the number of firms *i*'s common shares outstanding at the end of the year to which month *t* belongs, $P_{i,t}$ is *i*'s USD price quoted on the first day of month *t*.

- *Book-to-market-ratio* (*BTM*): stock *i*'s B/M in month *t*.

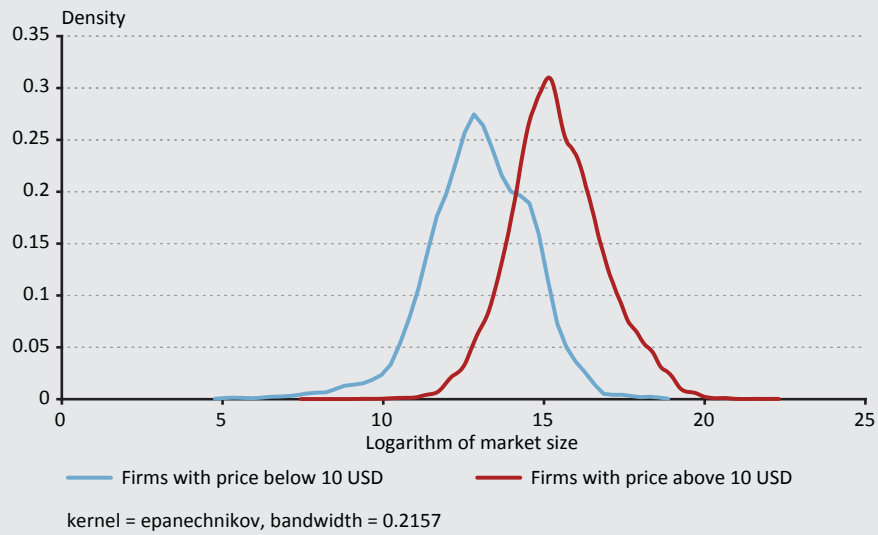
$$BTM_{i,t} = ln\left(\frac{BVPS_{i,t}}{P_{i,t}}\right) \quad (3)$$

Where $BVPS_{i,t}$ is the book value per share of firm *i* at the end of the fiscal year to which month *t* belongs and $P_{i,t}$ is the price of *i* quoted at the first day of month *t*.

- *Momentum* (*Mom*): the average return on asset *i* over the last 3 to 12 months.

We followed the procedures proposed by *Ince – Porter* (*2006*) with a few modifications and additions for data cleaning. They suggest deleting stocks traded at prices below USD 5. However, our news database represents a news archive of only US equities publicly traded on NYSE/NASDAQ with a price higher than USD 10 per share. For this reason, we used USD 10 as a threshold instead of USD 5. *Figure 2* shows that firms with prices below USD 10 generally have smaller market capitalisation. Before dropping stocks with a price under USD 10, the 5th percentile of market value was USD 12.46. After excluding stocks with a price under USD 10, only 1 per cent of the firms have a market value below USD 12.14. Hence, we did not only delete the cheapest stocks: dropping the stocks with low prices partially tackles the problem of small firms. Otherwise, dropping the smallest 5 per cent of firms is a common way of screening small firms.

Figure 2
Kernel density of firms below and above USD 10



Following *Amihud* (*2002*), we also delete the most illiquid stocks every month (first decile based on turnover). Observations with returns equal to zero or over 200 per cent or with a total return index smaller than 1 per cent or with missing variables were also omitted. After these steps, we also ignored months which had less than 50 data points.

After cleaning, the database contains 97,178 observations for 1,983 firms, covering the 122 months between January 2010 to February 2020. On average, we have around 800 observations per month. This data excludes the period of Covid-19 to avoid the discussion of how this special period influences our results. According to the literature, Covid-19 had a strong impact on stocks which represents the special nature of that period for both ESG and non-ESG-related financial questions (e.g. *Demers et al. 2021*; *Kökény et al. 2022*).

2.3. Descriptive statistics of ESG scores

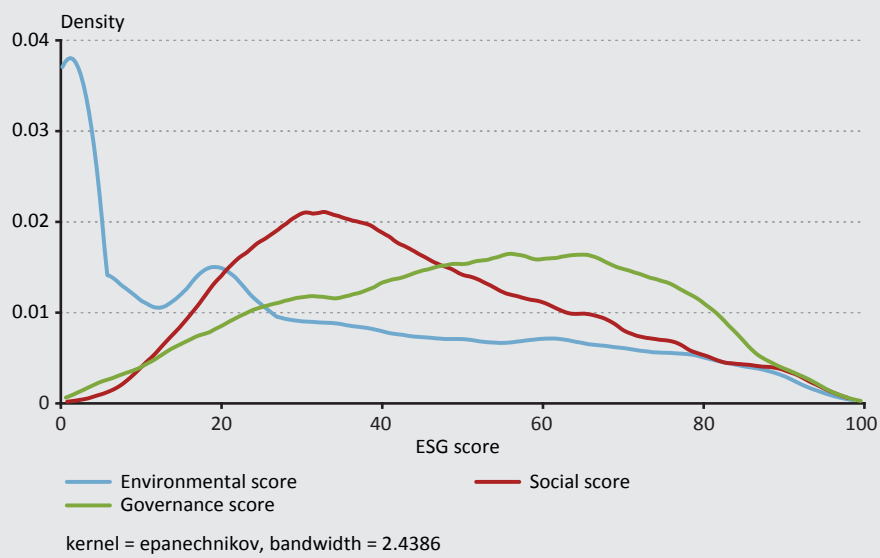
This section provides descriptive statistics on the ESG scores, with *Table 1* showing the summary statistics. ESG scores take on values between 0 and 100. Generally, the Environmental score is lower relative to Social and Governance scores.

Table 1
Descriptive statistics of ESG scores

Variable	Mean	Median	St. Dev.	Minimum	Maximum
Environmental Score	28.59	21.14	27.34	0	98.55
Social Score	43.98	40.685	20.23	0.6	97.95
Governance Score	51.27	52.6	21.4	0.44	99.54

Figure 3 presents that stocks in our sample generally have lower environmental scores and higher governance scores. A large share of the companies has an environmental score close to zero, which may bias the results. Around 20 points there is a second spike in the distribution of environmental scores. This might be incorrect data. However, we could not identify any data cleaning step after which the suspicious spike disappears.

Figure 3
Distribution of ESG scores



3. Methodology

This section presents the applied methodologies in detail. The first step to measure the impact of the news on financial markets is to generate a time series that quantifies the green intensity. For this purpose, we use the topic models. The steps for topic modelling are detailed in *Section 3.1*, while *Section 3.2* presents the methodology of the Fama-MacBeth regression. There are several empirical

approaches for investigating the relationship between a characteristic such as an ESG score and expected returns (*Mérő et al. 2020*). The standard portfolio-based approaches (e.g. *Neszveda – Vágó 2021*; *Neszveda – Simon 2021*) or alternative portfolio-based approaches (e.g. *Fain – Naffa 2019*; *Naffa – Fain 2022*) have the advantage that they do not assume any linear relation and reduce noise, but compared to Fama-MacBeth regressions these approaches have the disadvantage of losing information by creating portfolios. Furthermore, Fama-MacBeth regressions are stricter in controlling for other known characteristics related to expected returns. Consequently, we apply Fama-MacBeth regressions to test our main hypothesis.

3.1. Structural topic model

The topic model is a commonly used, unsupervised machine learning tool that identifies topics based on the pattern of occurrence of words in text data. The most common algorithm among topic models is the Latent Dirichlet Allocation (LDA). The general concept of this is that every topic occurs in a certain proportion in every text, and every topic is a mixture of words (*Blei et al. 2003*).

LDA is a statistical method to find the associated words, sort them into topics, and estimate the proportions of these topics in the documents (news articles in our case). As a result, we can derive several coefficients for each word, which shows the probability of that coming from a given topic.

The number of topics is the only tuned hyperparameter of the model. Too few topics will produce overly broad results and it is impossible to interpret them, while choosing too many topics will result in the "over-clustering" of a corpus into many small, highly similar topics (*Greene et al. 2014, p. 498*). Similar to clustering methods, there are rules to determine the optimal value of this parameter, for example, semantic cohesion and exclusivity (*Bischof – Airoldi 2012*), but we apply a different framework, because of the interest in one topic.

We estimate the model with several numbers of topics (from 2 to 30 for each even value) and use the one with the smallest number of topics and containing one in an identifiable way related to the environment. The proportion of that topic in the news on a given day can be used to extend the general Fama-MacBeth regression. The reason is that if we use a model not having enough topics, then the environmental topic will be mixed with something else, while a model with too many topics would require additional effort to correctly aggregate the environmental topics (we did not observe the appearance of multiple environmental topics with a higher number of topics).

The general approach of Structural Topic Modelling (STM) is very similar to the LDA, but it also uses metadata information on the documents. The proportion in which each topic contributes to a document is called topic prevalence. With the structural

topic model, the prevalence can vary according to the metadata. This causes that, in contrast to the LDA case, the expected topic proportion is not equal for each topic.

Following *Cerchiello – Nicola* (*2018*) and *Dybowski – Kempa* (*2020*), we extend the topic model with *time covariates*, which means that the prevalence of the topic varies over time, and *some topics may go out of fashion while others start trending*. A spline function is used on the number of days since the first article, to ensure that non-linear effects can also be captured. This also results in the prevalence of topics possibly not being equal.

The first step to run STM is to assign a corpus (a collection of words in an ordered form) from the investigated text. Here, we follow the framework of *Roberts et al.* (*2019*). As it is a commonly used approach, we omit numbers, stop words (e.g. "and", "or", "the") from the corpus and stem the words (remove the "s", "tion" and others from the end of the word). We estimate the model with several numbers of topics, from 2 to 30 for each even value, since the runtime is still two days.[3]

To identify each topic, we use the words that are most likely to come from that topic. The probability of the occurrence of topics in each article is estimated by the model, and the occurrence of each topic about the environment is averaged for a given monthly intensity of the green topic (γ). At this point, we have two options to aggregate: (1) calculating the monthly average disregarding the length of the texts assuming that an article does not carry more weight just because it is longer or weighting the scores by the number of words, or (2) using weighted average. For robustness check, we calculate the Fama-MacBeth model with both frameworks.

3.2. Fama-MacBeth regressions

We first run the following time series regression on the future return for all stocks to obtain each stock's *i* ∈ {1, ..., *I*} exposure to the m ∈ {*Beta, MV, BTM, Mom, ES, SS, GS*} variables.

$$r_{i,t+1} = \alpha_t + \beta_{t,F_1} F_{1,t} + \cdots + \beta_{t,F_m} F_{m,t} + \varepsilon_{i,t} \tag{4}$$

Finally, we test whether the average of the estimated betas is equal to 0 for a given factor in a given time period. A significant average beta suggests that the corresponding factor can predict future returns in a given time period.

4. Results

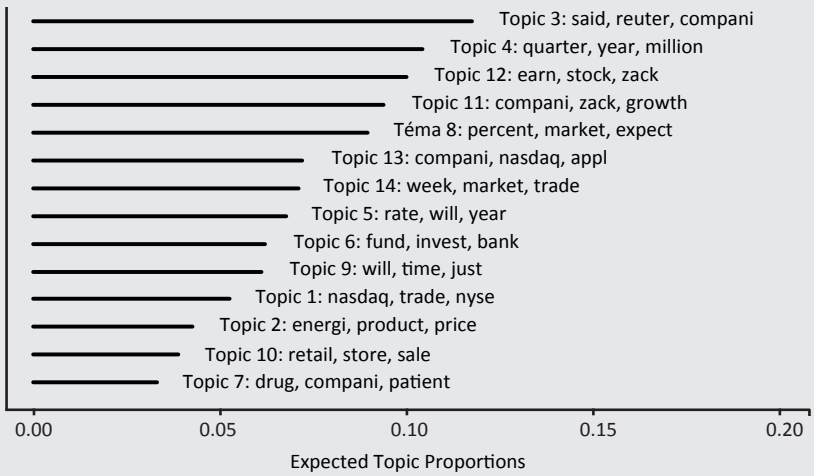
In the discussion of the results, we keep the same order as for the methodological description, but the descriptive statistics of the green intensity index generated by the topic model are presented between the two model frameworks.

[3] CPU: Apple M1 Pro (10 cores), RAM: 17.2 GB.

4.1. Structural Topic Model

Running the structural topic model with a different number of topics, we found that an environmental topic appears first if we categorise the texts into 14 topics.[4] The topic proportions are demonstrated in *Figure 4*, the environment-related topic is the second one. In support, *Figure 5* shows the words that are most likely to have been generated from Topic 2.

Figure 4
Estimated topic proportions



Note: The word stems are displayed in the figure, because the applied modelling procedures are based on them.

Examining the texts containing the highest estimated proportion of Topic 2 by the model is also apt to confirm our assertion that the occurrence of these topics is a good measure of the intensity of the green topic in the news. Three of these are listed in the following as examples.

"Exxon Mobil NYSE XOM says it is restarting its 560K bbl day Baytown Tex refinery second largest in the US six days after it was shut because of heavy rain from Hurricane Harvey Phillips 66 NYSE PSX says it is preparing to resume operations at its Sweeny refinery and its Beaumont terminal in Texas its Pasadena refined products terminal is resuming truck loading for gasoline this afternoon while operations at its Gulf Coast fractionation plant in Mont Belvieu are suspended Also Occidental Petroleum NYSE OXY has loaded and shipped its first crude oil cargo from its Western Gulf Coast terminal at the Port of Corpus Christi since Harvey"

"Exxon Mobil NYSE XOM has made its seventh major oil discovery in the Stabroek block offshore Guyana following drilling at the Pacora 1 exploration well partner Hess NYSE

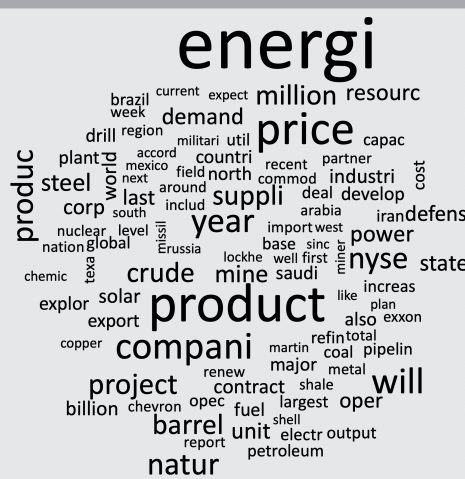
[4] The outcome of the other models can be found in the related GitHub repository: https://github.com/MarcellGranat/green- finance-news/blob/main/result.md.

HES reveals Pacora resources will be integrated into the third phase of development at the Guyana project helping bring production to more than 500K bbl day of oil Hess says The Pacora 1 well discovery adds to previous world class discoveries at Liza Payara Snoek Liza Deep Turbot and Ranger 1 which are estimated to total more than 3 2B recoverable oil equivalent barrels XOM is operator of the 6 6M acre Stabroek block and holds a 45 while Hess owns 30 and Cnooc s NYSE CEO Nexen has 25”

“Petrobras NYSE PBR subsidiary In Bolivia and the country s state run YPFB Chaco have signed a 1 2B agreement to explore two natural gas fields with potential reserves of 4T of the Bolivian government says The fields are Astillero and San Telmo in southern Bolivia YPFB has a 40 stake in San Telmo and PBR has 60 while PBR owns 40 in Astillero and YPFB has 60 Both fields are expected to begin producing gas in 2022”

It can be seen from the examples that the topics discussed contain terms mainly *related to the energy sector*: energy, nature, barrel, nuclear, chemical, and mine. We use the proportion of this topic in the articles to proxy the media’s attention to environmental issues.

Figure 5
Word cloud display of the environmental topic

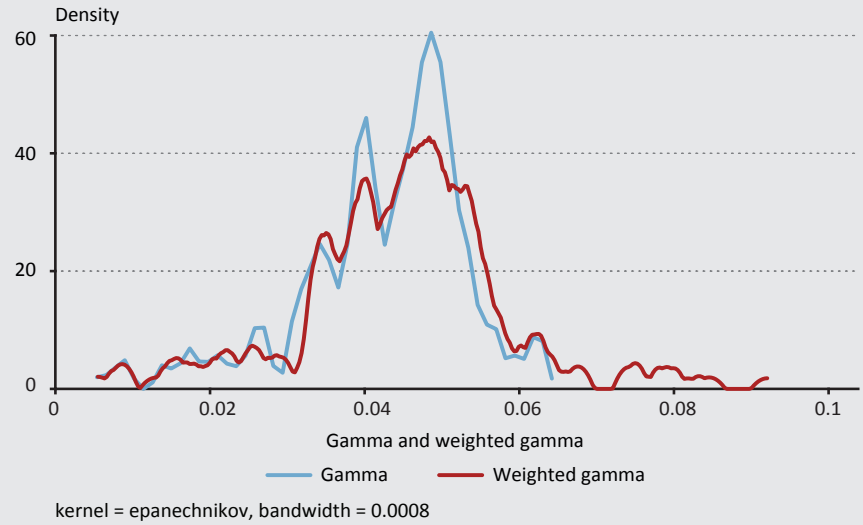


Note: The word stems are displayed in the figure, because the applied modelling procedures are based on them.

4.2. Descriptive statistics of the prevalence of environmental topics

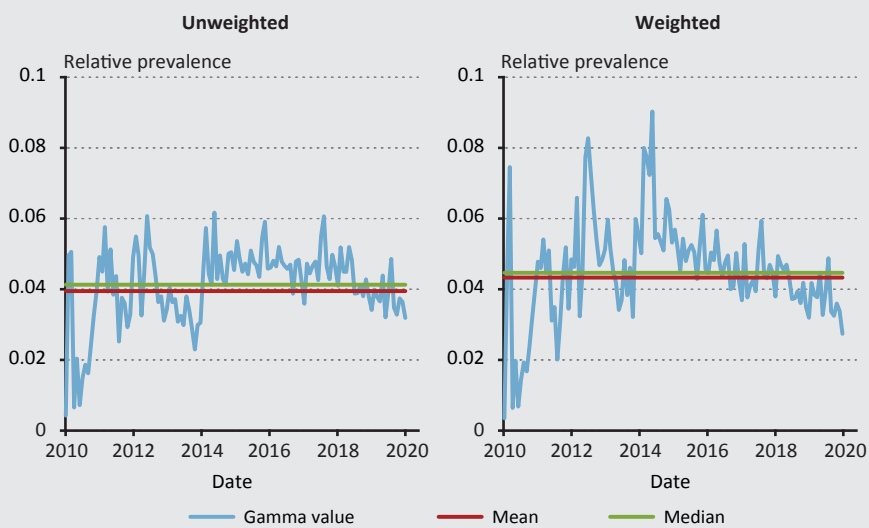
The following subsection describes the time series describing the intensity of the environmental topic generated by STM. As mentioned, we aggregate the prevalence in articles to the monthly level weighting by the number of words in the texts and unweighting. *Figure 6* shows that unweighted and weighted monthly prevalence values are concentrated around 0.032, 0.039 and 0.045, but the distribution of weighted values is smoother.

Figure 6
Distribution of unweighted and weighted prevalence of green topic



In *Figure 7*, we see the time series plot of unweighted and weighted prevalence between 2010 and 2020. The mean and median values are the thresholds used to define high and low-intensity periods, leading to four possible formalisations of intensity.

Figure 7
Monthly aggregated prevalence (January 2010 – February 2022)



4.3. Fama-MacBeth regressions

In this section, we examine whether the effect of ESG scores is different when environmental issues receive more media coverage. To check this, we run Fama-MacBeth regressions (*Fama – MacBeth 1973*) on different subsamples. First, we run regressions using observations in months when the environment received high media coverage. These months are referred to as intensive periods. Then, we use observation in months when environmental issues were less intensively presented in the media. These months are referred to as non-intensive periods. We hypothesise that ESG scores will have a higher effect on future returns in periods of high intensity media coverage. We control for the variables in the Carhart four-factor model (*Carhart 1997*), namely the respective market beta, size, book-to-market ratio and momentum.

We define intensive periods of environmental media coverage in the following four ways:

1. $\gamma > \gamma_{mean}$: *Figure 4* shows which 73 months are identified as intensive periods based on this criterion (*Table 2*: *2nd column*). The remaining 49 months are the non-intensive periods (*Table 2: 3rd column*).

2. *weighted* γ > *weighted* γ_{mean}: *Figure 4* shows which 67 months are identified as intensive periods based on this criterion (*4th column*). The remaining 55 months are the non-intensive periods (*5th column*).

3. $\gamma > \gamma_{median}$: *Figure 5* shows which 72 months are identified as intensive periods based on this criterion (*6th column*). The remaining 50 months are the non-intensive periods (*7th column*).

4. *weighted* γ > *weighted* γ_{median}: *Figure 5* shows which 67 months are identified as intensive periods based on this criterion (*8th column*). The remaining 55 months are the non-intensive periods (*9th column*).

We summarise our results in *Table 2*. *Column 1* shows that in the period January 2010 to February 2020 *Environmental Score* had no significant impact on stock returns. However, *Social Score* was associated with an average monthly return of 0.0062 per cent (Newey-West t-statistic: 2.27), while *Governance Score* decreased future returns c.p. on average by –0.004 per cent (Newey-West t-statistic: –2.45).

These results suggest that stocks with a higher *Social Score* outperform firms with lower social indicator values, while firms with higher *Governance Score* have lower future returns than those with a lower score. The direction of the relationship between these scores and future returns does not change between intensive and non-intensive periods.

Environment and *Governance Scores* have a negative impact on future returns, while *Social Score* has a positive impact. This suggests that different ESG scores are considered differently by investors. Also, these results might be driven by investors' different perceptions of different industries. To analyse this question, one should group stocks into sectors and focus on how ESG scores change among industries. However, this is beyond the scope of this research. Overall, we obtain a rather mixed picture, which is in line with the results of *Cao et al.* (*2020*): they find ESG scores to have significant impacts on specific industries, and no effect on others.

Even in some cases where ESG was significant, in general, it causes a decrease in the expected return. This suggests that investors do not value sustainability to the extent that it constrains companies or distracts them from their focus on customers and shareholders. Our results are similar to previous studies focusing on the US market that used the Fama-MacBeth regression methodology (*Timár 2021*). Since ESG scores take on values between 0 and 100, which is significantly different from what characterises the other factors of the regression, comparison of the relative sizes of the coefficients is not feasible.

We find that in periods of intensive environmental media coverage *Social* and *Governance Scores* significantly affect future returns, while in low-intensity periods they have no explanatory power. These findings are robust to different definitions of intensive and non-intensive periods. Moreover, we find that – using the median as a threshold to define high-intensity periods – all of the ESG pillar scores significantly predict future returns.

Our findings also show that in intensive periods the average of the coefficients of *Environmental Score* is –0.0049, while in non-intensive periods the average of the beta is –0.0017. The effect is almost three times larger in intensive periods relative to non-intensive months.

These results imply that investors pay attention to ESG scores when environmental issues receive high media coverage. However, in months when investors are less confronted with environmental problems in the press, they do not take these issues into account in their investments.

Table 2
Fama-MacBeth regressions

			Identifying intensive periods based on γ				Identifying intensive periods based on weighted γ			
		Benchmark (1)	Intensive (2)	Non- Intensive (3)	Intensive (6)	Non- Intensive (7)	Intensive (4)	Non- Intensive (5)	Intensive (8)	Non- Intensive (9)
	Months in regression	*Every month*	$\gamma > \gamma_{mean}$	$\gamma \leq \gamma_{mean}$	$\gamma > \gamma_{median}$	$\gamma \leq \gamma_{median}$	$w.\gamma > w.\gamma_{mean}$	$w.\gamma \leq w.\gamma_{mean}$	$w.\gamma > w.\gamma_{median}$	$\gamma \leq w.\gamma_{median}$
Beta (A)	**Average return**	0.000	0.002	–0.003	0.003	–0.005	0.003	–0.005	0.004	–0.005
	NW t-statistics	–0.110	0.350	–0.550	0.600	–0.860	0.630	–0.870	0.740	–0.980
	NW p-value	0.911	0.728	0.582	0.549	0.396	0.530	0.389	0.459	0.331
MV (B)	**Average return**	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.000	0.001
	NW t-statistics	0.350	–0.690	1.010	–0.610	0.840	–0.520	0.780	–0.200	0.500
	NW p-value	0.723	0.492	0.316	0.544	0.407	0.604	0.439	0.846	0.616
BTM (C)	**Average return**	–0.001	–0.001	–0.001	–0.001	–0.001	0.000	–0.002	0.000	–0.001
	NW t-statistics	–1.400	–0.630	–1.520	–0.590	–1.370	–0.410	–1.570	–0.560	–1.470
	NW p-value	0.165	0.532	0.136	0.554	0.177	0.682	0.123	0.577	0.148
Mom (D)	**Average return**	0.001	0.004	–0.004	0.005	–0.004	0.003	–0.003	0.005	–0.004
	NW t-statistics	0.400	0.930	–0.990	1.100	–1.230	0.830	–0.670	1.230	–1.040
	NW p-value	0.690	0.358	0.325	0.275	0.223	0.408	0.504	0.224	0.304
ES (E)	**Average return**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	NW t-statistics	–1.400	–1.590	–0.690	–1.750	–0.540	–1.430	–0.420	–1.810	–0.110
	NW p-value	0.164	0.116	0.496	0.086*	0.589	0.157	0.679	0.075*	0.911
SS (F)	**Average return**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	NW t-statistics	2.270	2.500	0.710	3.040	0.540	2.110	1.050	2.370	0.810
	NW p-value	0.025**	0.015**	0.482	0.003***	0.592	0.038**	0.301	0.021**	0.422
GS (G)	**Average return**	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	NW t-statistics	–2.450	–1.940	–1.590	–1.880	–1.600	–2.110	–1.570	–2.230	–1.480
	NW p-value	0.016**	0.057*	0.118	0.065*	0.115	0.039**	0.122	0.029**	0.145

*Note: * p<0.1, ** p<0.05, *** p<0.01. In Column 1 we run FM regressions using every observation in months between January 2010 to February 2020. In Columns 2 to 9 we 9 run FM regressions using observations from months that meets given criteria. For instance, in Column 2 we use months in which y was higher than Y mean. This way there are gaps in the time series in Columns 2 to 9. Average return shows the estimated coefficients, NW-statistics shows Newey-West t-statistics with 12 months lag, while NW p-value shows corresponding p-value. Beta is monthly beta; MV is the logarithms of the stocks' market capitalisation; BTM is the logarithm of the firms' book-to-market ratio, while Mom is the momentum: the average return over last year; ES, SS and GS show weighted average relative ESG ratings of a company.*

5. Conclusion

This paper examined the relationship between the effect of ESG scores on future returns and the intensity of media coverage of environmental issues. We assessed the importance of environmental issues in the media with a machine learning-based Structural Topic Modelling (STM) methodology. We subsequently ran Fama-MacBeth regressions (*Fama – MacBeth 1973*) using observations in months when environmental issues received higher-than-average (lower-than-average) media coverage. We found that in intensive topic periods (using the median as a threshold) ESG scores negatively and significantly affect future returns, while in low-intensity periods they have no explanatory power. These results suggest that investors pay less attention to firms' attitudes towards sustainability when they see fewer articles related to environmental issues. However, when environmental issues receive high media coverage investors do consider ESG scores. Generally, we find a negative relationship between *Environmental score* and future return, irrespective of the media's attention to climate change. This contradicts the idea that investors value sustainability. However, it is important to mention that we did not consider that the impact of the ESG scores might differ between industries and ignored the fact that retail traders may assess ESG scores differently than institutional investors. Hence, our results are not intended to measure the magnitude of the effect, but how the effect varies with media attention.

Our research has three important limitations. We adopt gamma's and weighted gamma's statistical measures of central tendency (mean, median) to define intensive and non-intensive periods. We used monthly gamma and weighted gamma values over the period from October 2008 to February 2020 to assess the mean and median. However, this information became available only as time progressed. Thus, we calculate media intensity in period *t* using information that was not yet available in that month. This method was necessary because we did not have any prior knowledge about which gamma values should be considered relatively high or low.

Second, we do not answer which factors are causing the phenomenon we have found. Previous research found that capital market anomalies are amplified by the presence of small investors. Previous studies (e.g. *Csillag – Neszveda 2020*; *Choi et al. 2020*) also find that retail investors' (not institutional investors') ESG trading patterns are exposed to extreme weather in their location. This study did not examine whether our finding was led by increased retail investor attention to global warming in periods of intensive media coverage.

Also, this study did not seek to uncover what causes the deviation in media coverage of environmental issues. However, to truly understand the connection between our *gamma* and ESG scores one must answer that question. Based on our results this might be a reasonable next step. The paper of *Choi et al.* (*2020*) suggests that

extreme weather might grab press attention, resulting in more intensive media coverage of environmental issues. However, as our news data source is investment specific it might be less exposed to this effect. Also, other events may affect the intensity of the environmental topic, such as energy, environmental regulation and weather-related events. Moreover, further research could analyse how media intensity affects ESG scores in different sectors. Finally, another interesting question could be whether media intensity differently impacts low-emission "green" stocks and high-emission "brown" stocks.

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Regulatory and Market Trends for ESG Bonds and Funds, and Some of the Associated Risks of Sovereigns*

László Bokor

Promoting the financing of the transition to a sustainable economy is one of today's key issues. However, access to scarce resources is further complicated by a striking new phenomenon: both regulators and investors are becoming increasingly "choosy", as they make their decisions on whom to give money to dependent on circumstances that go beyond green and scientific aspects. It is therefore no coincidence that an increasing number of investment funds are obtaining ESG[1] ratings that formulate exclusion rules for sovereign bonds based on NGO indicators (e.g. civil liberties, level of corruption). If such criteria become an international standard, a sovereign that fails to meet them could be threatened with total exclusion from the green/ ESG market. The aim of this essay is to review the regulatory environment and the market situation through this lens. It is important to note, however, that both legislation and market preferences are in a quickly evolving, amorphous state, and thus continuous monitoring of the conditions is essential.

Journal of Economic Literature (JEL) codes: G12, G18, G20, G28, G38, K22, K32, Q01, Q50

Keywords: green investment, ESG, regulation, bond, market, sovereign, risk

1. Introduction

The answers to global warming as a scientific question have long been sought by experts and policymakers in the same terrain. However, a significant redefinition of this focus is currently underway in the Western world. Looking at legislation and

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

László Bokor is an ESG/Quantitative Analyst at the Hungarian Government Debt Management Agency Pte. Ltd. Email: bokor.laszlo@akk.hu

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[1] ESG stands for Environmental, Social and Governance. The aim of these frameworks is to give investors a better understanding of the risks inherent in the environmental and social sustainability and governance of business organisations.

market developments, it is clear that "social" and "sustainable" are increasingly coming to the fore as keywords – i.e. a context that belongs wholly or partly to social sciences – rather than "green". In any case, finding a new, unified focus is substantially hindered by the fact that the final, long-term shape of the now gigantic regulatory edifice, which is unstable due to the centrifugal force of counter-interests or even external shocks, is rather blurred.

The essay aims to provide a context for regulatory and market trends related to the financing of the green transition and draws attention to some little-known sovereign risks that are quietly building up.

2. Green/ESG bond standards

One of the necessary preconditions for the green transition as a global process is the creation of a common language in many dimensions of our lives, including finance. At the global level, with regard to bonds, the voluntary standards of two organisations, the International Capital Market Association (ICMA) and the Climate Bond Initiative (CBI), have become widespread: the Green Bond Principles (GBP) (*ICMA 2021b*) and the Climate Bond Standard (CBS) (*CBI 2019*), respectively. The market is super-dominated by the GBP, which has been in existence and evolving since 2014 and is now considered the global standard.[2] Although the GBP provides detailed guidance on the selection of projects, it does not provide a precise definition of what constitutes a green activity (i.e. there is no taxonomy). In deciding the latter, it proposes only a third-party review. The CBS is more constrained than the GBP, as the CBI has also published a relevant taxonomy (*CBI 2021b*), while expecting the same external validation. This makes it a less attractive alternative for many, which may also explain its lower take-up.

The EU Green Bond Standard (EU GBS) has been in development since 2018.[3] As proposed by the relevant working group, the so-called Technical Expert Group on Sustainable Finance (*EU TEG 2020*), the EU GBS would expect consistency with the EU Taxonomy, transparency, external evaluation and even supervision of external evaluators by the European Securities and Markets Authority (ESMA). Although it is still only a proposal, some bond issuers are already adapting to it in practice.

In 2020, the Hungarian Government Debt Management Agency set up a green bond framework in line with the GBP (*Government Debt Management Agency 2020*). Green government bonds, which have since been issued in euro, yen, forint and yuan, are designed to channel some of the funds needed to meet international commitments to fight climate change (other sources of financing include EU funding

[2] According to *ICMA* (*2022*), their "share" averaged at 98 per cent in 2021.
[3] Legislative text proposed by the European Commission: *EC* (*2021*); as corrected by the European Parliament: *EP* (*2022*).

from various sources, European Investment Bank loans and proceeds from the sale of EU ETS quotas[4]). In order to facilitate the issuance of green bonds by market participants, the Central Bank of Hungary (Magyar Nemzeti Bank, MNB) has also published its guidelines in 2022 (*MNB 2022*).

It is worth noting that non-resident issuances outside of Europe and North America have also been more or less consistent with these principles for some time. Two markets of particular importance are worth mentioning: the panda (yuan) and the samurai (yen). The Chinese central bank issued its own green bond guidelines in 2015 (*PBC 2015*) and the Green Finance Committee established the relevant taxonomy (*GFC 2015*), which was updated in 2021 (*PBC 2021*). In summer 2022, the first framework combining Chinese practice and the GBP was born (*GFC 2022*). The Japanese Ministry of the Environment issued GBP-consistent green bond guidelines in 2015 (*JME 2017*), which were updated in 2020 to include guidelines for green and sustainability-linked loans (*JME 2020*). Additionally, Asia's most important stock exchange – the world's third largest – the Japan Exchange Group, unveiled its green bond framework in spring 2022 (*JPX 2022*).

In contrast to the green standards, the range of social and sustainability guidelines is still much more limited. The ICMA is currently leading the way, having already issued recommendations on social, sustainability and sustainability-linked bonds[5] (*ICMA 2021c, 2021d, 2020/2021a*, respectively). The EU has also followed the ICMA social bond principles in the design of the framework for the EU's employment retention programme (*EU SURE 2020*), launched in the wake of the coronavirus pandemic.

Due to the continuing lack of a common narrative in the EU, several Member States have developed their own labels – initially green, later ESG – with a specific standard and mostly with a taxonomy, which can be awarded to the funds with the majority of their underlying products meeting these criteria. However, these labelling systems reflect and are optimised for national priorities.

3. EU regulatory environment

In 2018, the European Commission adopted the Action Plan for financing sustainable growth (*EU 2018*) with the intention of shifting resources towards sustainable investments. The subsequent series of measures is made up of a number of organically interlinked elements.

[4] The EU Emissions Trading System is the world's first and largest carbon market.

[5] Unlike GSS (Green, Social, Sustainability) bonds, funds raised through Sustainability-Linked Bond (SLB) issuance can be used for anything, i.e. the funds raised are not earmarked (there is no Use of Proceeds, UoP). The product is linked to sustainability by making explicit commitments (Sustainability Performance Target, SPT) in respect of one or more Key Performance Indicators (KPIs), such as greenhouse gas (GHG) emissions. If the commitment fails, the bond pays a higher interest rate ("step up"), and if it over-performs, it may pay a lower rate ("step down"). Chile was the first sovereign to issue an SLB in March 2022. In October, Uruguay followed suit with the debut of step down (for frameworks, see *CMF 2022; UMEF 2022*).

The EU Taxonomy (*EU 2020*) is an EU-wide classification system for determining whether an economic activity is environmentally sustainable. It requires companies subject to the Non-Financial Reporting Directive (NFRD) (*EU 2014*) to report on the extent to which their operations are in line with the regulation, i.e. how "green" they are. Under the NFRD, large companies (with more than 500 employees and a balance sheet total exceeding EUR 20 million and/or turnover exceeding EUR 40 million) are required to report non-financial information such as environmental protection, social responsibility, treatment of employees, human rights, anti-corruption or even gender and age diversity in the management. However, the Commission would widen this further (to those meeting at least two of the three criteria: more than 250 employees, a balance sheet total exceeding EUR 20 million, turnover exceeding EUR 40 million) in the context of the Corporate Sustainability Reporting Directive (CSRD) (*EU 2021a*), which among other things proposes to amend the NFRD from a sustainability perspective and would extend and tighten the requirements for the content and format of the reports (see also EU Sustainability Reporting Standards, ESRS).

The KPIs mentioned in Article 8(2) of the Taxonomy are only for non-financial companies: these are green ratios for turnover as well as investment (CapEx) and operating (OpEx) costs. The Green Asset Ratio (GAR), an indicator that can also be used for financial companies, is addressed in a delegated act complementing the Taxonomy (Delegated Act – DA, *EU 2021c*).

The regulatory environment is further complicated by the need to distinguish between the concepts of eligibility and alignment in the context of compliance with the Taxonomy. Eligible simply means that an activity is relevant to the six environmental objectives listed in the Taxonomy (see DA 1(5)), while the aligned status requires more criteria to be met than this. An activity is aligned if:

- It is in line with the technical screening criteria (TSC) set out in the DA, i.e. the activity contributes positively and substantially to the achievement of the environmental objective(s) concerned. Currently, accepted TSCs exist for two of the six environmental targets – climate change mitigation and climate change adaptation.
- It does not significantly hinder the achievement of other environmental objectives ("do not significant harm", e.g. recyclability), including the four other environmental objectives, i.e. the sustainable use and protection of water and marine resources, the transition to a circular economy, pollution prevention and control, and the protection and restoration of biodiversity and ecosystems.
- Basic human and employee rights ("minimum [social] safeguards") are guaranteed.

Regarding the missing TSCs, an expert group[6] mandated by the Commission published its report in March 2022 (*PSF 2022a, 2022b*), but this material currently has no legal consequences.

For the financial year starting from 1 January 2022, the reporting obligation came into force for all companies concerned, but temporarily only at the level of eligibility. For non-financial companies, the reporting obligation at the alignment level will be effective from 2023, while financial companies have been given an additional year's grace, starting in 2024.

It is important to point out that, according to Article 7(1) of the DA, the securities of government, central bank and supranational issuers should not be included in the calculation of the KPI (neither in the numerator nor in the denominator) for the time being, due to the lack of a methodology, but financial corporations may voluntarily disclose their figures including sovereigns. This is scheduled to change from 30 June 2024, when the DA methodology will be updated.

The coming into force of the Taxonomy in 2022 was preceded by the entry into force (10 March 2021) of the Sustainable Financial Disclosure Regulation (SFDR) (*EU 2019a*). The aim of this regulation is to increase transparency, thus channelling financial resources towards activities that serve sustainable development. The obligated subjects are large financial market participants with more than 500 employees, i.e. investment funds, pension funds, asset managers, insurance companies, banks, venture capital funds, financial advisors and portfolio managers. Smaller companies, although not required to report, are obliged to explain the reason for non-compliance ("comply or explain principle"). The regulation makes transparent (i) the extent to which actors are exposed to and their methods of managing sustainability risks, and (ii) the impact of their activities on sustainability itself (this two-way street is called "double materiality"). Point (ii) is the so-called Principal Adverse Impact (PAI), an indicator of which can be for example, the magnitude of GHG emissions or the human rights situation. By standardising the information to be disclosed, the regulation also combats greenwashing[7].

The SFDR's classification system essentially separates funds into three categories:

- Article 6: Funds without explicit sustainability scope.
- Article 8: Funds that promote environmental or social characteristics that are not specifically sustainability-oriented (light green).
- Article 9: Funds that have sustainable investment as their objective (dark green).

[6] Platform on Sustainable Finance (PSF)
[7] The term refers to the deceptive practice of an organization falsely presenting itself as environmentally sustainable.

Article 6 obliges all funds to disclose their sustainability risks, so this minimum level of disclosure applies to all funds, including non-green/ESG funds. Funds advertised as green/ESG are classified under Article 8 or 9, depending on their characteristics. Funds classified under Article 8 offer financial products that promote environmental and/or social objectives, provided that the underlying companies in which the investments are made follow good governance principles. The funds under Article 9 are more forward-looking in that they are backed by investments with a specific sustainability objective and a concrete, measurable positive impact (e.g. solar investment with measurable GHG emission reductions).[8]

The SFDR, like the other rules, suffers from a number of shortcomings. Based on the experience since its introduction, the clarity and interpretability of the definitions is often compromised, according to the assessment of market players (see *So 2022*). A further problem is the lack of data, which is not expected to change until the first CSRD reports (the Commission proposal is for the reporting period to start from 1 January 2023, with publication from 2024).

Additional recommendations and legislation also help to promote transparency. For example, the ESMA's guidance issued for credit rating agencies: If they include ESG considerations in their ratings, it is of utmost importance to provide a detailed justification (*ESMA 2019a*, *2019b*). Another important piece of legislation is the Low Carbon Benchmark Regulation (*EU 2019b*), which is a sustainability amendment to the Benchmark Regulation (*EU 2016*), created after the LIBOR and EURIBOR manipulation scandals. This provides a single, transparent methodological standard for ESG benchmark administrators.

The continued reflection on the overall EU strategy has not stopped, of course. In summer 2021, the working document of the new strategy for financing the transition to a sustainable economy was completed, based on the 2018 Action Plan (*EU 2021b*).

Overall, the regulatory environment is constantly evolving, both in terms of the above rules and their interconnections. However, the regulation is company-centric for the time being, lacking in many respects the considerations arising from the specific situation of sovereigns as bond issuers. The rating/labelling schemes that are emerging in parallel with the regulatory environment (and in many cases before it) partly fill the gap left by the delay in detailed regulation, but sometimes go beyond the current requirements and impose stricter requirements on sovereigns. The question is the extent to which these specific responses will coincide with the EU's future position. There are signs of this, but the debate is far from over. It is also unclear to what extent the EU market would accept a potentially compromise

[8] Being under Article 9 is not in itself an alignment with Taxonomy.

rating system with light standards or even a rating system that is too strict. In other words, could it be the case that, despite the introduction of the EU Ecolabel for financial products (*EU Ecolabel 2018*), which is still being developed, the established national labels for qualifying funds will continue to be the most authoritative? This is not just a mind game, as the EU GBS, even in the (more stringent)[9] form proposed by the *EP* (*2021*), potentially allows for it:

- The draft regulation lays down rules primarily for, but not limited to, bonds to be issued with the "EuGB" label (Article 1). It would therefore not exclude for the time being the issuance of bonds that are advertised as sustainable, but not labelled as EuGB, but would only make it conditional on the disclosure of certain information (such as allocation structure, degree of compliance with EU Taxonomy, etc., see Article 7c(3)).
- Two years after the entry into force of the draft, and every three years thereafter, the Commission will prepare a comprehensive impact report for the Parliament and the Council proposing whether or not the EU GBS should become mandatory (Article 63a(2)).

Accordingly, for the time being, the EU GBS barrier does not seem to be hard: adoption of the regulation may be delayed and it is not even certain that a decision on making it mandatory will be taken after two years. In the event of such a postponement, for example, green bonds could continue to be issued under a national framework for five (2+3) years after adoption. However, it is important to note that the mandatory or voluntary nature of the standard is far from decided.

4. Member State qualification of green/ESG portfolios

In recent years, the need for a standard rather than an untransparent system of self-certification has become more pronounced. Novethic's (*2019, 2020a, 2020b*) market overviews show that by the end of the decade, there were nine fund labels on the market in Europe.

Two types of labels can be distinguished: ESG and green focus. The former guarantees that the financial products are backed by an integrated ESG strategy, while the latter is available for thematic green funds. The origins and underlying organisational background of the labels vary widely (*Table 1*).

[9] While the European Commission's initial proposal (*EC 2021*) is for a voluntary framework, the European Parliament, in line with the European Central Bank's recommendation (*ECB 2021*), advocates making it mandatory.

Table 1
European green and ESG fund labels

Name	Created in	Type	Country	Characteristics
Umweltzeichen	2004	ESG	AT	Under the direction of the Ministry of Environment
LuxFLAG Environment	2011	green	LU	Set up by Luxembourg financial institutions. Cross-border certification.
LuxFLAG ESG	2014	ESG	LU	See above.
LuxFLAG Climate Finance	2016	green	LU	See above.
SRI Label	2015	ESG	FR	An independent committee with the support of the Ministry of Finance.
Greenfin Label	2016	green	FR	Independent committee chaired by the Ministry of Ecology.
FNG-Siegel	2015	ESG	DE, AT, SUI	Expert committee overseen by the German-speaking region's sustainable investment forum (Forum Nachhaltige Geldanlagen, FNG).
Nordic Swan Ecolabel	2017	ESG/green	DK, SE, NO, FI, IS	Committee set up by the governments of the Nordic countries. The Nordic Ecolabel has been in existence since 1989 in 60 retail product categories, with the financial products category launched in 2017.
Towards Sustainability	2019	ESG	BE	Launched by the Belgian financial sector association (Febelfin); this was the original name of the label. The classification is issued by a non-profit organisation (Central Labelling Agency, CLA). Aims to become a market standard, at least within Belgium.

Source: Novethic (2019), FNG-Siegel (2020), Greenfin Label (2019), Nordic Swan Ecolabel (2022), SRI Label (2020), Towards Sustainability (2021)

Four out of six ESG-focused labels exclude certain companies and sovereigns. The starting point is the ten principles of the UN Global Compact, such as human rights, employee rights, environmental protection and anti-corruption (*UN 2000*). Companies may be excluded on the basis of standards for the manufacture or resale of weapons and certain components thereof, tobacco products, or even for genetic engineering. For sovereigns, disqualifying factors may include limited human freedoms, high levels of corruption, death penalty, nuclear energy, international sanctions, lack of ratification of the Paris Agreement (*UN 2015*) and Rio Conventions (*UN 1992*). Several labelling agencies rely on indicators from non-governmental organisations (NGOs), such as the country rating of the Freedom House[10] or the

[10] https://freedomhouse.org/explore-the-map?type=fiw&year=2022

Transparency International[11] Corruption Perceptions Index (CPI).[12] In the cases of the *FNG-Siegel* (*2020*) and *Towards Sustainability* (*2021*), the "not free" country rating and a corruption index lower than 40 (the lower the worse) are clear disqualifiers, but the latter criterion is also explicitly mentioned for example in the *Nordic Swan Ecolabel* (*2022*). This orientation in ESG ratings is not just a European phenomenon. In the *Morgan Stanley* (*2020*) framework, the criteria "Voice & Accountability", "Rule of Law", or "Corruption" appear in the Governance dimension.

In terms of hydrocarbon exposure, not only the thematic green labels, but also the majority of ESG labels set strict criteria, typically a threshold of 5 per cent based on revenue, not only for extraction but also for energy production. But even more striking is the fact that nuclear energy (and in many cases elements of the associated value chain) is more rejected than fossil fuels and even coal. Some labels have no limit, or even have a limit of 25–30 per cent for fossil fuels and coal, compared to 5 per cent for nuclear.[13]

The minimum requirement for green activities in green label funds expressed as a percentage of turnover varies from 10 to 37.5 per cent (*Novethic 2019*). These figures are usually the result of a combination of two thresholds: on the one hand, there is a minimum requirement in the percentage of revenue for companies to qualify as green, and on the other hand, there is an expectation for the total portfolio, i.e. what percentage of companies should be green. It is expected that the financial EU Ecolabel will follow a similar two-step system.

There are also significant differences between labelling agencies in the exclusion or acceptance of certain green bonds. For some, a gas company's green bond is a green investment, while for others it is not. For some, it is not a problem if the sovereign invests in nuclear energy (France), while for others it is a reason for disqualification if it involves an expansionary development (Austria). The French Greenfin, for example, is partly based on the CBS (*Greenfin Label 2019*), which is why it can be receptive to nuclear energy (when it comes to sovereigns, but not in the case of companies). Of course, the causality may be the other way round: the national label was based on this standard in the first place because it is not dismissive of nuclear energy.

[11] https://www.transparency.org/en/cpi/2021

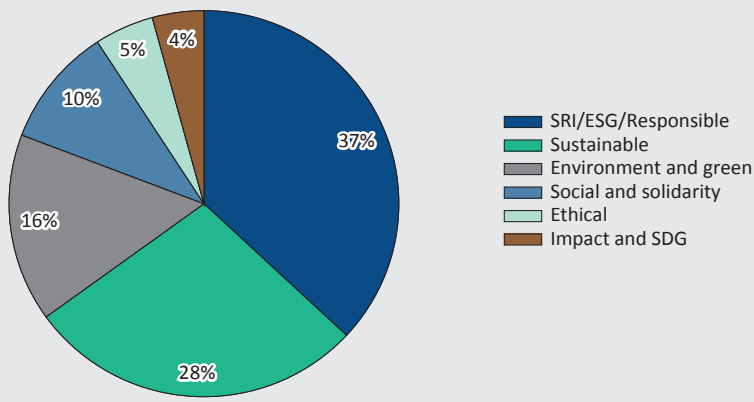
[12] The World Bank also prepares a set of indicators on the same theme (see Worldwide Governance Indicators, http://info.worldbank.org/governance/wgi). It is worth noting, however, that while on some issues the World Bank and NGO indicators arrive at qualitatively the same assessment of the situation, on others they present a markedly different picture.

[13] The European Commission's and the European Parliament's recently more liberal standpoint – which is diametrically opposed to their earlier position – on nuclear energy and fossil gas (see *EU 2021d* versus *EU 2022*) is just another fault line in the relationship between some market players (plus some Member States) and the EU institutions.

4.1. Conceptual proliferation

The lack of a common language has inevitably led to babelism in terms of names. This is illustrated by *Novethic*'s (*2020a*) collection at the end of 2019 including 806 labelled European fund names (*Figure 1*). The most frequently used key words were "socially responsible investment" (SRI), "ESG" and "responsible" (225). However, "sustainable" in different languages was on the rise (171). Also significant were "environment and green" (96) and "social and solidarity" (61). There were also the terms "ethical" (30) and "impact and sustainable development goal" (SDG) (26). A fund could fall into several categories (68). It is interesting to note, however, that the remainder of the labelled funds, more than a quarter of them, did not even mention sustainability in their marketing materials.

Figure 1
Distribution of names of labelled European funds at the end of 2019



Note: Some funds were associated with more than one name, i.e. there was overlap between categories.
Source: Based on Novethic (2020a)

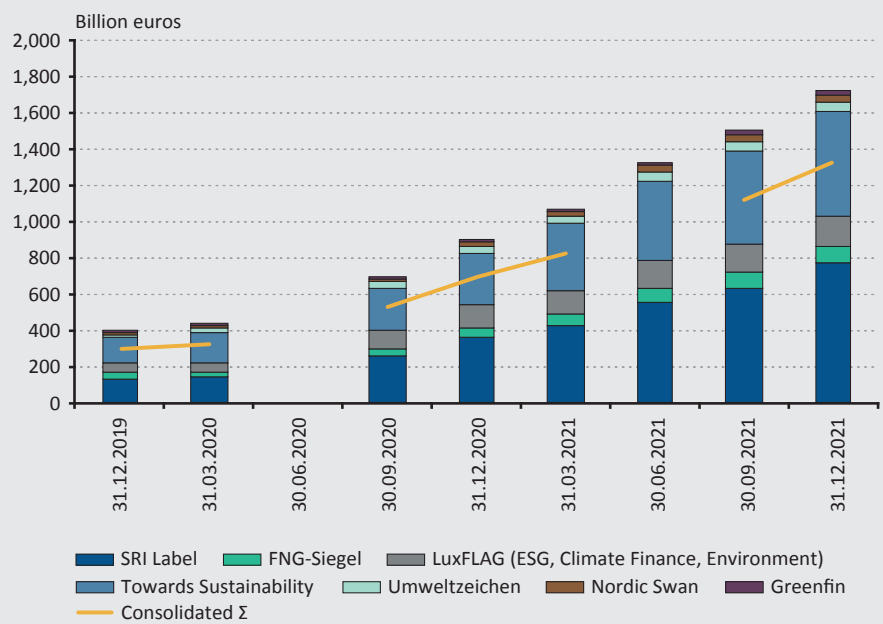
4.2. Competition between labelling agencies and NGO aspects

In 2019, a big race started, mainly between Belgian and French labellers as market leaders (*Figure 2*). At the same time, convergence towards EU regulation, ultimately towards the financial EU Ecolabel, started. However, this has by no means brought about a convergence between the systems to remove all significant differences. There continue to be striking differences, mainly in the exclusion of certain industries, but also possibly in transparency, documentation and reporting requirements.

In my view, what is actually missing for full harmonisation is an underlying interest. It may be that, although they all have a declared desire to expand abroad, maintaining a dominant position in their home country/region is the minimum objective. It follows that the specific interest of a country/region cannot be ignored. For example, a French rating agency will not exclude a sovereign developing the nuclear sector, while an Austrian one will. This creates the disadvantage that if a fund were to operate in more than one country/region, it would be worthwhile from a marketing point of view to have the label of more than one country/region, which in turn could imply compliance with a significantly different set of criteria. Of course, harmonisation is not helped by the fact that the pan-European objective itself is not yet settled, as the debate on the treatment of gas and nuclear energy, for example, is far from being decided.

It is worth pointing out that at the end of 2021 nearly half of the rated assets had a label that excluded sovereign bonds of countries with a corruption index below 40 (see FNG-Siegel, Towards Sustainability, Nordic Swan in *Figure 2*).

Figure 2
Assets managed in labelled funds



Note: A fund can have more than one label, so the consolidated value is lower. Mid-2020 data is not available.

Source: Based on Novethic (2020c, 2021a, 2021b, 2021c, 2021d, 2022)

4.3. Public awareness of labels

To what degree are retail investors interested in the label? In 2021, the French financial market authority launched a survey on responsible investment and awareness of labels among the general public. The results showed that 71 per cent of French people had never even heard of either of their two home labels (*AMF 2021*). Only 6–7 per cent knew in depth what the labels in question meant.

Given the fact that the French ESG label is also the European market leader and is hardly known at home, it would not seem realistic to assume, on the basis of pure competitive market logic, that retail funds would voluntarily exclude certain instruments from their portfolios. This would be of no benefit to them, as it would require a massive transformation of preferences. Such a shift can best be enforced by the regulator, for example through the financial EU Ecolabel, or indirectly through the rules for institutional investors.

4.4. The Climate Bond Certificate (CBC) as a scientific label

The CBI not only provides standards, taxonomy and information, but also acts as a labelling agency for green bonds. The CBC certifies that the asset/project meets the criteria set out in the CBS (currently a standard is in place that was prepared at the end of 2019).[14] As it is a green label, the standard does not include any points beyond climate/environmental issues (e.g. corruption), so in this respect it is analogous to the European green labels for investment funds discussed above. It should be stressed, however, that nuclear energy is listed as green in the CBI taxonomy, as its focus is on carbon intensity (only uranium mining, which is an indirect risk, is in the zone requiring more detailed assessment). Another important element is that it also places natural gas in the non-rejection zone, unlike coal, which is only given the green light in the specific case where carbon capture and storage is 100 per cent (so-called clean coal technology).

At the end of 2021, bonds with a value of more than USD 200 billion worldwide had CBI certification. Among these bonds there is also a Hungary-related security, namely the green mortgage bond issue of the Erste Jelzálogbank[15] Zrt. amounting to HUF 10.43 billion on 6 December 2021 (see *CBI Certified Bonds database*[16] and *Erste 2021*). Among European sovereigns, the Netherlands for example already applied for CBI certification for an issue of EUR 10.7 billion in September 2019.

[14] The new version (v4: *CBI 2022c*), published on 6 September 2022 for consultation, would add to the current standard (v3: *CBI 2019*) the necessary aspects for the rating of non-financial corporates, including the issue of SLBs by these corporates.
[15] mortgage bank
[16] https://www.climatebonds.net/certification/certified-bonds

5. Overview of SFDR Articles 6, 8 and 9

According to *Novethic* (*2022*), at the end of 2021, more than one fifth of the 1,799 funds (EUR 1,330 billion in assets under management) labelled as such were funds under Article 9. Green labels (Greenfin, LuxFLAG Environment, LuxFLAG Climate) are typically associated with funds under Article 9, but the share of such funds was also not negligible in the case of ESG labels (20–40 per cent).

The relevant sample from *Morningstar* (*2021, 2022a, 2022b*), a US financial services provider, covers 82–97 per cent of all funds traded in the EU, including unlabelled and non-green (Article 6) funds as well. Since the launch of the SFDR in March 2021, the data shows a significant uptake of funds under Articles 8 and 9. In fact, their asset ratio already exceeded 50 per cent in 2022, albeit in a general capital market contraction (*Figure 3*). It is also clear, however, that the funds under Article 8 are by far the most dominant.

Figure 3
Assets of funds under SFDR Articles 6, 8 and 9 (sample)

Note: The samples cover 82, 91 and 97 per cent of all European funds, respectively, in chronological order, and exclude money market funds, funds of funds and feeder funds (channeling funds into an umbrella fund).

Source: Calculation based on Morningstar (2021, 2022a, 2022b)

At this point, it is worth recalling that sovereign ESG bonds with a corruption index below 40, according to the status at the end of 2021, would be excluded from about one half of the labelled funds (Towards Sustainability, FNG-Siegel, Nordic Swan). This roughly EUR 700 billion of assets (unconsolidated) certainly seems significant compared to the EUR 1.33 trillion of total assets labelled, but it is dwarfed by the

total number of Article 8 and 9 (EUR 3.60+0.45=EUR 4.05 trillion) or even that of Article 6 (EUR 5.5 trillion) (the latter comparison is also relevant, as green bonds are far from being bought only by green investors). Thus, the funds that would certainly exclude sovereigns in the case of an unfavourable corruption figure represent only a fraction of the total European capital market of EUR 9.55 trillion, and since these stock data for Articles 6, 8 and 9 do not cover the entire population, the proportion is somewhat even smaller.

5.1. Greenwashing

The severe disproportion between Article 9 and Article 8 funds (1:8 ratio at the end of 2021 compared to 1:4 for labelled funds) shown in *Figure 3* indicates, in my view, the significant presence of greenwashing.[17] The phenomenon is probably closely related to the as yet unresolved dilemma of whether a company and its thematic project can be separated, i.e. whether a company's or government's bond is green/sustainable because of the name given to the product or because of the functioning and strategy of the whole underlying organisation. As long as a gas utility issuing a green/ESG bond is given the same return advantage (greenium) by the market as the solar park as an issuer, the triumph of these issues and the funds that build on them – whether new or existing but re-branded – can be predicted. Once the waves of regulatory uncertainty and green communication fervour subside, the market will be better able to price the underlying transition risks of a particular firm or sovereign. If a company's revenues come 99 per cent from brownfield, it is difficult to see why its ordinary and green bonds should be treated differently in terms of debt risk, i.e. why it should be entitled to greenium.

The recent semantic innovations ("green", "sustainable", "responsible", etc.) are presumably also partly due to this pricing defect, a kind of adaptive thinking. Practically, as soon as the arbitrage opportunity behind a fancy name starts to run out, it is worth coming up with a new, catchy product, for which the market is unlikely to be able to make an accurate value judgement at the outset, and which is likely to be overvalued at this stage due to strong green/ESG communication and partly regulatory pressure.

6. Greenium

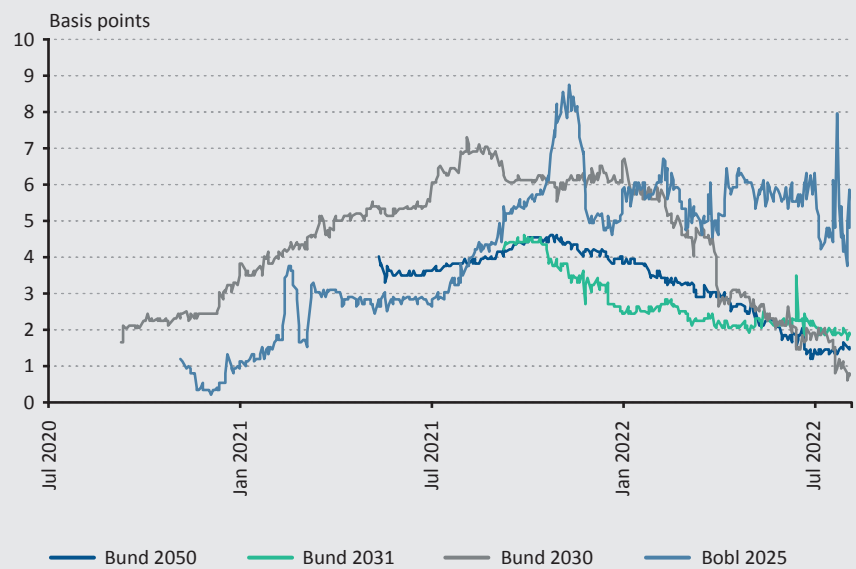
In a study by the CBI, the general experience of the sampled sovereigns issuing GSS bonds is that there is higher demand for their GSS bonds compared to conventional bonds (*CBI 2021a*). The Hungarian oversubscription rate was among the highest, but there were one or two odd cases, such as in Lithuania, where the opposite was observed.

[17] The only detailed and widely accepted system of guidelines and regulations that could provide some protection against greenwashing is specific to dedicated green (environmental) investments so far.

The excess demand can provide a yield advantage for the issuer. Looking at the data of 23 sovereign issues between 2017 and 2020, 9 showed greenium and 10 yields fell on the yield curve (*CBI 2021a*). Looking at non-sovereign issuance data for the second half of 2021, half of the 73 green bonds were greenium-affected or on the yield curve (*CBI 2022a*). As for EUR issuances, greens were oversubscribed by an average of 3.4 times, while the equivalent vanilla was oversubscribed by only 2.7 times (19.3 and 17 basis points spread compression, respectively). The same figures for USD issues showed 3 times and 2.7 times oversubscription (25.9 and 21.7 basis points).[18]

In Europe, the greenium can be examined particularly in the case of German government bonds due to the practice of twin issuance ("green twins", *Deutsche Finanzagentur 2022*). This means that the green paper issued has a normal counterpart with the same maturity and coupon. There are currently four such pairs, of which three are bonds (Bund with maturities in 2030, 2031 and 2050) and one is a treasury bill (Bobl 2025).

Figure 4
Yield advantage of green German government bonds at the individual maturities



Source: Calculation based on Bloomberg data (https://www.bloomberg.com)

[18] According to *Kotró* and *Márkus* (*2020*), investors in the US reward companies with a better ESG rating, i.e. not only financially-oriented companies, with a risk premium of up to 35 basis points lower on average. It is true, however, that they saw the exact opposite in Japan and a mixed picture in Europe.

Figure 4 clearly shows that there is a green premium for German papers, although all bonds had negative returns until the end of 2019, meaning that holding a green bond was more draining on the owner's wealth than holding a conventional one. It is worth noting that the investors' enthusiasm for long green paper, which was growing before, has reversed and the momentum is starting to fade.[19]

It is not at all common for sovereign GSS bonds to be bought by dedicated green investors alone; their percentage on average was only 44 per cent, with a wide dispersion (*CBI 2021a*). The 57-item non-sovereign sample for the second half of 2021 showed a higher average of 66 per cent (*CBI 2022a*).

As long as this kind of over-demand is felt, it does not seem reasonable to narrow the scope of green bond issuers beyond environmental criteria (except for excluding greenwashing). However, there is a risk that the line between the green and sustainability categories is becoming increasingly blurred (see the Nordic Swan's hybrid green/ESG label). Since the latter are not based solely on a set of scientific criteria and supply-demand rules, but on a different set of criteria that emphasises certain qualitative elements, this approach could even undermine the factual basis for the valuation of green bonds.

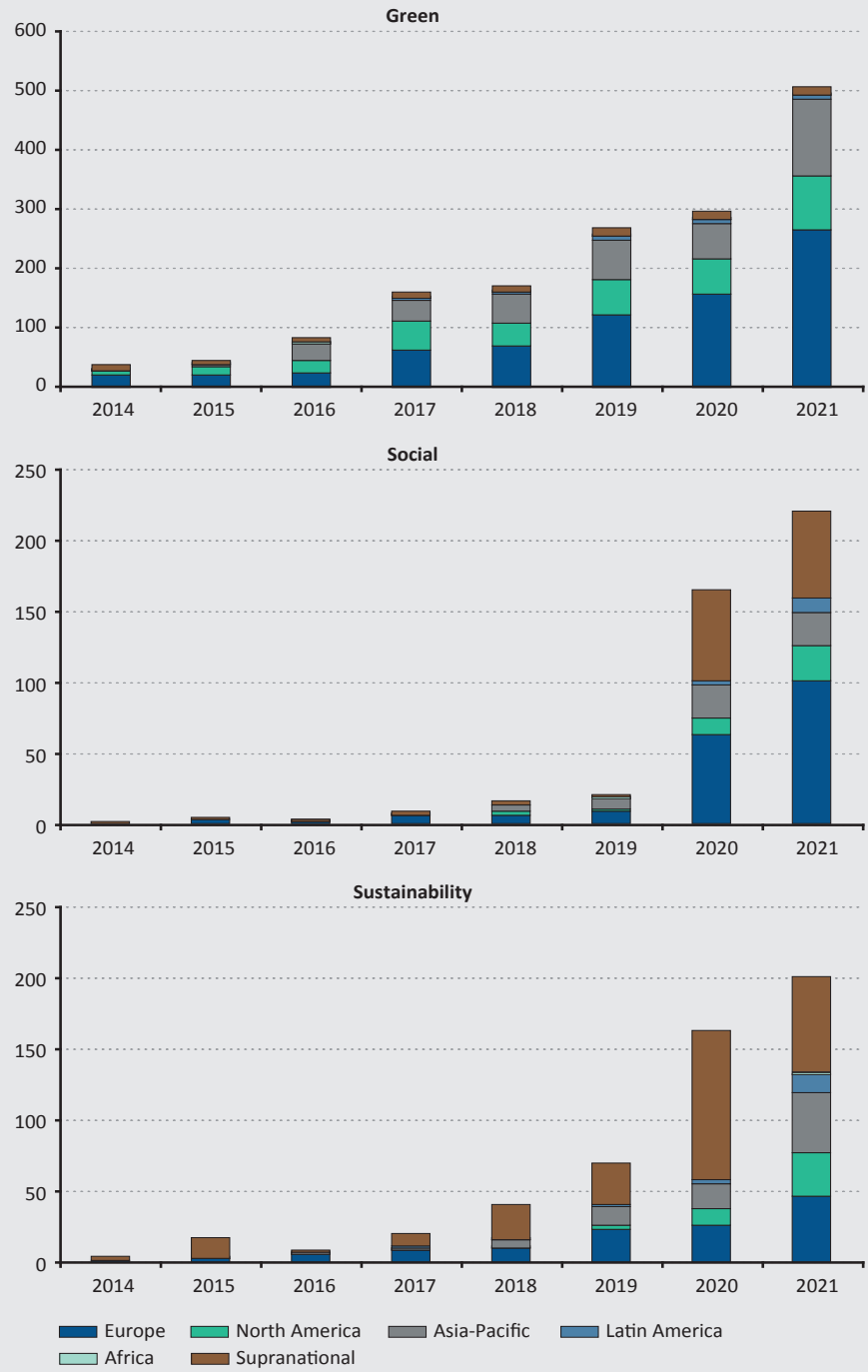
7. Global outlook

The CBI, as a non-profit international organisation with the declared aim of promoting a climate-friendly global economy, is the only organisation in the world to operate a free database[20] of annual issuance of green, social and sustainability products, at the global level and in different sections. The database includes debt products that the borrower itself describes as green, social or sustainability products (for more on the methodology, see *CBI 2020, 2022b*). According to the information provided by the data provider, the data are sufficiently representative, i.e. the distributions that can be drawn from them are adequate.

Figures 5–9 clearly show that green bond issuance continues to dominate, with more or less steady growth, while the combined issuance amounts of social and sustainability bonds has jumped to roughly similar levels, from virtually nothing, in two years.

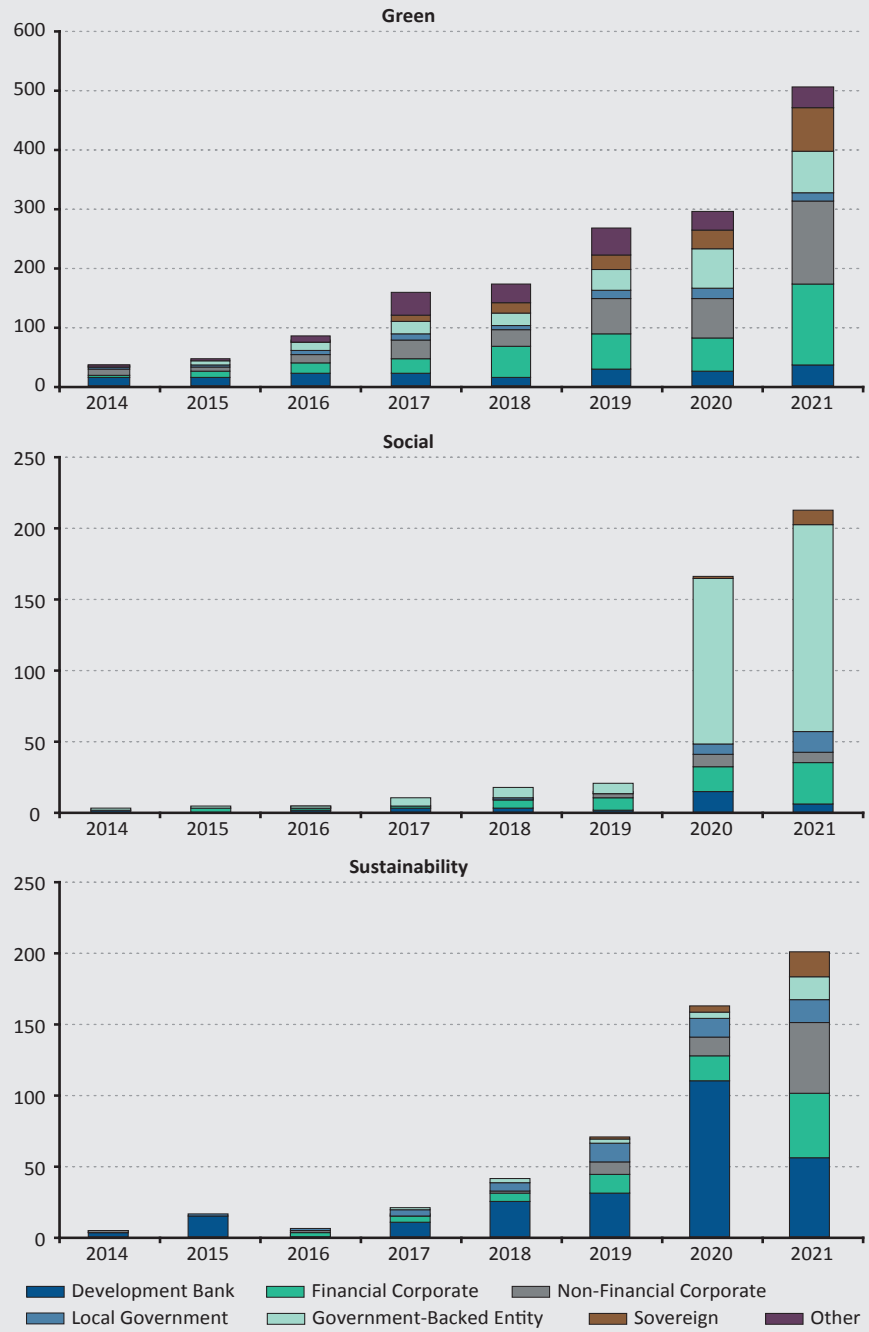
[19] *Németh-Durkó* and *Hegedűs* (*2021*) also conclude in their analysis of green bond funds that greenium exists but is declining. The difference, they argue, could disappear as the regulatory environment for the funds settles down.
[20] Interactive Data Platform: https://www.climatebonds.net/market/data

Figure 5
Breakdown of GSS issuance by continent (USD billion)



Source: Based on CBI data

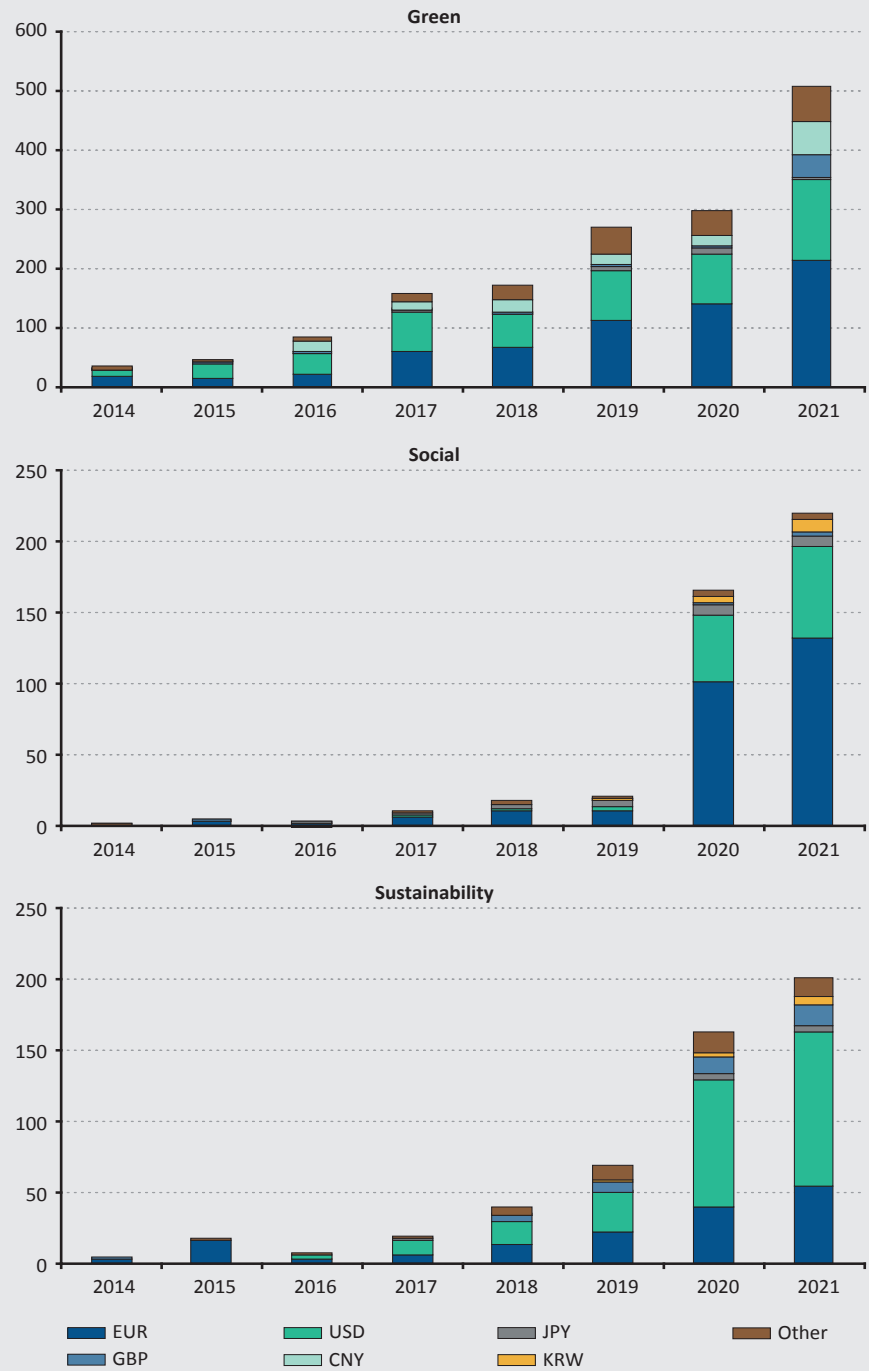
Figure 6
Breakdown of GSS issuance by issuer (USD billion)



Note: For this section, the sustainability bond data for 2021 is incomplete, so I have increased each element proportionally up to the total sum consistent with the other sections.

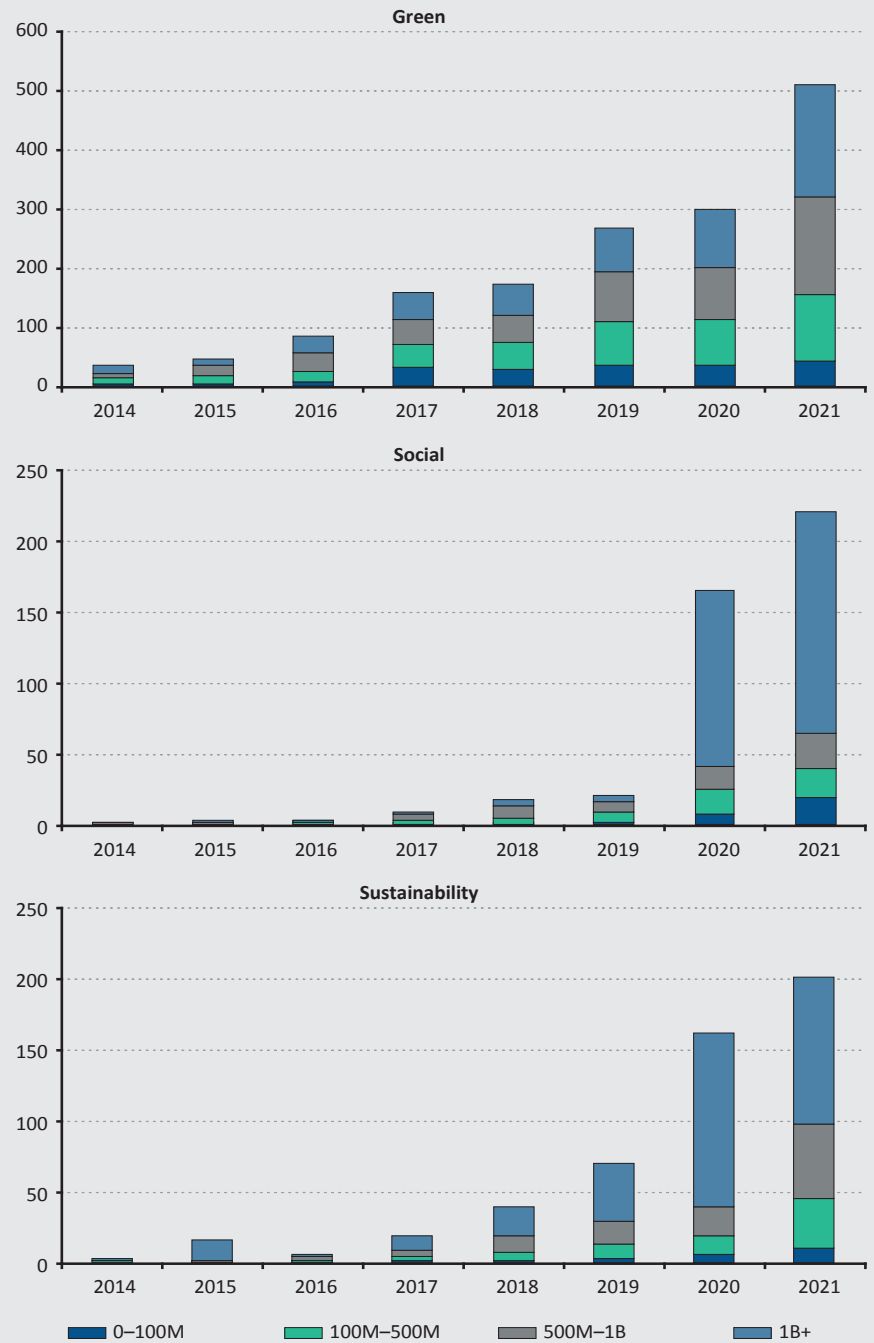
Source: Calculation based on CBI data

Figure 7
Breakdown of GSS issuance by currency (USD billion)



Source: Based on CBI data

Figure 8
Breakdown of GSS issuance by issue amount (billion USD)



Source: Based on CBI data

By location, Europe leads the way in green and social bonds (*Figure 5*). In the case of greens, the Asia–Pacific region is also active, while for social bonds, supranational organisations have played an active role in enhancing the dynamics of a market that effectively did not exist before 2020. Sustainability bonds were initially clearly dominated by supranational organisations, but by 2021, the picture was much more heterogeneous.

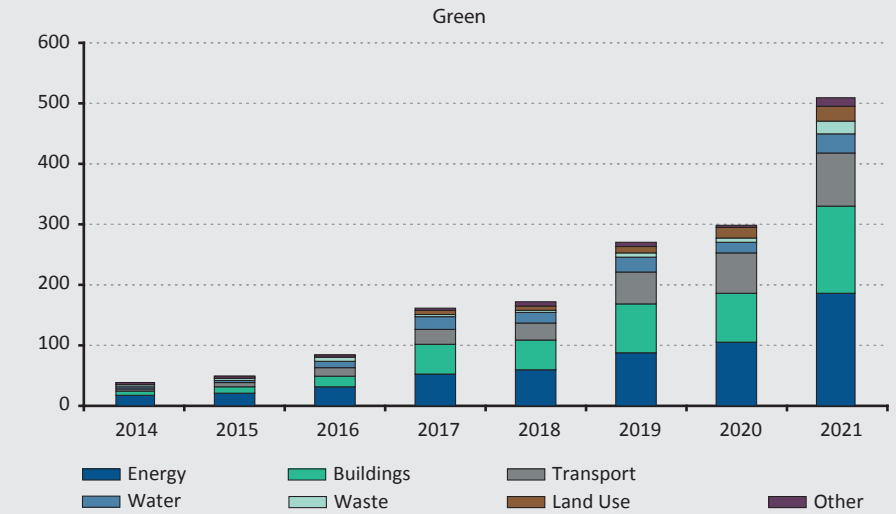
By type of issuer, we see the most pronounced sovereign presence in greens (*Figure 6*). Although government-backed entities accounted for the largest share of issuers of social bonds, it is worth noting that sovereign issuance – albeit starting from a low base – showed a strong increase in 2021. The sustainability category used to be dominated by development banks, but by 2021 the field became more diverse.

The currency of the majority of issues is basically euro and US dollar (*Figure 7*). In the green and social case, the euro is more dominant, while in the sustainability case, the dollar dominates. In the case of green, the yuan and, more recently, the British pound are also prominent, but together there is also significant issuance in Swedish krona and Canadian, Australian and Singapore dollars. In the social and sustainability cases, the noticeable increase in Korean won is an interesting development, but in the latter category it is also worth noting the significant share of British pounds (also in supranational issuances, see CBI database).

There are also significant differences between the types of issuance by volume (*Figure 8*). Although the importance of issues over USD 1 billion has increased for greens, the proportion of smaller transactions is still significant. However, regarding social and sustainability bonds, large issues are clearly dominating.

In terms of objectives, green bonds are mostly related to energy, buildings and transport (*Figure 9*). The large increase in 2021 is also mainly related to the first two allocation targets.

Figure 9
Breakdown of green issuance by allocation target (USD billion)



Source: Based on CBI data

8. Summary

Creating a common language is a necessary precondition for the global green transition. In the area of bonds, the voluntary standards of two organisations, ICMA and CBI, have been adopted worldwide: the GBP and CBS, respectively. The market is dominated by the GBP which has been in existence since 2014 and is currently the global standard. The EU GBS has been in development since 2018. According to the plans, this would require compliance with the EU Taxonomy, transparency, external evaluation and even supervision of external evaluators by ESMA. In contrast to the green standards, the range of social and sustainability guidelines is still much more limited. ICMA is currently leading the way (in this area as well), having already issued recommendations on social, sustainability and sustainability-related issues.

At the EU level, the recent entry into force of the SFDR has brought some progress in the area of fund self-certification. Its classification system essentially divides the funds into three categories. Article 6 obliges all funds to disclose their sustainability risks, even if they do not advertise themselves as green/ESG funds. Funds classified under Article 8 offer financial products that promote environmental and/or social objectives, provided that the underlying companies in which the investments are made follow good governance principles. The funds under Article 9 are more forward-looking in that they are backed by specific sustainability investments with

concrete, measurable positive impacts. The SFDR, like the other rules, still suffers from several shortcomings (e.g. ambiguity of definitions, lack of data).

To go beyond the untransparent system of self-certifications, financial organisations lobbies or even governments have taken the initiative, thanks to the delay in EU regulation. By the end of the last decade, there were nine fund labels on the market in Europe. Two types of labels can be distinguished: ESG and green focus. The former guarantees that the financial products are backed by an integrated ESG strategy, while the latter is available for thematic green funds.

Labels with an ESG focus tend to exclude certain companies and sovereigns, for example because of their support for arms production or nuclear energy. However, despite their convergence with the EU regulatory environment, the labelling systems reflect and are optimised for national priorities and therefore still differ significantly.

It is important to point out that many of the ESG-labellers rely on NGO indicators, such as Freedom House's country rating or Transparency International's corruption index. For several of these labels, the "not free" country rating and/or a corruption index of less than 40 (the lower the worse) are disqualifying factors. An additional risk for the sovereigns concerned could be the possible blurring of the boundaries between green and sustainability categories, i.e. the addition of qualitative criteria to the purely scientific ones currently existing in the field of green. A further risk could be if these criteria are incorporated into general investor expectations and scorecards, as this could lead to a lower rating of normal (non-ESG) bonds. The analysis of risks can therefore by no means be limited to legislation alone, as investor preferences can be more stringent than this.

The general experience of sovereigns issuing green, social or sustainability bonds is that there is a higher demand for their GSS bonds compared to conventional ones. A demand surplus can give the issuer a yield advantage, i.e. a greenium. Marketing considerations and the uncertainty of the regulatory environment, including pricing difficulties, may also be behind the over-demand.

From a global perspective, green bond issuance continues to dominate, while the combined issuance of social and sustainability bonds has jumped to roughly similar levels over two years. By type of issuer, greens continue to have the strongest sovereign presence. The majority of issues are denominated in euros and US dollars. An interesting element in the social and sustainability cases is the visible increase in Korean won. There are also significant differences in terms of the volume of issues, with a still significant share of smaller issues for green bonds, while social and sustainability bonds are clearly dominated by large issues.

In summary, there are elements of risk associated with sovereign ESG issuance that are not very well known by the public, even though they may be potentially

salient. Within the European Union itself, there are significant economic conflicts of interest, which can be seen by looking at the conditions of labels attached to each country. It remains to be seen how this will be reflected in the still-forming financial EU Ecolabel and EU GBS. Given the diversity of potential exposures, no sovereign can forego the constant monitoring of domestic, European and even global market developments and preferences. It follows organically from the latter that it is not enough to know the market for standards, taxonomies and certifiers only at the EU level.

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Green Bond Impact Report as an Essential Next Step in Market Development*

Gergely Manasses – Éva Paulik – Attila Tapaszti

The measurement of the environmental impact of green bonds, its reliability and the publication of measurement results are crucial for the transparent functioning of the market and supporting investor decisions. However, this segment of the financial markets is still at an early stage of maturity, and the lack of adequate data and methodologies is a common problem that can only be solved by the development of single-market best practices and regulations. The essay reviews the trends, characteristics and current regulation of existing green bond impact reports and describes the challenges of evaluating impact reports, based on the literature and our own practical experience. In our view, the market has already moved past its "virtue-signalling PR" stage, but there is still a long way to go before impact data become as standardised as traditional financial data.

Journal of Economic Literature (JEL) codes: G11, O13, O44

Keywords: green bond impact reports, quantification of environmental impacts, impact investing

1. Introduction

We live in an era of rapid change, and one of the most significant areas of this change is the transformation of climate conditions. This is one of the biggest socio-economic challenges of our day and age, both globally and domestically, and one that may largely determine our future as well. Ensuring environmental sustainability will require huge financial resources: according to the World Bank's estimate, between 2015 and 2030, USD 90 trillion in global infrastructure investment would be needed to meet climate targets (*UN 2021*). OECD calculations also project a significant investment need of USD 6,900 billion annually to meet the climate targets of the Paris Agreement (*OECD 2020*).

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Gergely Manasses is a Risk Analyst at the Magyar Nemzeti Bank. Email: manassesg@mnb.hu
Éva Paulik is a Risk Analyst at the Magyar Nemzeti Bank. Email: paulike@mnb.hu
Attila Tapaszti is a Principal Portfolio Manager at the Magyar Nemzeti Bank. Email: tapasztia@mnb.hu

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Today, an increasing number of countries are embarking on the path of the green economic transformation, and many businesses are striving to achieve sustainable operations. A key factor in the success of the green transition is strategic cooperation with the financial system, as financial intermediation brings banks and other financial service providers into contact with the economy as a whole. The role of the financial sector is also underpinned by the fact that the green transition of the economy presupposes that the financial system can finance green investments to an adequate extent, but for this it will need to undergo a significant transformation (*Carney 2021*). By the second decade of the 21st century, the role and responsibilities of central banks have also changed, and as prominent actors in economic policy they cannot afford not to address the issue of the transition to a carbon-neutral economic model (*Matolcsy 2022*).

One precondition for a successful green transition of the economy is that financial markets take into account and appropriately assess climate risks[1] and are able to monitor the expected or realised positive environmental impacts of their investments. This requires a suitable methodology, but there are major challenges in the field, both in terms of the content and comparability of the available data, as well as in terms of methodologies and models.

Transparency rests on data, the evaluation and analysis of which requires an appropriate methodology. While the traditional securities market offers decades of data and experience, green markets are only 5–10 years old (*Climate Policy Institute 2021*), and they are also tiny compared to the entire bond market, amounting to approximately 1–2 per cent (*ICMA 2020; CBI[2] 2022b*). Regulation should solidify on the market, best practices should emerge in disclosure and models, and data transparency should meet the demands of investors. All of this takes time. An appropriate attitude on the part of regulators and financial sector supervisors is essential for the development of green markets and transparency.

1.1. Green bond issuances

The European Investment Bank was a pioneer with its Climate Awareness Bond in 2007, the world's first green bond issue, but the market only started to develop dynamically from 2014–2015 (*EU 2022*). Over the past 3–4 years, the volume of green bond issuance has grown significantly: while annual global issuance in 2018

[1] The risks that summarise the impacts of the climate change and the resulting vulnerability of the financial markets, current and future climate variability and extreme events, and the implications for sustainable development. There are several types of impacts that can result from these risks, some with a lingering process (e.g. changes in temperature and precipitation) and others with a sudden onset (e.g. tropical storms and floods) (*UNFCCC 2007*).

[2] CBI: Climate Bonds Initiative – International green bond market development organisation with its own quality scoring system and taxonomy.

was less than EUR 200 billion, it already approached EUR 500 billion in 2021 (*CBI 2022a*), with total outstanding marketable stock of EUR 1,300–1,400 billion by the first quarter of 2022 (*IIF 2022*). Developed markets account for the largest share of this stock, at around EUR 1,000 billion, but the share of developing markets is growing (around EUR 200 billion, with the remainder mainly attributable to supranational issuers).

In addition to green bonds, the number and volume of green investment funds in international financial markets has been steadily growing since 2017–2018. According to a CBI summary, 13 green bond ETFs (Exchange Traded Funds) in EUR or USD were available in the first half of 2022, with a total market value of nearly USD 1.7 billion (*CBI 2022c*). More and more financial institutions are launching ESG-rated funds in Hungary, but dedicated green bond index-tracking funds are not yet available. As with the green ETFs, the volume of other bonds with a positive social and environmental impact has also shown a dynamic increase (in 2021, the outstanding stock of these securities was also around EUR 500 billion).

Several studies have already been carried out on the basic parameters of green bonds, their qualification methods, the types of green projects financed and their markets in general (greenium, volumes, types of issuers, etc.) (see for example one of the first analyses on the subject: *Mihálovits – Tapaszti 2018*), so it is not the purpose of this essay to discuss these characteristics.

The significant expansion of the market for green products has brought green bonds into the mainstream rather quickly, but while the structure itself is rapidly moving towards maturity, the standardisation, availability and reliability of impact reports is still at an early stage. All of the major frameworks require some form of annual reporting (supplemented with an allocation report), and thus it is unavoidable for issuers to produce better and better quality reports if they wish to meet market expectations.

The focus of this paper is therefore on the challenges around green impact reporting and a brief overview of current practices and regulations. Without well-functioning impact reporting mechanisms, the integrity of the green bond market could be compromised, and we believe that the most important area for development in the near future will be to ensure the credibility of environmental impact data.

2. Impact report

2.1. Current regulation

The impact report summarises the environmental impact of the projects that have been implemented with the funds generated by green bond issuances. The report is primarily intended to inform investors that the utilisation of the resource is in alignment with the predetermined financial and environmental framework. Its credibility is based on continuous measurement, the reliability and regular publication of data, and their integration into the company's reporting structure. The international Green Bond Standards (*Table 1*) are designed to ensure the comparability of sustainability targets, the transparency of appropriate use of resources and the investor expectations of sustainability. Within the framework of the international standards, taxonomies have been established, defining all of the economic activities that are acceptable under the sustainability objectives of the Green Bond Standards. First, the Climate Bond Initiative developed a taxonomy to identify the activities and projects needed to achieve a low-carbon economy, in line with the goals of the Paris Agreement. The regulation is based on the latest climate science, including research from the Intergovernmental Panel on Climate Change (IPCC) and the International Energy Agency (IEA). The taxonomy is regularly updated based on the latest climate science findings, the emergence of new technologies and sector-specific criteria (*CBI 2021*).

In 2015, the International Financial Institutions (IFI) proposed a harmonised framework for impact reporting with associated metrics in the renewable energy sector and for cross-sectoral energy efficiency projects (IFI Harmonised Framework). Subsequently, the International Capital Markets Association (ICMA) published further documents, building on the work of the International Financial Institutions, and this collaboration resulted in the ICMA Harmonised Framework. Likewise, these documents outline proposed impact reporting metrics for the water and wastewater, waste and resource efficiency, and low-carbon transport sectors (*ICMA 2021b*).

In order to properly identify sustainable financing opportunities, in June 2021 the European Union adopted the first major piece of the detailed EU taxonomy regulation for sustainable economic activities, the Climate Delegated Act on climate change mitigation and adaptation, which provides the basis for sustainable financing in a broader sense (including debt and other forms of financing in addition to bonds) (*EU 2020*).

Table 1
Comparison of green bond standards

	ICMA GBP*	CBI Standard	EU GBS** (planned)
Green Bond Framework/ European Green Bond Factsheet	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments	Use of proceeds Project evaluation and selection process Management of proceeds Reporting commitments
Reporting	Allocation Report (mandatory) Environmental Impact Report (mandatory)	Allocation Report (mandatory) Compliance Report (mandatory) Environmental Impact Report (mandatory)	Allocation Report (mandatory) Environmental Impact Report (mandatory)
External authentication	Green Framework (recommended) Allocation Report (recommended) Environmental Impact Report (recommended)	Green Framework (mandatory) Allocation Report (mandatory) Compliance Report (mandatory) Environmental Impact Report (recommended)	Green Framework (mandatory) Allocation Report (mandatory) Environmental Impact Report (recommended)
Accreditation/ supervision of external certifiers	-	CBI	ESMA

*Note: The content of the reports requested by each organisation may differ. For example, an Allocation Report deemed compliant with an ICMA standard may not be compliant with the other two standards. * ICMA: The International Capital Market Association – is an international non-profit organisation of financial institutions that shapes market frameworks in a self-regulatory manner and represents them to regulators. / ICMA Green Bonds Standard: It forms the basis of the green bond market standards, which seeks to provide guidance for the market on key aspects. ** European Green Bonds Standard: An EU-wide green bond standard, which will be voluntary for issuers, but if they issue a bond under this framework, they will have to comply with binding standards.*

Source: MNB (2022a)

With regard to *Table 1*, it is important to underline that, with the exception of the EU GBS, in the designation of recommended/obligatory categories in the reporting section a voluntary commitment was understood not as an explicit legal obligation, but as an integral part of the framework and expected by the market (*MNB 2022a*).

In addition to the standards and taxonomies above, it is worth mentioning the comprehensive guidance document for preparing impact reports developed by a group of Nordic public issuers (Nordic Public Sector Issuers Position Paper). The document aims to complement the work of the International Financial Institutions. It includes reporting requirements on climate-related physical risks and the Sustainable Development Goals (SDGs) (*NPSI 2020*).

Reporting is becoming more widespread as the green bond market expands, but it also raises a number of concerns, particularly because of the lack of detailed, binding, accountable standards and consistency. Currently, post-issuance reporting is fragmented, and without a common framework it is up to the issuers to decide which metrics to report. The accuracy and reliability of impact measurement and monitoring also has great potential for improvement, as verification and evidence of impacts are often lacking (*CBI 2021*).

A significant proportion of green bond issuers see the use of frameworks as useful, but many market players see impact reporting commitments as a barrier to further green bond issuance. This may be because perceptions of difficulty and costliness are associated with an initially steep learning curve, which is expected to flatten over time as issuers gain reporting experience. The already existing and future initiatives can certainly help this learning process (*CBI 2021*).

2.2. Characteristics of impact reports, related trends

The design of impact reports is significantly influenced not only by regulatory requirements but also by the needs of market participants and the capabilities of issuers, and therefore the market environment should also be considered when analysing the current structure of impact reports. On the whole, there is a positive trend, with more and more issuers preparing impact reports but in a significantly different structure, while investors, supported by regulatory initiatives, expect a gradual improvement in their coverage, quality and comparability.

In the normal decision-making process, investors increasingly consider impact reports as crucial to their financial decisions. Both investors and issuers have highlighted as an advantage of green bonds that the investment can be linked to a specific and verified project. Metrics such as emissions avoided or improved water efficiency allow the investor to demonstrate to its partners how the capital received is being used to achieve sustainability (*Maltais – Nykvist 2020*). As the Green Bond Principles (GBP)[3] require issuers to report annually on the use of bond proceeds and the environmental impacts achieved, it is expected that similar requirements will be imposed on green bond funds as well (*ICMA 2021a*). Two main types of report may be distinguished in relation to green bonds: the allocation report describes the use of the proceeds at the specific project level, and it is also the first step towards the other type, the impact report, and, for the time being, is more common than the latter.

[3] Green Bond Principles. The Green Bond Principles are a set of voluntary frameworks motivated and aimed at promoting the role of global securities markets in financing progress towards environmental and social sustainability (*ICMA 2021a*).

An increasing part of the market is producing impact reports, although full market coverage is still a long way off. Based on the responses of market participants surveyed by the CBI, 77 per cent of issuers prepared allocation reports on the use of proceeds, while only 59 per cent reported on environmental impacts (*Table 2*) (*CBI 2021*). According to a survey by Environmental Finance, for 2021, 72 per cent of issuers produced impact reports, meaning that the majority of "green" projects already have environmental impacts reports, making it a common market practice, but coverage needs to be improved (*Environmental Finance 2021*).

There may be several types of issuers representing themselves on green or sustainability bond market. They have different backgrounds and motivations for preparing impact reports. Issuance by financial institutions is common, but sovereign, non-financial or government-backed entities also play a significant role among issuers. The utilities and the energy sector are the largest contributors to corporate sector issuance, with more than 30 per cent of issuance stemming from these two sectors (*Environmental Finance 2021*). In general, large issuers are more likely to publish their environmental impact measurements and data. The main reason for this is that larger companies have more resources and are thus better able to cope with the increased burden of disclosure. In addition, such companies tend to be more stable issuers in the green securities markets, so their long-term strategies are better suited to the development of a proper reporting framework. Furthermore, the regulations often set expectations and more stringent principles for larger companies in the first place. Financial institutions are the top reporters, with more than 90 per cent of them producing at least allocation reports, but development banks and local governments are not far behind (*Environmental Finance 2021*).

The issuers are dominated by European and North American entities (*CBI 2021*). These regions have the most developed financial and, to a certain extent, climate protection cultures, where proactive regulation and strong investor (and public) pressure can support the development of reporting.

Table 2
Prevalence of reporting structures

	Report types			
	Allocation report	Impact report	Both	At least one of them
Proportion of reporting issuers, %	77	59	57	79
Proportion of bonds issued by reporting issuers, %	77	63	62	78
Proportion of issued volume by reporting issuers (billion USD), %	88	74	73	88

Note: The reporting coverage is the stock of green bonds issued between November 2017 and March 2019 and included in the Climate Bond Green Bond Database. The total universe is made up of 694 bonds from 408 issuers, amounting to approximately USD 212 billion. Loans and securitised assets are not included.

Source: Based on Climate Bond Initiative (2021)

Green projects in different sectors have different environmental impacts, which has an effect on the design of the relevant impact reports. In emerging markets, the energy sector dominates the use of green bond proceeds. Nearly two thirds of the resources acquired in these markets are used in the energy and transport sectors, but there are also significant uses in water, property and waste management (*Environmental Finance 2021*).

The financial backgrounds, resources and needs of the users of impact reports also vary widely. Issuer impact reports are currently used mainly by large green investors, central banks and fund managers. They can also optimise their investments on an impact basis and provide information to their end investors. There is strong demand from large investors for adequate, comparable impact reporting and they can put considerable pressure on the issuers to do so. Substantial human resources are also allocated to the analysis of impact reports.

2.3. Existing challenges and development points

The Central Bank of Hungary (Magyar Nemzeti Bank, MNB) is also present as an investor in the green bond market, and so we have tried to summarise the difficulties and challenges that investors currently face in this segment of the securities market, based on the MNB's experience. The MNB has produced impact reports in a number of ways and on a number of occasions in recent years, such as the impact analysis of the green bond portfolio within the foreign exchange reserve, published in 2021 (*Elek et al. 2021*) and 2022 (*Paulik – Tapaszti 2022*).[4]

[4] In addition, in 2022, the MNB published its climate-related financial disclosure, based on the recommendations of the Task Force on Climate Change Financial Disclosures (TCFD) (*MNB 2022b*).

The primary purpose of impact reports is to provide investors with the right information to help them allocate resources between issuers and projects, i.e. they are prepared ultimately for investors, to convince them and support their work, so that optimal investment decisions can be made from a green perspective. To do this, the investors need to have ex ante and, where possible, ex post impact reports available in a comparable, standardised format for a possibly large proportion of issuers and projects at regular intervals.

According to the 2021 research of Environmental Finance, more than 90 per cent of the investors surveyed said they consider the impact reports of bond issuers and green bond funds to be "crucial", and more than half of them said they are deterred from further investment in bonds that are characterised by poor impact data and the impact reports that such data lead to (*Environmental Finance 2021*).

2.3.1. The environmental impacts of green bonds are building blocks in the green strategies for transition

Projects financed by green bonds are ideally "building blocks" of the environmental objectives explicitly defined in the issuing entity's green strategy, i.e. the green investments are part of a larger strategy. However, our experience so far suggests that the green strategies of the majority of issuers are not yet sufficiently developed to enable investors to judge the usefulness of individual green projects within this higher-level framework.

Of course, most of the large issuers already have some kind of strategy supporting net-zero/emissions reduction/transition in place, but the level of detail varies. The desired green strategic status would be an emissions reduction plan explicitly supporting compliance with the 1.5/2 degrees Celsius targets, in a form validated and benchmarked by an external body (i.e. showing the deviation from the emissions reduction pathway calculated from the "sub-division" of the major targets committed to in the Paris Agreement).

The organisations supporting and monitoring the development of the green strategy include TPI (Transition Pathway Initiative), SBTi (Science Based Target initiative), GFANZ (the Glasgow Financial Alliance for Net Zero) and CA100+ (Climate Action 100+). There are many differences in the methodologies and assessment systems of these organisations, but their objective is broadly the same: to provide a framework within which the credibility of the climate commitments of these entities can be assessed, alongside the ability to identify and manage the financial and environmental risks/opportunities inherent in the transition to low emissions. In short: Is the climate plan undertaken by the company sufficient to meet the Paris targets, and does the company have the commitment, financial, technological and human resources required to realise it?

From the perspective of the main topic of this paper, it is therefore worth highlighting that while green bond impact reports are valid on their own and may even show the adequacy and quality of the projects, it is desirable to assess environmental impacts at a higher level, in order to maintain the integrity of the green bond market, in the interest of a more holistic perspective.

The following section looks in detail at the main challenges related to impact reporting.

2.3.2. Regulations

As already discussed, identically to the Hungarian market, there is currently no explicit international regulation on the obligation and form of an allocation report or impact analysis for green bonds. This may change in the near future with the adoption of the EU Green Bond Standards (EU–GBS), where certain conditions are already legally required[5] (*EC 2019*). For the time being, however, the reporting of impacts is somewhat based on self-reporting and defined by standards voluntarily undertaken by the issuers. It is important to underline that the current standards are voluntary for the issuers, but still represent some level of commitment, so the recommended points they contain are not completely arbitrary. At the same time, the degree of freedom of feasibility of the points contained in the standards is high, affecting the time interval, structure, etc.

2.3.3. Challenges in relation to the data appearing in the impact reports

The shortcomings of green impact reports, the lack of standards, the difficulty of comparability and other technical problems have already been mentioned several times in this essay. It is important to stress that this is far from always being the fault of the issuers, as the publication of impact reports at this level of detail is a new phenomenon in the capital markets, and thus it takes time to develop, understand and implement protocols and quality assurance.

One of the weaknesses of sustainable finance concepts, whether we are talking about impact investing or other forms of ESG, is the challenges related to data: sometimes there is even no data, or often it is not collected and published in a systematic way; there are no data providers or widely accepted estimation methods.

There is an old adage that can be applied to sustainable finance as well: you can only manage what you can measure. However, it should also be borne in mind that if the measurement is wrong or deliberately biased, the decisions based on it are less likely to achieve their real purpose. Accordingly, it is one thing to accept

[5] However, in the first instance, the issuers will not be obliged to issue green bonds in this format, even within the EU.

exactly what needs to be measured, but another equally important question is how to measure it and ultimately how to arrive at the desired value of the given green indicator. The latter should also be presented transparently to avoid greenwashing (*Alogoskoufis et al. 2021*). Greenwashing is the term used to describe activities that risk making unsubstantiated and misleading claims of environmental benefits, i.e. the practice where a company communicates positively about its environmental performance, but its actual environmental performance has negative impacts (*Delmas – Burbano 2011*).

Looking at the user side of the reports prepared by issuers, the impact reports to be prepared by fund managers may also involve several technical difficulties. Investors often have to collect the reports related to the green bonds in their portfolio individually, for example from the issuers' websites. This is a very time- and resource-consuming process for a large portfolio with many securities. One solution to this problem can be for example the service provided by the company of Green Assets Wallet, which collects published impact reports in a common database; however, if there are uncertainties in the input data, the resulting databases will also not be perfect. In the following, we focus on methodological issues related to data and other technical factors.

How impacts are reported depends, of course, in the first place on the type of project: different indicators may be expected for a renewables project than for a waste management or adaptation project, for example. For example, *Table 3* highlights some important indicators per project (*NPSI 2020*).

Table 3
Key indicators for each green project

Renewable projects:	
Energy production capacity	MW (megawatts)
Annual renewable energy production	MWh (megawatt hours) or GWh (gigawatt hours)
Annual GHG emissions avoidance/reduction	CO_2 equivalent* in tonnes
Green buildings:	
Annual energy use avoided – compared to national average standards	kWh/m^2 or percentage (%)
Annual energy use reduction compared to the pre-investment status (in the case of renovation)	MWh (megawatt hours) or GWh (gigawatt hours)
Annual GHG emissions avoidance/reduction	CO_2 equivalent in tonnes

Table 3
Key indicators for each green project

Transportation:

Annual GHG emissions reduction/avoidance	CO_2 equivalent in tonnes
New railway lines, cycle paths, etc.	km
Estimated car use reduction	km

Adaptation projects – investments to help adapt to inevitable negative impacts of climate change:

Protection against heat waves (protected area)	m^2 or number of protective devices
Protection against storms (protected area)	m^2 or number of protective devices
Resilience projects against other elements	capacity (for example water diverters, etc.)

*Note: GHG – greenhouse gasses, * Based on the strength and persistence of the greenhouse effect, the effect of each gas can be "converted" into a carbon dioxide effect.*

It is important to note that these indicators are only examples; as the sophistication of the impact reports increases, the number of relevant indicators may also increase somewhat by project type. It is essential that not all material environmental impacts can be quantified with sufficient precision, so a qualitative presentation of projects can also deepen the knowledge needed to evaluate projects, but in general, issuers should aim for a quantitative presentation.

As shown in *Table 3*, there are indicators that are interpreted in absolute terms, such as energy production or the commissioning of energy production capacity. These indicators are characterised by their relative accuracy, although in the case of intermittent renewables the ex ante determination of energy production is always based on baseline assumptions due to the year-to-year variability of the weather (number of sunny/windy hours in a given area). This is why it would be also beneficial to publish ex-post reports, where the issuer can report on the energy production already achieved. In the case of capacity indicators, this is not a problem in most cases, as the peak capacity can be explicitly determined. However, the resulting production naturally varies from one geographical location to another, e.g. solar panels in Germany produce on average around 10 per cent efficiency per year compared to the peak capacity, while in Spain this can be more than double on average (*Aszódi et al 2021*).

Currently, one of the least funded areas is adaptation projects, partly due to the difficulties in directly defining technological solutions and the less explicit nature in terms of environmental impacts. However, their role may increase in the coming decades, as in the absence of a significant global emissions turnaround, the pace and magnitude of climate change may become increasingly drastic even within a few years, making adaptation, even at high costs, inevitable. In the worst-case

scenario, warming could reach a level where mitigation projects may be sidelined for rational reasons ("race to the bottom" scenario).

2.3.4. Indicators interpreted against an emissions benchmark

In addition to absolute indicators, indicators describing the environmental impact relative to the emissions baseline scenario are very popular. In the vast majority of cases, these are the most prominent indicators in issuer/investor impact reports, as they are the most publicly relevant on the one hand and they are the financial impact that is "translated" into relevant environmental indicators on the other.

In the examples shown in *Table 3*, this is the so-called "avoidance or reduction of carbon dioxide equivalent per tonne". As the name suggests, we are talking about emissions avoidance/reduction relative to some benchmark emissions, which has two basic cases: when the *emissions reduction* can be directly identified in the case of the operation of the entity (for example, in the case of a property renovation project, the reduction relative to the carbon emissions from last year's consumption); and when we are talking about *emissions avoidance* relative to some reference baseline or benchmark. The reference emissions are therefore what the emissions level would have been if and when the green project had *not* materialised, i.e. if the traditional, fossil-based technological solutions of the past had not been *substituted*. A fundamental question is which fossil energy sources will be substituted and in what order.

It is therefore easy to understand that the impact of the avoidance/reduction demonstrated by the issuer is influenced not only by the impact of green projects, but also by the definition of the reference pathway (substitution parameter). The lack of standardisation is perhaps most pronounced in the definition of baselines, which can be reflected in the very different values across regions. It is important to stress that this can be seen as natural to some extent, as the energy mix varies from country to country (for example, France has a high share of near-zero emissions nuclear energy), the quality of existing real estate assets (the EU's northern part already has a better energy efficiency of buildings), the current energy efficiency of different sectors, and so on. Obviously, the relative emissions avoidance impact of a new renewable project in a region that is already fundamentally greener will be smaller than that of a green project in a predominantly fossil region (e.g. Poland due to coal dominance). In the former, for example, gas-fired power plants could be substituted, while in the latter, the most polluting coal-fired power plants could be slowly phased out of the energy market.

This phenomenon also points to the need for global coordination at a higher level of abstraction, since, assuming that developing countries rely more on cheaper fossil energy, it makes a difference in terms of emissions reduction efficiency in which region a green investment to substitute existing energy production is implemented

(not to mention that the cost of green projects may be even lower in developing countries). Unfortunately, there is currently only little global coordination – realised mainly through large global development banks and UN initiatives.

As already stressed, the determination of baseline reference emissions is rather hypothetical and based on scenario analysis. In most cases, a fossil power plant is not taken off the grid when a renewable project starts to generate power, all the more so because, for example, the European electricity market is integrated to some extent (depending on cross-border capacities), so it would be difficult to clearly identify the incoming and the ceasing energy generation. Not to mention the fact that energy consumption (electricity) may even rise in the EU under the green strategy, so it is not even certain that fossil production units can be phased out at all. In such cases, the calculation becomes even more difficult and complex, especially as a green project once implemented will run for many years. In other words, the positive impact may be higher at the beginning, while later on it may decrease year by year due to the greener overall operation.

Hence, the differences in the relative emissions impact of green projects in different regions with almost identical technical parameters are not only due to the existing, fully justifiable parameters (e.g. the existing energy mix) but also to the calculation methods of the baseline/substitution parameter itself.

2.3.5 Other methodological issues

In addition to the aspects outlined above, there are still a number of questions regarding the reporting methodology, which we believe are also key to the further development of the market:

- *Data published at different levels:* Some issuers disclose environmental impacts at the individual bond level, but most of them only disclose portfolio-level data for the entire project. So, while some issuers directly disclose the impact share attributable to green bond financing, which makes the life of the investors much easier, others disclose the total impact of projects, preferably showing the corresponding shares (green bonds vs. normal bonds in the project) separately. Publication at the bond level can be more complicated for large issuers that finance many projects in parallel, making it more difficult to track the source of funds raised from each bond. This can sometimes result in a flawed methodology, whereby the reported impacts cover a wider range of projects than those financed by the green bond(s), and the impact of the part financed by green bonds is not clearly defined. At the other extreme, the impact is presented on a loan-by-loan basis where it is not possible to aggregate these impacts. In the absence of methodological background documents, it is also questionable whether the projection basis is the loan granted or the loan disbursed in such cases.

For investors, of course, the ideal solution would be to report on a per bond basis, with impacts even per unit of invested resources (e.g.: 400 tonnes of CO_2 avoided/1 million euro invested, etc.), but this would understandably place too heavy a burden on issuers, and in extreme cases could discourage them from issuing green bonds. Finding a good balance is therefore an important task for the future.

- *GHG dominance:* The most widely used indicator among issuers is GHG impact/avoidance. However, in many projects, GHG is not the indicator that best captures the environmental impact of the project. Water projects, which have a negligible GHG impact, are a good example, but they are also valuable and indispensable for the green transformation as well.

- *Time:* This refers both to ensuring comparability over time period, and to the time required for the impacts of the implemented green projects to "manifest" in the impact report. Investors currently face serious challenges in this respect: in some reports, it is not possible to properly separate the green projects already underway from the impact of the projects financed by the funds newly raised. In addition, the reports are not produced at the same time, nor do they cover the same period.

- *Regional differences*: As already indicated, similar projects in different regions have very different impacts. This may be partly due to the intuitive approach that the impact of projects in less developed regions is greater than in developed economies. On the other hand, the different calculation methodology or the entity/service provider performing the calculation may also be an explanation. Without detailed knowledge of the methodologies, it is difficult to decide whether the discrepancy is based on a legitimate methodology or greenwashing.

- *Transparency:* The methodological details and the data published in reports are often not well supported by data sources and methodological descriptions. Among the data published with high dispersion, it is therefore difficult to decide which are outliers and which are realistic effects. This can be helped by transparency, which is particularly true for developments related to environmental sustainability, for which this is an essential condition, either at the starting point or in measuring the impact of the steps taken (*Kolozsi et al. 2022*).

- *Separation:* Green financial instruments are often used by issuers for refinancing. This may cause further difficulties if one project cannot be sufficiently separated from the other, as it will be difficult to aggregate data across different reports and projects.

On the whole it can be said that the challenges outlined above create considerable uncertainty for investors. This can take the form of questions such as: Why has the portfolio's climate impact improved compared to the past period or to a benchmark? Is this due to a re-weighting, some kind of data error or simply a coincidence? It is not yet possible to answer these questions in all cases, so the changes in the climate-related risk performance of investments are often difficult to explain.

2.3.6 Risks of greenwashing

With the shift in investor attention or "shifting" by the regulations towards sustainability and the potential easier/cheaper source of financing that this may bring, the question may arise as to whether issuing entities may be implementing projects that are green only on the surface. Or the project is truly green, but the company is not making any effort to make the transition, and it is just a PR project, giving a false impression or misleading information about how environmentally friendly the company's products and operations are on a higher level. As for green bonds, research by the *CBI* (*2021*) suggests that the vast majority of issuers have now made at least their allocation report available – and mostly within the GBP recommended timeframe. Based on the environmental reports on the issues, no transactions have been excluded from their green bond database, suggesting that the issuers are indeed financing green projects/assets in a proper and promised way.

2.4. Impact reports in practice

2.4.1. Case study: avoided GHG emissions calculation for a large German bank

The bank included in our study is one of the most important agricultural development banks in Germany (Rentenbank), which invests the funds raised from green bonds mainly in renewable green projects (wind energy installations, photovoltaic panels on agricultural sites). The green bond impact report was prepared by the Center of Solar Energy and Hydrogen Research Baden-Württemberg and was based on the columns of installed power and electricity generation (*Table 4*). As already indicated, these numbers form the fully objective categories of the reports, while the numbers in the last column are based on the reference emissions figures against which the emissions avoidance is achieved (*Rentenbank 2021*).

Table 4
Excerpt from Rentenbank's impact report

	Installed power (MW)	Electricity production (GWh)	GHG emissions avoided (t CO_2eq)
Photovoltaic installations	1,670.8	1,464.7	1,003,900.0
Wind energy installations	3,502.8	6,390.5	4,820,700.0

Source: Rentenbank (2021)

Based on *Table 4*, the GHG avoidance per GWh is 685 tonnes for photovoltaic and 754 tonnes for wind energy installations. Given that the average German CO_2 emissions per GWh of production are currently in the range of 350–400 tonnes[6] (with some year-to-year dispersion due to some fluctuations in renewable generation), these figures may even seem a bit high, so it is worth looking at the methodology more closely.

In Germany, the key parameter for carbon dioxide avoidance calculations is the so-called "substitution factor" (SF in per cent, *Umweltbundesamt 2020*). As can be seen from the formula below, which quantifies gross carbon dioxide avoidance, the other parameters can be considered relatively objective, and the estimation error is therefore minimal. In the formula that gives the gross[7] carbon emissions avoidance for a given volume of renewable energy production, the numbers that can be well calculated are:

RE: Renewable energy production */ FE_d and FE_{id}*: Direct and indirect, entire value chain carbon emissions from fossil energy production / *fee* (*%*): fossil energy efficiency, i.e. what percentage of the primary energy is utilised.

$$E_{a,gross}[t] = RE[GWh] * \sum SF[\%] * \frac{FE_d[g/kWh] + FE_{id}[g/kWh]}{fee[\%]}$$

This formula therefore captures the proportion of green-fossil substitution: the energy (GWh) produced by renewable projects that substituted for each and each fossil energy production method in a determined proportion and, as a consequence, the avoidance of carbon dioxide produced by the given fossil production method. The key is therefore to define the SFs, i.e. the proportion and extent to which the projects in question substitutes for fossil-based production. The general approach to substitution by solar power in Germany is shown in *Table 5*.

[6] https://ourworldindata.org/grapher/carbon-intensity-electricity?tab=chart&country=~DEU
[7] Gross value because the production of renewable capacity also generates carbon emissions.

Table 5
Substitution factor for photovoltaic installations in Germany

%	Nuclear energy	Lignite	Hard coal	Natural gas	Oil
Photovoltaic panels	0.5	17.5	49.4	32.6	0.0

Source: Umweltbundesamt (2020)

Accordingly, the incoming renewable energy generation replaces 0.5 per cent of nuclear energy production, 17.5 per cent is lignite based energy production, and so on. This is, of course, an expert estimate, since, as detailed above, exact figures are not available due to the complexity, size and dynamic nature of the system. Of course, the higher the proportion of lignite and hard coal in the parameter estimate, the higher the avoided carbon dioxide emissions, as these are the most emissions-intensive energy production modes. Naturally, individual issuers can still adjust this general estimate if they believe it is justified.

The calculation of gross carbon avoidance also needs to be adjusted for the embedded full-life-cycle carbon emissions of renewable energy production, as the production, installation, etc. of photovoltaic and wind energy installations also come with CO_2 emissions. This can also be seen as a relatively objective calculation, although there are still many challenges, for example in the large-scale recycling of photovoltaic panels. Currently in Germany these figures are 56 g CO_2/kWh in the case of solar and 17 g CO_2/kWh in the case of wind energy installations (without adding any energy storage capacity), which are far below, for example, the emissions of up to 1,000 g CO_2/kWh from coal-fired power plants.

2.4.2. Defining the Nordic reference pathway for impact reports

The *NPSI* (*2020*), which describes the proposed calculation procedure for specific green bond impact reports, adopts a somewhat different "big picture" approach from the German example, with the clear advantage of simplicity. Accordingly, green projects in the region can use the following reference pathway (baseline emission) to calculate avoided emissions (*NPSI 2020*): *CM* (*combined margin*) *= OM + BM.*

OM (operating margin) is the emissions of the current generating capacity for which the substitution for the generation is likely to occur in the current dispatch hierarchy. (That is, the order in which fossil production methods are replaced.) BM (build margin), on the other hand, is intended to capture a future state, namely the future emissions that will accompany the operation of energy production. Of course, the model (which is based on countries' commitments) assumes that energy production will become greener and greener, so that the "impact" of substitution

will decrease steadily over the life cycle of green projects. The key in this model lies in the weighting of the two factors, which as currently proposed looks like this:

$$CM\ (315g\ CO_2/kWh) = 0.5*OM\ (476g\ CO_2/kWh) + 0.5*BM\ (154g\ CO_2/kWh)$$

On the whole, therefore, there is a distinction between indicators in terms of the objectivity of reporting, some indicators are more specific, while others have more significant estimation assumptions. This is of course not a problem, but the investors need to be aware of these parameters, as in many cases it can be difficult to compare the impacts of green projects on a one-to-one basis.

2.5. Experiences with Hungarian green mortgage bonds

The Hungarian green bond market is still at a relatively early stage of development, and thus the available impact reports are also characterised by the challenges of the learning phase (*Bécsi et al. 2022*). Accordingly, in Hungary (in line with the EU), there is currently no legal requirement for reporting; it is based on self-declaration, so no uniform best practice has been established. Allocation and impact analyses are typically a few pages in length, describing the characteristics and impacts of a given project. In terms of indicators, they are dominated by data on carbon dioxide emissions, but indicators linked to the Sustainable Development Goals (SDGs) have also started to appear.

The challenges are thus fully in line with those faced by international issuers, but the lack of stronger energy efficiency data and reference pathways forces issuers to use even more estimation parameters. As the report by OTP Jelzálogbank[8] notes, "...there is, among other things, a lack of data; where data exists, the reliability of data quality is low, additionally, given the lack of experience and established good practices there is no consensus related to the share of the client – financed by the financial institutions – emissions that the banks are responsible for" (*OTP Jelzálogbank 2021*).

In the following, we would like to highlight some important aspects from the green mortgage bond reports of OTP (*OTP-J 2021*), Takarék (*TJ 2021*) and UniCredit (*UniCredit-J 2022*) (*Table 6*). In the first instance, even the selection process for green loans differs, as the surveyed banks apply differently strict criteria to determine what they consider to be eligible for green real estate financing. This will of course affect the extent of the published impacts – banks that are "more lenient" in the green aspects are likely to publish lower impacts. However, as we have already indicated, the question of "energy efficiency improvement, but relative to what", i.e. the definition of the reference pathway, is at least as important: while OTP, for example, considers the energy consumption/environmental impact of all non-green

[8] mortgage bank

projects in its own loan portfolio as the baseline, the other two issuers use a less precisely defined national building stock benchmark (*Mihálovits – Paulik 2022*). The OTP report can be considered much more detailed in this respect; they try to provide more data points (indicating estimation difficulties), which is positive, as it makes a step towards transparency.

Table 6
Impact report data on some Hungarian green mortgage bonds

	Green mortgage bond financing (HUF billion)	Avoided energy consumption (GWh)	GHG emissions avoided (t CO_2eq/year)	Tonnes of GHG avoided per HUF 1 bn/year	Tonnes of GHG avoided per EUR 1 mn/year
OTP Jelzálogbank	95	45	10,059	105	41
Takarék Jelzálogbank	97	102	18,761	193	75
UniCredit Jelzálogbank	22	18	3,411	155	60

Source: OTP-J (2021); TJ (2021); UniCredit-J (2022)

As shown in *Table 6*, the impacts per HUF 1 billion of financing show a significant dispersion, which is the result of the two effects already explained – different energy efficiency properties are considered green by each issuer, and the reference pathways differ as well. From an investor perspective, the problem is that it is difficult to compare the results and optimise the environmental impacts.

The conversion of avoided energy consumption to GHG avoidance is not uniform. The GHG avoidance calculated from the GWh avoided also shows a dispersion (183–223 GHG avoidance/GWh), even though the reference pathway roughly represents the domestic housing stock in all cases. This indicator is the unit GWh,[9] which reflects the average emissions load of energy use, which preferably could be estimated with a lower standard dispersion. It is clear, also from this, that standards are the cornerstone of market development.

If we compare the above values with those published by international, mainly Western European covered bond issuers – where the GHG avoidance per EUR 1 million typically ranges from 10–40 tonnes/year – the main difference is mainly in the definition of baseline scenarios: a green loan even with more stringent characteristics can only achieve a lower impact considering the baseline scenario includes buildings with much better average efficiency.

[9] The main driver here is the type of heating.

It is worth highlighting the important aspect that the impact of each green bond is highly dispersive (10–800/900 tonnes CO_2 avoided/year/1 million euro invested), which is mainly explained by the different impact of the green projects financed: while renewable projects have a positive impact of several hundred tonnes per unit of the amount invested, the covered bond (mortgage bond) market analysed represents the lower end of the range. In other words, if in the management of green bond portfolios only a narrow-minded optimisation of the impacts were to take place, it could induce the sale of covered bonds, even though the upgrading of the housing stock is a key area for the green transition (*see also Baranyai – Banai 2022*). On the whole, therefore, the situation is much more complex than can be captured by a single indicator (*Elek et al. 2021*).

3. Future opportunities and conclusions

The impact of regulatory decisions and the consolidation of market best practices is realistic in the medium to long term, but in the meantime, investors need data and procedures to support their decisions. Larger groups of investors, who often have a dedicated "green department" to deal with these investments, often contact emitters directly and discuss the data, requesting any additional information they may have, in an attempt to bypass difficult-to-interpret data and inadequately detailed methodologies. Small investors are in a much more difficult position, as they do not have the resources or the right channels to reach the issuers.

Due to the resource-intensive processing and preparation of the reports and the often inconsistent reporting of the impacts of similar projects, we believe that in general, the areas that need to be improved most in the future are transparency and standardisation of impact assessments. In the long term, only the homogenisation of reports, the creation of a common reporting structure and a centralised platform can provide a solution. In addition, the responsibility of issuers and rating agencies in the process should be increased ("skin in the game"). In addition, reporting and external rating should be made explicitly mandatory, which would strengthen the reliability of the information provided and the confidence of customers. In addition to improving data quality and developing methodologies, issuers and fund managers should be required to meet standards that do not entail excessive costs. A standardised reporting structure and the creation of a common database could help also in this.

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Trends and Dilemmas in Green Financial Capacity Development*

Balázs Sárvári

At the global level, including in Hungary, green finance capacity building is key to ensuring that green efforts can contribute their full potential to achieving a sustainable economy. In this article, we review the current challenges of green finance from the perspective of the scarcity of expert capacity, and then look at the present international good practices in capacity development and the related activities of the Magyar Nemzeti Bank. We conclude with a summary of future outlooks for green financial capacity building in relation to the key players.

1. Introduction

In past decades, humanity has been making increasing efforts to set its development on a sustainable path, taking into account environmental aspects. Weighing up the results so far, we can see that the environmental burden of the global economy has not been substantially reduced. This realisation can lead us to a number of underlying reasons. These may include the lack of financial resources and technological solutions. Perhaps the coalition for climate protection is not deep enough and not enough time has passed since the measures were put in place in order for the positive developments in environmental change to be recognised (*Kutasi 2022; Zöldy et al. 2022*). There is a lack of expertise in many areas, including the young and dynamic field of green finance. The shortage of expert capacity here is due to a lack of knowledge and experience in relation to sustainability among people working in banks, companies and households to effectively pursue green goals in their decisions. The lack of capacity is also reflected in the research and methodological development that underpins the preparation of decisions.

Green finance is a way to increase the level of financial flows (banking, micro-credit, insurance and investment) from the public, private and not-for-profit sectors into sustainable development priorities (*Desalegn – Tangl 2022*). Thus, the only essential difference between a traditional and a green financial instrument is that the latter is in line with environmental protection objectives (*Nyikos 2022*). Green finance, as part of the green transition of the economy, represents a new era of

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Balázs Sárvári is a Senior Researcher at the Magyar Nemzeti Bank and a Senior Lecturer at the Corvinus University of Budapest. Email: sarvarib@mnb.hu

finance that is now in line with ESG considerations, i.e. environmental, social and governance sustainability. Because of its novelty, green finance still faces a number of challenges, not least the need to build the right expertise.

2. Green finance challenges in light of capacity constraints

Viewed from a practical point of view, we can see the complexity of the problem of capacity constraints in green finance. The main areas of green financial capacity constraints are summarised below.

1. *Methodological challenges.* Detailed knowledge of green financial products and the willingness to carry out the associated environmental measurements are widespread in only a few financial institutions (*Kolozsi et al. 2022*). Even in pioneering institutional systems, this expertise is confined to the centres. For projects with an environmental focus, it is methodologically challenging to carry out cost-benefit analyses, while the uptake of green financial products would also require moving beyond this dichotomy itself. One key factor is that economic actors should not only interpret their projects in the traditional return/risk-based approach, but also from a sustainability perspective.

2. *Financial innovation.* To develop green financial products[1] and analyse the impact of new initiatives, securities and fund managers, as well as banks and insurers, need considerable expertise before they can bring new products to market. As green technologies are typically capital intensive (*Papp et al. 2022*), the way to achieve the necessary robust resource allocation is through the development of novel financial instruments. This requires cooperation between investors, lenders and developers, which assumes the presence of green finance experts on all sides.

3. *Government strategy formulation.* The financial system alone is not enough for the green transition of the economy. The government's economic policy and the preparedness of central and local structures are all essential. To illustrate how complex the problem of progress is, take the example of local governments. This organisational level is itself directly involved in achieving energy efficiency. At the same time, it is likely that different motivations and barriers influence their decisions at the national level. To promote green financing, municipalities need targeted incentive packages and calls for proposals. Their development can hardly be confined to the state administration, and this requires the development and involvement of local expert bases in the preparation of programmes. Green finance capacity, therefore, needs to be developed at different government levels.

[1] A prominent group of green financial products is green bonds. The studies by *Bécsi et al.* (*2022*) and *Mihálovits and Paulik* (*2022*) provide a valuable overview of the related steps emphasising their innovative aspects.

4. *Transparency.* As long as we cannot classify economic activities according to a universally accepted classification into sustainability-enhancing or sustainability-threatening clusters (of course, this dual approach can be extended to include additional clusters), there is a risk of profiteering and misleading (*Lee 2020*). There can be many financial benefits to labelling a project as green – this is "greenwashing",[2] which can lead to the misallocation of capital and also reduce confidence in green finance solutions. Currently, verifying the "greenness" of green financial products is mainly done through external expertise (SPO, External review). The European Union's Green Taxonomy (*EU 2020*) represents an important milestone on the long road to addressing this challenge. The development and harmonisation of such standards at the national and international levels cannot be done without expert capacity (*Papp et al. 2022*).

In recent years, we have identified a number of good practices in green finance capacity building. Building on these experiences, effective training and information practices can be developed to provide the necessary background for the development of green finance. In the following sections, we first look at international examples and then at the activities of the Central Bank of Hungary (Magyar Nemzeti Bank, MNB).

3. Good practices in capacity building

In November 2020, the United Nations Framework Convention on Climate Change (UNFCCC) Secretariat launched a series of events under the name Capacity-Building Talks.[3] It is meaningful that out of the four rounds of negotiations so far, one focused on developing countries and one on small and medium-sized enterprises. These thematic choices also illustrate the need to develop green finance capacity at many different levels.

The example of small and medium-sized enterprises is a useful lesson in itself. As these companies are small, they face serious capacity constraints in greening their operations. Like the majority of economic operators, they can be said to already have a lot of information on the topic of sustainability, but they are not ready to apply it and often not even to interpret it. It is up to the experts to outline how the specific institution will be affected by environmental processes at different time scales, and what green finance, specific technologies or partner organisations they can turn to for solutions. Without such expertise, companies become increasingly vulnerable and then uncompetitive. Government funds may be needed to stop this downward spiral. The Dubai Green Fund, managed by the UAE government, is

[2] Frequent translations of the word greenwashing in Hungarian mean "painting green" or "washing green".
[3] Detailed information on the events is available on this page: https://unfccc.int/Capacity-building%20Talks and capacity building in the UNFCCC process organised by the UNFCCC here: https://unfccc.int/topics/capacity-building/the-big-picture/capacity-in-the-unfccc-process

a benchmark initiative in this field. Universities are also important capacity-building institutions, and thus they can also play an important role, even at the local level. In this area, the example of the Kenya Climate Innovation Centre is a case in point. In the international discourse, women-led companies receive special attention. Successful programmes dedicated to them include the Women in Agriculture Impact Investment Facility (*UN 2022*).

Other good practices from international organisations include the Principles for Responsible Investment, an investor network supported by the United Nations (*Lee 2020*). In several cases, the development of voluntary regional standards has been effective in promoting the development of green finance in a given area. Examples of such regional cooperation are the EU Green Bond Standards and the ASEAN Green Bond Standards. The Sustainable Banking and Finance Network (SBFN), supported by the World Bank, is an informal network of banking supervisors and industry associations that promotes green finance knowledge transfer and capacity building. In February 2022, the International Monetary Fund announced its capacity development strategy for the period 2022–2025 (*IMF 2022*) to contribute to the work of central banks and financial supervisors.

One important actor in international green financial capacity building is the Network for Greening the Financial System (NGFS), established in December 2017. In January 2019, the MNB was the first Central European institution to join the network, whose membership has been steadily growing since its creation. Members seek to support environment-related projects by sharing experience and good practices and developing new risk-management tools as well as to support the functioning of central banks and financial supervisors by developing professional skills (*NGFS 2018; Chang 2019*). Members of the network include the Bank for International Settlements and the Sustainable Insurance Forum created by the UN, and the IMF has joined the NGFS as an observer as well.

4. The role of the Magyar Nemzeti Bank in domestic green finance capacity development

Green finance in Hungary does not yet have a strong track record. This new development is reflected in clear capacity gaps in four areas: the existing expert base, the research background, the system for training new experts, and the general awareness of specific financial instruments; all of these four areas need to be developed further. In this context, the MNB is aware of its responsibility to contribute to overcoming these capacity gaps and thus also to promote the development of green finance in Hungary. *Csaba Kandrács* (*2021*), Deputy Governor of the MNB, put it this way: “We need excellent professionals to deliver our programme. It is important to develop young experts in the various sectors and

research centres, in addition to the regulatory and public administration areas, to ensure that sustainability and the links between the financial sector and the real economy are addressed with sufficient staff numbers."

This commitment was first set out in the Green Programme published by the central bank in 2019 (*MNB 2019*).[4] This document organises the MNB's efforts to link environmental sustainability and finance into three pillars. As part of the second pillar, which focuses on capacity building, the MNB has launched and supported a number of education, research and awareness-raising initiatives to contribute to the development of expertise and to exploit synergies between academia and the central bank. The MNB's training and research programmes emphasise interdisciplinary approaches in order to promote the current renewal of the financial profession, and within this, intensive cooperation between economics and natural sciences is particularly encouraged. These good practices are summarised below (*Matolcsy 2022*).

4.1. The MNB's green financial education activities

The green finance education activities implemented by the MNB aim to support the development of green finance courses that fit the educational profile of each partner institution.

- In collaboration with the Budapest University of Technology and Economics (BME), the focus is on the financial approach to sustainability. The concrete steps include the preparation of a green financial and accounting specialisation and participation in the implementation of the sustainability programme of the Liska Tibor College.

- The partnership with the John von Neumann University (NJE) is based on the objective of cooperation opportunities and applicability for the green transition, with a range of interdependent green finance courses[5] and student competitions.

- The partnership with the Research Centre of the Faculty of Economics of the University of Szeged (SZTE) and the Institute of Finance and International Economic Relations approaches sustainability from an economics perspective and introduces students to this field through a range of interrelated courses.

- An intensive green finance course is also part of the Budapest Metropolitan University's continuing professional development programme for financial regulators and supervisors.

[4] The MNB also contributes to the achievement of the sustainability goals via a number of other initiatives. These include, among others, the MNB's Green Monetary Policy Toolkit Strategy, the FGS Green Home Programme, and the addition of green reporting requirements to the MNB's collateral management system.
[5] These include the Green Finance course which is part of the newly announced MNB Institute's Master of International Economics and Business.

- The course "Sustainable Economics of the Future" at the University of Debrecen (DE) demonstrates how green finance can be applied involving a range of disciplines. The mandatory literature for the course includes the textbook The Sustainable Economics of the Future (*Virág 2019*), also by MNB authors.

The MNB's non-university training partners include the Budapest Institute of Banking (BIB), which provides training for experts with experience in the financial institution sector. The MNB and its partner organisations help the public to become knowledgeable about green financial products through a variety of channels.

4.2. The MNB Green Research Workshops and the Green Finance Science Awards

The results of green finance research are important shapers in the development of the field. As this is a new area, special incentives can be provided to speed up the process to give green finance the focus it deserves in academic research. Such incentives include support for the launch of new research and recognition of talented researchers with outstanding impact.

4.2.1. Research Workshops

One of the ways in which the central bank supports the start-up of new research is by establishing partnerships with existing research communities.

One of these is the Green Finance and Green Economy Research Workshops, realised jointly with BME. In some topics, the researchers focus on the policy context, in others on the development of the waste management market or on possible business strategies for a circular economy. Research projects such as the development of an electric vehicle calculator,[6] the production of a Smart Map of Hungary[7] and the MNB Solar Energy Forum[8] have already been implemented.

Building on the previous educational collaboration, in 2021 the MNB and SZTE signed a formal cooperation agreement, which also provides opportunities for joint research projects. In addition to its existing research networks, the MNB seeks to maintain active links with other research groups and foreign institutions.

[6] The calculator supports the estimation of the total cost of vehicle ownership and thus helps to compare the unit and total costs of different vehicle types and modes of operation. The calculator is available on the following websites: https://www.mnb.hu/fogyasztovedelem/csaladi-zold-penzugyek/zold-gazdalkodas-otthon/kozlekedes/zoldkerek-alkalmazas, https://kozlekedes.bme.hu/2022/08/15/elindult-a-zoldkerek/.
[7] The aim of the project was to transform the geospatial data of Hungary into a unified data system, which prepared the ground for further research.
[8] The aim of the programme was to develop a complex set of indicators to measure the market integration of weather-dependent power generation.

4.2.2. Scientific awards and research funding

The Green Finance Science Awards and the Green Finance Research Initiative were established by the MNB in 2021 to recognise the achievements of international and domestic researchers with outstanding impact and promising young talent, and to enhance new research initiatives. The scientific awards also include the International Green Finance Lifetime Achievement Award, which the MNB awards to researchers who have made a global impact. The prize was awarded in 2021 to Naoyuki Yoshino, Professor Emeritus at Keio University in Tokyo, and in 2022 to Sean Kidney, Co-Founder and CEO of the Climate Bonds Initiative and Professor at the SOAS Centre for Sustainable Finance. To incentivise new research, available grants include the Green Finance Research Initiative, for which researchers can submit research proposals.

4.3. MNB action for wide dissemination of information

General information for households is also an important segment of green finance capacity building, as demand for financial products is stimulated by increased consumer awareness and confidence. To this end, the MNB has launched the Family Green Finance Programme[9] initiative, which shows how to make environmentally conscious choices by linking them to everyday life situations. The Green Financial Product Finder service, which is currently under development, aims to provide information on domestic green financial products in a comparable format and accessible to the general public, thus helping to promote these products and increase the knowledge of retail customers.

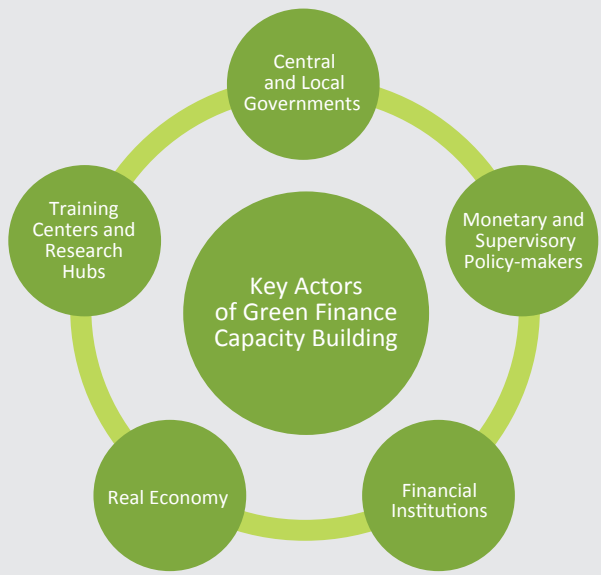
5. Reflections on the next steps for green finance capacity building

In recent years, green finance initiatives have already demonstrated their potential for significant impact in terms of putting the economy on a sustainable path. To capitalise on this, further green finance development is needed, and one of the keys to this is well-designed capacity development. According to *Ma Jun*, Chair of the NGFS Microprudential and Supervisory Working Group, capacity building should serve a dual purpose: on the one hand, it is necessary to develop the levels of decision-makers and preparers to take proper account of the green finance dimension, and on the other hand, it requires a broader expert base to develop methodologies and procedures for analysing environmental risks (*Wedell 2017*). These objectives outline a whole institutional web, as decision-making takes place at different levels of the government, banking and real economy, and both financial institutions and academia are essential actors in methodological developments.

[9] Family Green Finance Programme: https://www.mnb.hu/fogyasztovedelem/csaladi-zold-penzugyek

It should also be added that the growth of the green finance market goes hand in hand with the need for an expanding pool of experts, i.e. training new generations of experts is essential for the development of the field. In the following, we look at the key players in capacity development, as shown in *Figure 1*, and their responsibilities and opportunities in this area.

Figure 1
Key players in green finance capacity development



Central and local governments have a strong influence on green finance capacity development at the level of strategy development and the regulatory environment via the formulation of policy guidelines and regulations, and supporting various collaborations. The way in which governments engage in international negotiations and provide incentives to different organisations, including NGOs,[10] is of particular importance. Government involvement is also crucial in the accreditation of different levels of training in general and in the definition of curricula and objectives,[11] especially because training in each country needs to be tailored to its own environmental risks, its industrial structure, its role in supply chains or its existing

[10] The National Clean Development Strategy specifically highlights that in line with the National Core Curriculum, the Hungarian Society for Environmental Education, a non-governmental organisation, also contributes to the implementation of the training guidelines.
[11] This is reflected in the fact that a separate sub-chapter on education and training has been included in the National Clean Development Strategy (2020–2050) (*ITM 2021*).

building stock. It is a canonical statement from green finance experts that the most important factor for a breakthrough in the field is the political will to do so (*Lee 2020*).

Institutions with monetary and supervisory roles also act as a guiding force through strategic guidelines, new protocols and data reporting procedures (*Horváth – Lehmann 2021*). The opportunities associated with these institutions were discussed in *Section 4*.

Financial institutions still lack the proper number of green financial advisors to develop new financial products and measurement methodologies (*Lee 2020*). In addition, their existing capacity is disproportionately distributed and typically concentrated in central offices, leading to regional differences in the popularity of green financial products. The general lending periods are also an important factor in the uptake of this product scope. The longer the time horizon for financial services and internal strategies and back tests, the more scope there is for sustainability-oriented solutions.

In-house training structures in the *real sector* are also increasingly looking at how to protect firms from environmental impacts and turn opportunities to their advantage. At the corporate governance level (business planning, strategy development), sustainability and green finance expertise will become increasingly important. To accumulate expertise in this area, it is important to consider to which specialised organisation (e.g. consultancy firms) or experts (e.g. professional/technical consultants in the real estate and energy sectors) green finance issues are delegated and where they are located on the organigram.

As *training centres and research workshops*, private companies and civil society organisations, in addition to academic actors, can also generate significant added value in the field of capacity development, as they can all be involved in the delivery of courses, training, workshops, curriculum development (from introductory courses to dedicated vocational training) and research. But developing capacity at the academic level is an extremely long process (*Sterner et al. 2012*). Dedicated individuals in the relevant departments of each institution need to study green finance for many years on a continuous basis in order to build up sufficient green finance academic capacity and standardised curricula in a country.

Recognising the challenges and good practices emerging globally, several institutions in Hungary are already training green finance experts. The strategic question before us is what kind of green finance capacity development plan can serve Hungary's interests and the domestic green finance sector. For such a plan to be successful, it is essential to clarify, among other things, whose responsibility it is to develop it, in which areas (from municipalities to insurers), in what numbers and with what

exact skills will be needed, and what international standards should be followed in the process. Answering these questions is beyond the scope of this article, but the search for answers must surely be built on collaboration. This cooperation should combine government, central bank and supervisory approaches, the preferences of the real economy and financial market participants, and the results of natural science and economics.

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A New Perspective on Sustainability*

György Kocziszky

József Benedek – Gábor Nevelős:
Átfogó ökológia. Párbeszéd hit és tudomány között a Laudato si' enciklika jegyében. (Comprehensive ecology. A dialogue between faith and science in the spirit of the encyclical Laudato si'.)
JTMR Faludi Ferenc Jezsuita Akadémia – Jezsuita Kiadó, Budapest, 2022, p. 409
ISBN: 978-963-422-055-2

Concepts favoured by societies and economic policies tend to change from era to era. Clearly, one of the most prominent topics in today's public discourse is sustainability, and the literature discussing this topic in narrower or broader interpretations is continuously expanding by leaps and bounds. In addition to the wealth of books and academic articles, professionals and celebrities also give voice to their well-prepared pros and cons. But there are good reasons for this intense interest.

The geopolitical, social and economic crisis caused by the financial crisis of 2008, the pandemic that emerged in 2019 and the ongoing Russian-Ukrainian war have triggered legitimate worries and fears in anyone with common sense. Therefore, it is reasonable to question the future we face. What do representatives of science and historical Christian churches recommend for the protection of creation? What position does the encyclical *Laudato si' of Pope Francis* take in the matter, and how can it contribute to the sustainability of human life?

In a situation full of fear and dangers to human life, the natural world and the built environment, it feels good to read the conference proceedings of "Comprehensive ecology" published by the *Faludi Ferenc Jesuit Academy*, which bears the same name as the lecture series and discusses the problems of squandering the created world and possible options to find a way out.

Besides its rich content and multi-directional perspective on sustainability, the message of the study volume is clear: *science dedicated to good helps faith avoid being fanatical and superstitious; and faith helps science see the bigger perspective*

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

György Kocziszky is a Member of the Monetary Council of the Magyar Nemzeti Bank and a Professor at the University of Miskolc. Email: kocziszkygy@mnb.hu

and not just the details. We are responsible for taking care of created world, and for this, an ecological rebirth is needed so that we can get to know and rediscover the values of nature and created world. This holistic view is supported by the group of authors, who are theologians, geographers, urbanists, biologists, philosophers and economists.

The 16 studies in the proceedings are divided into 8 individual chapters (Partnership: a dialogue between science and faith; Green economy; Sustainable lifestyle; Ecological crisis; Poverty; Sustainable communities; Environmental change; and Social justice) and send a clear message that the issue is much more complex, and the crisis is not merely ecological.

The two studies framing the first chapter, written by *József Benedek* and *Gábor Nevelős*, present the hypothesis that the classical, i.e. social, economic and environmental, dimensions of sustainable development should be complemented with a spiritual dimension as well. The hypothesis is based on two sources of wisdom, a dialogue between science and faith, based on the comprehensive ecological views of Pope Francis' encyclical *Laudato si'*. According to the authors, ecological rebirth reinforces sustainability efforts, and incorporating sustainable perspectives into the functioning of society promotes ecological conversion.

The two authors of the second chapter (on green economy), *Sarolta Laura Baritz* and *György Kocziszky* write about the misdirection of economics and the need for a new paradigm, i.e. maximising the common good, instead of maximising profit as a sole objective. Contrary to the opinion of many, globalisation does not guarantee the common good due to the geopolitical and economic centres it creates, and in their target system, sustainability efforts do not or merely virtually appear.

The studies on the third topic by *Klára Csiszár* and *János Zlinszky* provide a detailed discussion of unnecessary overconsumption and the depletion of resources. The authors deliver a clear and well defined message, i.e. our current lifestyle is not sustainable, and it destroys life.

The authors of the studies in the fourth chapter dealing with the ecological crisis, *Zsolt Hetesi* and *Tibor Görföl*, examine the issues of biosphere destruction, soil depletion, climate change and interdependency. The authors clearly consider it necessary to face ourselves and rethink our values.

According to the fifth chapter, by *Gergely Rosta* and *Miklós Vecsei*, on the relationship between poverty and the environment, global warming is caused by the wealthier part of the world, and it should be a basic goal to harmonise income disparities and eradicate poverty. For this question, the Hungarian Charity Service of the Order of Malta brings some worthy examples to follow.

The sixth chapter by *Géza Salamin* and *Csaba Török* focuses on the problems of sustainable communities and cities, and the model of the sustainable city. The topic is particularly relevant as 55.3 per cent of the world's population lives in cities, where we can observe multiple problems of ecology, demography and migration, the inequality of income and wealth, and disorientation due to a distorted liberal perception.

As the seventh chapter by *Balázs Nagy* and *Ferenc Patsch* puts it, the presence of humans causes slow healing wounds to nature. Balázs Nagy summarises the environmental changes of certain geographical regions supported by rich illustrations. The other author of the chapter, Ferenc Patsch, examines the possibility of a paradigm shift through Martin Heidegger's guidelines and critique of technique. The authors urge the implementation of changes in the way of thinking, attitude and technology.

The eighth chapter by *János Székely* and *Márton Péti* is centred on social justice vis-à-vis a false view of life hindering social justice. The reasoning is supported by the fact that 84 per cent of goods are consumed by the wealthiest 20 per cent of the world's population, whereas the poor consume only 1.4 per cent of goods. As Márton Péti summarises his findings, a very significant message of comprehensive ecology is that our most important focus should be the fair treatment of people and society when emphasising the careful management of the Earth's resources.

The main merit of this appealing book of studies is that it shows the way to a beneficial and progressive dialogue between the practitioners of science and religion about the future of humanity.

The book encourages readers to re-read certain chapters and give them further consideration. Its holistic approach helps us realise that a paradigm shift is needed for a sustainable life. The studies provide not only intellectual, but also spiritual growth to their readers. This well-edited book with its aesthetic design and sophisticated graphics is heartily recommended to people who consider themselves thinkers.

The Central Bank of the Future is Green – Sustainability and Monetary Policy in Hungary*

Géza Sebestyén

Norbert Kiss-Mihály – Pál Péter Kolozsi:
Monetáris politika a fenntarthatóság jegyében – A Magyar Nemzeti Bank tanulmánykötete a zöld monetáris politikai eszköztár első évéről[1]
(Monetary Policy for Sustainability – A Book of Studies by the Magyar Nemzeti Bank on the First Year of the Green Monetary Policy Toolkit)
Magyar Nemzeti Bank, Veszprém, p. 169
ISBN: 978-615-5318-56-6

With global temperatures continuously increasing, droughts occurring more and more frequently in recent years and floods, hurricanes and other natural disasters taking place almost on a daily basis, it has become imperative to treat policies addressing the quality and condition of our natural environment as top priorities. Having chased economic growth, GDP and per capita income indicators, humanity has entered a new era: the period of sustainable growth, or at least in terms of the goals.

However, setting the world on the path of sustainable growth requires serious intellectual and material resources. According to World Bank estimates, infrastructure investments amounting to nearly USD 90,000 billion are needed globally to achieve climate targets between 2015 and 2030. Such an investment volume can only be realised if funding is ensured, which necessitates support from banks, banking systems, regulators and central banks. The importance of this issue has also been recognised by the management of the Central Bank of Hungary (Magyar Nemzeti Bank, MNB).

In many respects, sustainable monetary policy and the toolkit for the green monetary policy were developed and introduced in Hungary with outstanding precision and speed, even from an international point of view. The events and observations of the first year of the green turnaround by Hungary's central bank are

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Géza Sebestyén is the Head of Economic Policy Center of Mathias Corvinus Collegium, and an Associate Professor of the Department of Macrofinance at Corvinus University of Budapest. Email: sebestyen.geza@mcc.hu

[1] Available at: https://www.mnb.hu/letoltes/monetaris-politika-a-fenntarthatosag-jegyeben-a-magyar-nemzeti-bank-tanulmanykotete-a-zold-monetaris-politikai-eszkoztar-elso-everol.pdf

described in *Monetary policy for sustainability – A book of studies by the Magyar Nemzeti Bank on the first year of the green monetary policy toolkit*, edited by Norbert Kiss-Mihály and Pál Péter Kolozsi.

The chapter *International developments in green central bank programmes and practices* presents the sustainability measures of the world's largest central banks. As the authors highlight, the increasing number of negative effects of climate change, rising global temperatures and the related natural and material damages have made it clear to central banks that they must play an active role in catalysing sustainable economic development.

The primary goal of the central banks also justifies the necessity of their action. Droughts, fires and floods negatively affect the volume of agricultural production. The deteriorating quality of the air and drinking water, accompanied by an increased risk of quantitative and qualitative starvation, poses challenges in the availability of the workforce. The effects detailed above collectively result in inflationary pressure in the economy.

In terms of the actions initiated by central banks to address climate risks, the Network for Greening the Financial System (NGFS), established in 2017, can be considered a flagship. The organisation had 114 members on 13 April 2022. The rapid increase in the number of members clearly shows the turnaround in central banks' thinking and the advancement of the role of green finances. The MNB was the first Central European participant to join the group in January 2019.

The chapter *Green bond standards as the bases of sustainable financing* provides an explanation of the standardisation process in a market of new, innovative financial instruments. Among investors and issuers, instruments for financing environmentally-friendly activities have appeared in recent years, but the initial state of the market is well represented by the fact that no standardised definition of a green bond has been set, even though more than 14 years have passed since the first issue.

In addition to the world's first Green Bond Principles, established by the International Capital Market Association (ICMA), we can also list the Climate Bonds Standard, the European Green Bond Standard, which was only a draft at the time of preparing the study, the ASEAN Green Bond Standard in the countries of South East Asia, and the Green Bond Endorsed Project Catalogue in China. The market is in serious need of regulations as green bonds had been issued in 58 countries in 33 different currencies by 2021, and based on the market trends, this form of financing is expected to spread and become more and more popular in the future.

The chapter *The Hungarian green bond ecosystem and its related central bank programmes* presents the development in this field in Hungary. It can be stated that

in the past years green bonds have become a key element in capital markets. The Funding for Growth Scheme (FGS) played a significant role in boosting the Hungarian bond market. Although Hungarian companies typically raised debt capital in the form of bank loans before 2019, the Hungarian corporate bond market caught up with the countries in the region by 2021. However, the Hungarian market for green bonds was not particularly significant at that time.

The MNB has made great efforts to reinforce the green bond market in Hungary. Up until the end of February 2022, all green corporate bonds in Hungary were issued within the framework of the Bond Funding for Growth Scheme (BGS). In addition, the share of green-rated securities in the central bank's corporate bond portfolio is also outstanding by international standards. The MNB purchased green corporate bonds with a nominal value of HUF 233 billion, accounting for 16 per cent of its total corporate bond outstanding.

The real estate sector, the construction industry and the financial sector are considered to be the most significant issuers of Hungarian green corporate bonds. This situation is beneficial for the achievement of climate goals as both the real estate sector and the construction industry have serious environmental footprints.

The chapter *Emergence of a new market segment: Central bank incentives for the Hungarian green mortgage bond market* explains the contribution of the MNB to developing and strengthening this market. In addition to the favourable indirect environmental effects, green mortgage bonds also represent beneficial, long-term financing for the banking sector. The advantage of this asset class is also emphasised by the green hypothesis. According to this theory, the risk profile of green mortgages is lower than that of similar standard loans. Hence, the increase in the volume of these investment products also reduces the investment risks of the financial actors holding them.

The issuance of Hungarian green mortgage bonds is further supported by the favourable treatment in the Mortgage Funding Adequacy Ratio (MFAR). In this sense, green mortgage bonds and refinancing loans can be weighted at 150 per cent in the MFAR indicator from 2021. This contributes not only to increasing the volume of green mortgage products, it also helps improve the capital position of the sector.

The chapter on the *Green turn of collateral management* presents the incentive and the method of expanding the range of the MNB's eligible collateral with green tools. The importance of this area is also indicated by the fact that central bank loans are only provided in secured forms. Therefore, the scope of eligible tools has a significant effect on what investments the banking system prefers to hold. The framework of collateral management is also influenced by monetary policy, risk management and operational aspects. In Hungary, government bonds account for

the main part of the eligible collateral range. Making the tools of eligible collateral greener was also justified by the dynamic development of the green bond market and central bank goals.

As a result, this step by the MNB was also in line with international trends. The People's Bank of China included green bonds in the range of eligible collateral in 2018. Since September 2021, the European Central Bank has rated Sustainability-Linked Bonds (SLBs) as eligible collateral. However, the Hungarian central bank is not just a trend-follower: it was one of the first central banks to introduce the preferential green haircut. In doing so, it took the first steps to implement climate risk considerations in the framework of collateral management.

The chapter *Promoting a green home loan market: the FGS Green Home Programme* presents the central bank measures that were introduced to make the Hungarian housing market greener. The housing market is also an excellent field for implementing green aspects, due to the low energy efficiency of the dwellings, which account for one third of primary energy consumption in Hungary.

In accordance with the monetary policy strategy aimed at sustainability, as one of its first steps, the Green Home Programme (GHP), which was introduced in October 2021, promotes the sustainability of the housing market by providing central bank resources at favourable interest rates that can be applied for the purchase or construction of new, energy efficient dwellings. With the GHP, similarly to the Certified Consumer-Friendly Housing Loans, borrowers are supported with a number of consumer-friendly conditions. Such conditions, for example, maximise the credit assessment time and limit the scope and rate of costs to be imposed; furthermore, a favourable interest rate on the funds gives further motivation to potential borrowers in the rising inflationary and interest rate environment.

The chapter *Green aspects of the government securities purchase programme and a snapshot of Hungarian green government bonds* provides a description of central bank measures supporting the funding of government projects aimed at sustainability. With regard to the turbulence in the financial markets caused by the coronavirus pandemic, the MNB launched a programme for purchases of government bonds in May 2020. As a result, 30-year green bonds issued in April 2021 were purchased in the value of HUF 29.4 billion. This amount represented 31.4 per cent of the total outstanding in December 2021.

The Hungarian Green Bond Framework provides simultaneous support for the funding of sustainable government investments, the stable liquidity of the market of green state bonds and the strengthening of the transmission mechanism of monetary policy.

The Guidance of Nature*

Gyöngyvér Szakál

Ruth DeFries:
What Would Nature Do? A Guide for Our Uncertain Times
Columbia University Press, 2020, p. 264
ISBN: 978-0231199421
Hungarian translation:
Mit tenne a természet? Útmutató bizonytalan időkre
Pallas Athéné Könyvkiadó, Budapest, 2021, p. 230
ISBN: 978-963-573-070-4

The uncertainty regarding the future of humanity gives rise to growing fear and anxiety. In the past, the future seemed predictable and foreseeable. However, the modern society created by humans is continuously becoming more and more complex, resulting in such a degree of interconnectedness that problems escalate with extraordinary speed. The world is becoming more and more unclear and dangerous, and in addition to earlier significant threats, such as global instability and terrorism, environmental pollution, climate change and the rise of autocratic political powers, we also recently experienced the impact of a major pandemic. Conventional crisis management tools are no longer adequate or sufficient, and it is difficult to ascertain the correct courses of action and behaviour at the level of individuals, economic operators and states. Bearing all of this in mind, the book's author deems it necessary to turn to nature and incorporate strategies which can be observed in nature and have proved to be successful for managing the problems of civilisation.

The author, *Ruth DeFries*, is a professor of ecology and sustainable development at Columbia University and has published more than one hundred scientific papers as an author or co-author. Her main field of research is how people treat Planet Earth, and how it affects society. One clear and central message in her book *What Would Nature Do?: A Guide for Our Uncertain Times* is that the key to the survival of humanity does not lie in the development or elaboration of new forms of behaviour, but in the adaptation of the methods found in nature for the management of complexity. Over the course of four billion years, nature has faced innumerable

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Gyöngyvér Szakál is a Senior Regulatory Expert at Magyar Nemzeti Bank. Email: szakalgy@mnb.hu

crisis situations and has developed various strategies for their management, which can be beneficial for handling unpredictable situations and the sudden crises that confront humanity.

In her book, DeFries identifies four main natural strategies that have proven useful in dealing with sudden, unpredictable shocks: they are self-correcting feedback, diversification, the application of certain redundancies as opposed to a fully efficient approach, and bottom-up decision-making. These strategies have stood the test of time, and we can take advantage of them in our dynamically changing, interconnected and complex man-made world as well.

One of the keys to the long-term functioning and survival of nature and complex systems in general is *the application of self-correcting mechanisms based on feedback*. In this context, DeFries highlights two important aspects. The first is to pay constant attention to feedback mechanisms created over time, and in relation to human knowledge or modern technologies, we should intervene in them as little as possible, because an effective, convenient short-term solution applied in the opposite manner may trigger unpredictable consequences in the long run. As an example, the author discusses American and Australian firefighting practice, which is based on a German model from the beginning of the 20th century aimed at extinguishing all fires at their start, and the application of this method in regions where smaller local fires played a significant role in preserving the ecosystem and the development of larger, unstoppable fires. Indigenous people never put out local fires as these fires stimulated natural regeneration and the growth of a flora and fauna more resistant to forest fires and bushfires. In order to protect people's property or semi-natural constructions, this practice ceased, which, along with several other factors, played a significant role in the recent occurrence of large-scale fires. Another important aspect crucial for the long-term operation of complex systems is the incorporation of built-in self-regulating circuit breakers, such as halting trading on an exchange, which are based on the lessons learnt from previous, smaller crises.

In addition to self-regulating mechanisms and circuit breakers, the options resulting from diversity are a key element to survival on Earth. In terms of the operation of unpredictable, complex systems, the stabilising power lies in diversity. In nature, the diversity of genes and species, and in conjunction with this the diversity of survival strategies ensure long-term survival. At the level of human civilisation, the diversity of ideas, concepts, knowledge, institutions, languages and cultures plays a stabilising role, similarly to the diversity of species in nature. In this context, it becomes obvious why the disappearance of certain languages and thus cultures, elements of knowledge and belief systems represents a dangerous trend. Regarding survival, this trend runs contrary to nature's rule of diversification, as we cannot know whether or not knowledge that has vanished with the disappearance of

a language as a knowledge-transmitting tool would have been or will be necessary for the survival of humanity.

The work subsequently explains that the basis of modern civilisation is *the operation of networks created by humans*. They ensure the flow of food, electricity, information and everything else necessary for modern life. In order to provide a smooth flow within the networks, the creation of redundant forms is encouraged. As an example, DeFries mentions the circular vein structure of leaves, which keeps delivering nutrients even if part of the structure is damaged, thus ensuring the survival of the whole plant. Although redundant flow paths reduce efficiency and thus may seem unnecessary under normal conditions, they ensure the survival of the system in the case of unexpected or unforeseen extraordinary events. Therefore, their application to an adequate extent is justified. On the other hand, besides their advantages, the operation of the networks may also involve risks. For example, diseases or harmful disinformation can spread very quickly or uncontrollably through them. Observing nature can also serve as a good example for dealing with these risks. Bees, termites and other insects also use techniques that can be applied to the modern civilisation created by humans. Such techniques include, for example, rapid, complete isolation of the infected segments of the network, or the concentration of other available limited protective methods on the parts that are the most exposed to infection. We can find these methods in the management of a pandemic as well.

In nature, cells and other living organisms work without any central guidelines, following their own rules determined by their immediate environment, for example, the way anthills and termite hills are built, or the way birds fly in a V-formation. Although the top-bottom governance model may be effective in many cases regarding the operation of civilisation, for example, in case of the international ban of chlorofluorocarbon gases to protect the ozone layer, bottom-up decision-making practices are much more successful in many other cases. The author gives several examples of the results achieved by the harmonisation of individual interests in certain important matters such as the more efficient distribution or preservation of public goods. In Nepal, placing new emphasis on a model focusing on the cooperation of locals and self-regulation instead of central management played a significant role in stopping deforestation. In terms of controlling population growth, educating women and providing more equal opportunities to them proved to be more effective tools than discipline and regulating the maximum number of children by law. For now, even for climate protection measures, it seems that the only feasible way is to supplement top-bottom measures based on past experience with bottom-up initiatives that increase resilience against unpredictable situations.

In conclusion, the author states that, similarly to nature, *mankind should solve four main problems* in order to manage unpredictable future events: keeping events

under control, ensuring adequate reserves for recovery and adjustment, providing for proper management of the benefits and dangers of networks, and encouraging cooperation and collective action for the appropriate treatment of common goods.

The tools for keeping events under control may be mechanical, which provides a direct solution for a certain problem such as James Watt's solution to ensure constant speed in the steam engine, or they can be based on feedback, such as the application of checks to prevent steep falls in stock prices. However, others are not as obvious, such as the example of smaller, controllable forest fires mentioned previously.

In order to *provide reserves* necessary to combat uncertainties resulting from climate change, pandemics and economic declines, it is crucial for mankind to foster diversification, i.e. to preserve and accumulate food-providing organisms, the water supply and the diverse gene pool necessary for life, on the one hand, and diversified knowledge, on the other.

When *creating networks* that ensure the flow of food and other goods, people and intellectual products, efforts must be made to maximise their benefits, while minimising the risks. The aim is to operate systems that are able to function at a level necessary for the survival of civilisation, even if a certain part of the system is disrupted. It is necessary to prevent harmful effects as well.

Similar to its predecessors, in the long term modern civilisation is also characterised by cyclicality, in which a stage of growth is followed by a decline. In order to make the stagnating stage less stagnant, the declines less severe and the renewal as rapid as possible, the author deems it worthy of consideration to apply a couple of successful strategies of nature, such as *feedback based on self-correction*.

Although the author does not state it explicitly, she comes to a very similar conclusion to that of *Sir David Attenborough* in his biographical documentary *A Life on Our Planet*, which was released in 2020 with great success. During the course of the development of civilisation, we have created an Earth where humans are in dominance, and all other creatures belong to a tolerated and perishing minority. Nonetheless, humans are very much part of nature, and if we continue exploiting and changing the climate and the environment, at best we will put the civilisational achievements of the past ten thousand years at risk, or at worst, we risk our own survival. There have been five mass extinction events on Earth, but life has always prevailed so far. For Attenborough, there is no question that, just as before, nature will survive the sixth mass extinction event as well, which we are heading towards at lightning speed unless we take urgent actions. But the Earth may move forward without us.

Report on the Fourth Green Finance Conference of the Magyar Nemzeti Bank*

Donát Kim – Vivien Vincze-Pintér

On 6 October 2022, the Central Bank of Hungary (Magyar Nemzeti Bank, MNB) organised its 4th Green Finance Conference, which was held at the MNB's Buda Centre. This year, the main focus of the conference was on the changing economic environment: at the event, the participants discussed and explored how to maintain the recent momentum in green finance during a time of rising inflation, recessionary concerns and geopolitical turbulence.

Csaba Kandrács, Deputy Governor of the Magyar Nemzeti Bank, opened the event. In his speech, he pointed out that despite the many geopolitical, social and economic challenges, we should not forget about the impending catastrophe caused by climate change and the reduction of biodiversity. China and Europe have been hit by extreme droughts, while Pakistan and the Death Valley in California, which is one of the hottest places on Earth, have suffered massive flooding. He finds it concerning that since the United Nations (UN) Climate Change Conference (COP26) in Glasgow, many of the main emitters have withdrawn from their commitment, while others are reluctant to make steps in accordance with their commitments in the Paris Agreement. It is important to emphasise that not only countries but also corporations have backed out: within the span of one year, several US banks left the Glasgow Financial Alliance for Net Zero (GFANZ), which sends a negative message. In his speech, Kandrács highlighted that Hungary is strongly committed to putting its financial system on a sustainable path. To this end, on 28 May 2021, the Hungarian Parliament decided to extend the mandate of the central bank to promote environmental sustainability as the first central bank in Europe. In accordance with its mandate, the MNB has supported the green transition of the Hungarian economy through several programmes over the last three years. As a result, amongst other things, it published its long-term climate stress test, issued a Green Recommendation for credit institutions, launched its Green Capital Requirement Relief Programme, announced a green mortgage purchase programme, launched its Green Home Programme, announced the Family

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Donát Kim is Head of the Sustainable Financial Analysis Department at the Magyar Nemzeti Bank and a PhD student at the Corvinus University of Budapest. Email: kimdo@mnb.hu
Vivien Vincze-Pintér is the Professional Assistant of the Sustainable Finance Department at the Magyar Nemzeti Bank. Email: pinterv@mnb.hu

Green Finance Programme, and concluded educational and research cooperation agreements with several universities and institutional partners. Moreover, it has recently been cooperating with the Organisation for Economic Co-operation and Development (OECD) and the European Commission to evaluate financial risks in Hungary due to the reduction of biodiversity. In addition, the MNB is also neutralising its own carbon footprint, to set an example for the financial sector as well, and as such, it also offsets the carbon footprint of this conference.[1]

Following the opening speech, the participants could watch a video message from *Frank Elderson*, Member of the Executive Board of the European Central Bank, in which he emphasised that the governments of EU member states remain committed to the targets set in the Paris Agreement. He added that central banks and supervisors need to pay special attention to these goals and measures, as well as the scenarios revealing climate risks when complying with their statutory mandates.

How to maintain momentum in green finance in a year of unprecedented challenges?

The first keynote speaker of the conference, *Thomas Steiner*, Executive Director of the Oesterreichische Nationalbank (OeNB), thanked the MNB for its work in the field of green finance so far, which sets a good example for the Austrian central bank as well. In his presentation, he explained that the ongoing Russian-Ukrainian war not only jeopardises the achievement of the UN Sustainable Development Goals, but also further aggravates other crises, such as the energy or food crises, not to mention its adverse effects on the inflationary environment. Due to the war, resources that are badly needed for tackling global challenges are being wasted, while at the same time it also hinders cooperation initiatives targeting the funding of sustainable investments at an international level. In his view, the European sustainable financial strategy (EU taxonomy, disclosure requirements, standards, etc.) is on the right path, but the transparency of the criteria for Environmental, Social and Governance should be promoted in order to increase business confidence and avoid "greenwashing". In his opinion, carbon pricing is the most effective incentive for real economic and financial changes, which may increase inflation at present, but in the long run, the tendency may reverse. Steiner also commented on the greening of the OeNB's own operations: they are currently working on the sustainability strategy of OeNB, which will set a target for the Austrian central bank to reach carbon neutrality by 2040. At the same time, the OeNB intends to increase

[1] With respect to the offsetting programme of 2021, a short movie on the afforestation project of the Körös-Maros National Park next to the village of Geszt was also presented at the conference. The links of the short video is as follows: https://www.youtube.com/watch?v=cKJOgkcXibY

the number of investments in green/sustainable bonds, focusing on the reduction of greenhouse gas (GHG) emissions, instead of their compensation.

Green transition challenges in the corporate sector

The other keynote speaker in the morning programme was *Pepijn Rijvers*, Executive Vice President of World Business Council for Sustainable Development (WBCSD). In his view, similarly to the digital revolution starting in the 1970s, we are once again in the middle of a large-scale transition process, which affects all sectors and countries. This time, however, the transition is not driven by innovations, but by a "perfect storm" of challenges, which is centred around the climate emergency and growing inequalities. He also added that, in terms of companies' operations, the scenario of "business as usual" is no longer a viable path as this perspective is becoming riskier with respect to the economy, is dangerous for the environment, and is socially and legally questionable as well. Furthermore, it is important to see that the adaptability of a business has a significant impact on its long-term value potential, which is why businesses need to develop competency in relation to sustainability issues in their business models in order to implement integrated decision-making. It is certainly positive that credit institutions and investors are increasingly focusing on the transition plans of a low-carbon and climate-resilient future. However, this transition requires significant funding and cooperation. At the same time, it is important for the financial sector to assign real value and appropriate incentives to business products and services that accelerate the transition to a carbon-neutral and fairer world. According to Rijvers, it is very likely that within three years, more than 50 countries will apply the framework of climate-related financial disclosures.

Award ceremony of the MNB Green Finance Awards and the Green Finance Science Awards

Within the framework of the conference, the central bank presented the Green Finance Awards for financial institutions and the Green Finance Science Awards, honouring outstanding scientific achievements. In 2019, the MNB awarded the greenest financial institutions with the Green Finance Award for the first time. The Green Bank Award are judged primarily on the extent of green lending, the proportion of green securities held by institutions in their portfolios and the exposure of the institutions to climate change risk. Accordingly, in 2022, the *Green Bank Award* was won by *Raiffeisen Bank Zrt.*, the *Green Insurance and Pension Fund Award* was awarded to *UNION Vienna Insurance Group Biztosító Zrt.*, while the *Green Investment Fund Manager Award* was awarded to *Raiffeisen Befektetési Alapkezelő Zrt.* by the central bank.

In 2021, the MNB established the Green Finance Science Awards and the Green Finance Research Initiative to encourage the promotion of environmental sustainability and to show its appreciation for Hungarian and non-Hungarian professionals who have conducted outstanding green finance research. The Green Finance Science Awards are awarded by a panel of academics and selected members of the Monetary Council. This year, the *Green Finance Science Talent Award* was awarded to *László Vértesy* for his outstanding research work, which is justified by his excellent publications and the high number of citations received, and which can be characterised by an interdisciplinary approach. *Elvira Böcskei and her research team* won the *Special Prize* of the competition of the *Green Finance Research Initiative* for their research plan elaborated on the topic of a more competitive and at the same time sustainable real estate sector. *The first place* in the competition of the Green Finance Research Initiative was awarded to the *MATE Centre for Circular Economy Analysis and Knowledge research team* for their research design on the financial preparedness of agri-food companies related to climate stress. *Áron Horváth and his team* were awarded *second place* in the Green Finance Research Initiative competition for their research project on the statistical analysis of the relationship between building energy data and house prices in Hungary. *The third place* in the Green Finance Research Initiative competition was awarded to *Antal Ferenc Kovács* for his research plan for the feasibility study of a corporate portfolio for the management of national natural assets. The *International Green Finance Lifetime Achievement Scientific Award* was awarded to *Sean Kidney*, co-founder and CEO of the Climate Bonds Initiative and professor at the SOAS University of London Centre for Sustainable Finance, who is a member of several green finance councils and committees at an international level.

Sean Kidney placed great emphasis on the fact that in the case of a green revolution, bigger countries can learn from small economies, which is why we can see that Singapore, Hong Kong and Hungary are at the forefront of the green transition. Considering the fact that greenhouse gases (GHG) show their impact later on, the climate change we are currently experiencing is due to the emissions up to the 1980s; therefore, even if GHG emissions were to cease immediately, we would experience a growing impact on the climate for 30 more years. Climate change inherently comes with the danger of war and conflicts, and may trigger massive migration and the complete collapse of the ecosystem. The transition to a green economy is best stimulated by an increase in volumes, because costs are reduced significantly. It also offers a serious investment opportunity: according to the study published by the global management consulting firm, McKinsey, the green transition requires the investment of USD 9.2 trillion, two thirds of which would require the reallocation of existing capital investments, whereas one third of which would appear as new capital need, as green investments have high investment costs, but

low operation costs. Investors are hopeful: they see the future is clear and green, but the market is quite volatile at the moment, as nobody can be certain which companies will be the front-runners. For example, it is an open question whether it is worth investing in an existing Chinese solar company or an Indian start-up subsidised by the state. In terms of the green bond market, it is clearly visible that in 10 years the outstanding stock increased a thousandfold, i.e. from USD 2 billion to USD 2 trillion. Experience shows that green bonds are more resilient and more liquid on the secondary market. According to the professor's vision, the next 30 years may bring about a boom in investments that results in a significant increase of workplaces and welfare.

Transition plans in the financial sector

In the next part of the conference, the existence of transition plans in the financial sector was discussed. The panel discussion was introduced by *James Vaccaro* (Climate Safe Lending Network). Based on the observations of climate change, countries will find themselves in a very difficult situation. Therefore, the transition plans will need to provide answers to two questions. On the one hand, how they can address micro-prudential risks, and on the other hand, how they can contribute to the management of systemic challenges. According to the suggestion of Climate Safe Lending Network, institutions should completely phase out the "harmful legacies" of the past, for example, using fossil fuels and supporting deforestation, and at the same time, they should reduce the carbon intensity of their existing, funded portfolio and find projects in line with the climate targets. A distinction must be made between those institutions that set carbon intensity ratios and those that set absolute emission targets, as only the latter can achieve an actual emissions reduction. Furthermore, Vaccaro emphasised that credit institutions have a chance to reduce carbon not only via financing channels, but as they influence the development of the regulatory environment, frequently provide business advice to borrowing companies, facilitate networking between different business partners, collect large amounts of data and create and analyse their databases, their financial relationships could be revised based on these factors as well.

After the panel introduction by Vaccaro, the first panel discussion was moderated by *Gábor Gyura* (UNEP FI) with *Mark Campanale* (Carbon Tracker Initiative), *Robert Spruijt* (ING) and *Beáta Paróczai* (European Bank for Reconstruction and Development, EBRD) taking part in it. During the panel discussion, the participants discussed the development of the transition into a green economy with respect to the financial sector, and what credit institutions and supervisory authorities could do in order to direct the world's sustainable financial activities onto the right path. One of Campanale's key messages was that all regulators should declare

a moratorium on the issue of bonds related to fossil fuels to prevent the expansion of the fossil fuel system. However, governments and individuals are not able to realise all these plans without each other since the problem is within the system, which needs to be handled at a systematic level. In his opinion, the issue could be tackled by involving the central banks into the solution through the International Organisation of Securities Commissions (IOSCO), the World Federation of Exchanges (WFE) and the Basel process. He added that reducing the funding of fossil fuels does not mean that funding for these programmes should be completely stopped, but that new research projects should not be allowed to start. According to Campanale, we cannot emphasise enough that renewable energy sources should be prioritised in the power supply systems, for example, instead of natural gas, as leaving fossil fuels behind may involve not only financial but also political benefits, such as reducing dependence on energy imports.

At *Gábor Gyura*'s request, *Robert Spruijt* explained that ING has recently joined the Net-Zero Banking Alliance, and detailed the future targets of ING related to sustainability. The Net-Zero Banking Alliance is a banking association founded by the United Nations (UN), whose members have committed themselves, among other things, to making their lending and investment portfolios carbon neutral by 2050 at the latest, in line with the goals set in the Paris Agreement. In 2018, ING launched a new initiative called Terra with the objective of influencing climate change measures more positively by means of its outstanding loans at each credit institution, via the funds lent to the companies and clients. Thus, hundreds of billions of euros are used in their loan portfolio to achieve net zero climate goals, while ING does not finance projects aimed at oil and gas exploration or expansion.

Since its establishment, the European Bank for Reconstruction and Development, as an international financial institution, has significantly supported the transition of the Central and Eastern European (CEE) countries, previously to a market economy, and nowadays increasingly to a green economy, explained *Gábor Gyura* and asked *Beata Paróczai* to present the EBRD's green strategy and its projects in the CEE region. Paróczai explained the EBRD's efforts regarding the Green Economy Transition, which has the aim of promoting the funding of projects that support the transition to an environmentally sustainable economy with low CO_2 emission, while using the environment without the complete depletion of natural resources. The EBRD has implemented several successful energy efficiency programmes in the Central and Eastern European region (mainly building energy efficiency investments, using small-scale solar and wind energy), as it seeks to create systemic changes in the economies of the countries of this region through technical assistance projects by developing their capital market especially green bonds market.

The role of green finance in the transition

The last panel discussion of the conference was led by *Eric Usher* (UNEP Finance Initiative). In his presentation, he pointed out that we can see rapid growth in the green economy, but in his opinion, the underlying cause of the problem is that financial companies are still funding the "old economy", whereas climate risks have not yet been incorporated in pricing. These are mainly due to the changing objectives of climate policies, the lack of adequate data and the immaturity of methodologies. He urged banks to elaborate on their climate stress tests, sector and scenario analyses, and take them into consideration in their pricing. The Principle of Responsible Banking was originally signed by 132 banks in 2019, and currently, it has 300 members, including the OTP group from Hungary, and other Hungarian institutions are also expected to join.[2]

Following the introductory presentation, the second panel discussion was moderated by *Pál Péter Kolozsi* (MNB), with *Luca Bertalot* (European Mortgage Federation), *Thibaud Clisson* (BNP Paribas) and *Andreas Rauter* (UNIQA Group) taking part in the conversation. The participants discussed the impact of green finance on the economic transition. *Pál Kolozsi* presented the estimates of the transition costs of the institutions, among others, OECD estimated an annual cost of USD 6.9 trillion, while McKinsey estimated an annual cost of USD 9.2 trillion to be spent in the next 15 years. This raises the following question: how much is the financial sector able to take over, and how can certain operators contribute to it? In his answer, *Andreas Rauter* highlighted that in addition to proper regulation, the most important focus of market institutions should be placed on joining associations internationally recognised in the field and initiatives launched by international organisations. As a good example, he mentioned the initiatives of Principles for Sustainable Insurance and Principle for Responsible Investment established by the UN. In his opinion, the return on the green transition is a long process, but a clear, positive correlation can be observed. The UNIQA Group intends to increase its green portfolio from the value of EUR 400 million to EUR 1.7 billion in the next three years, but the institutions are further hindered by the fact that unloading securities in polluting industries in a high yield environment involves higher losses.

According to *Luca Bertalot*, one of the main tasks in the field of finance is to turn challenges into opportunities. To take the example of a historical analogy, the Medici family also established the first banks during the time of the plague, the most destructive epidemic in Europe, which made the rise of city-states possible and laid the foundation of the Renaissance. The European Mortgage Federation, which has 2,000 European banks as members, developed a trademark similar to

[2] MKB Bank Nyrt. also joined the framework of Principles for Responsible Banking on 14 October 2022.

the Medici's fiorino to promote green mortgage bonds, supporting institutions to achieve a unified green rating. According to *Thibaud Clisson*, the actors of the financial system are able to influence the economy to a significant extent by means of capital allocation, for example, they do not finance certain activities, or they apply lower cost of capital for green investments. At the same time, due to increasing competition, it is more and more difficult to find green projects with good financial conditions. Another serious opportunity for asset managers is that they can participate in general meetings and, based on their ownership stake in certain companies they invested in, they can make proposals to the management.

In the second half of the panel discussion, *Pál Kolozsi* invited the participants to share their opinion on the challenges and opportunities related to green bonds and sustainability-linked bonds in the current market situation. *Luca Bertalot* emphasised that transparency is very important, which they paid special attention to on their website *Cover Bond Label* as well. All actors are looking for guidance; therefore, the guidelines of central banks are essential, which is why MNB's exemplary engagement is outstanding, as the central bank was one of the first to show the way forward in this field. In addition to regulatory issues, the green revolution is also an IT challenge, so all actors must allocate significant resources to IT developments, and at the same time, state actors need to provide a public central database, for example, for the availability of energy certificates.

Besides IT investments, *Thibaud Clisson* deemed it necessary to harmonise regulation as well, as the greenium (negative yield premium of green bonds) cannot be identified due to different state ratings and rules. With respect to sustainability-linked bonds, it is also problematic how companies define their sustainability targets. In contrast to traditional green bonds, many times there are no impact assessment reports, so if targets are not met, late realised penalty interest rates have little deterrent effect, which makes sustainability-linked bonds unattractive to investors. *Andreas Rauter* also found it important to learn who are financing 'brown' (environmentally harmful) investments at the moment. According to the investigative report of the Economies, these types of investments have been repackaged at 3–4 levels lower, and as funds of funds, they are held at less experienced asset managers, typically at smaller universities or pension funds. This is one of the reasons why a consistent and strict regulation is needed so that brown industries cannot just disappear from view.

Luca Bertalot drew attention to two additional problems as well. On the one hand, social opportunities and climate should also be taken into consideration, and no unrealistic expectations should be set when the majority of the society are looking at worsening living conditions. On the other hand, although Europe is moving in the right direction, the EU taxonomy is excessively complicated. Therefore, it is possible

that we will have the most energy efficient buildings, but the knowledge will be hard to share with emerging countries as they will not be able to implement it, whereas emerging countries provide the best opportunities for sustainability since the properties of their population will be built in the near future.

At the end, *Dávid Papp* (MNB) summarised the main remarks of the conference in his closing statement, and concluded the conference hoping that in the future, we can continue investigating the questions raised and finding solutions together, to which all the participants are warmly invited by MNB.

Sustainability and Financial Issues at the 2022 Annual Congress of the Hungarian Economic Association*

Ferenc Tóth – András Zsolt Szabics – Szabolcs Párkányi

On 22–23 September 2022, the Hungarian Economic Association (HEA) – founded 128 years ago – held its 60th Annual Congress. This Congress, which was organised in Szeged this time, is one of the most significant annual conferences of the Hungarian community of economists and also the largest. The opening plenary speeches were delivered by *György Matolcsy*, Governor of the Magyar Nemzeti Bank (the central bank of Hungary, MNB), *Laurent Maurin*, Head of the Economics Department of the European Investment Bank, *Sándor Csányi*, CEO of the OTP Bank Nyrt. and *László Windisch*, President of the State Audit Office of Hungary and Member of the Sustainability Section of the HEA.[1] In this report, we give information on the roundtable discussion of bank leaders, the new sustainable economics and the sessions on financing sustainability.

Roundtable discussion of bank leaders

The event was moderated by *Barnabás Virág*, Deputy-Governor of the MNB and Member of the Board of the Competitiveness Section of the HEA, and included a roundtable discussion with senior executives of Hungarian commercial banks. The participants were: *Éva Hegedüs*, President and CEO of GRÁNIT Bank Zrt., Secretary General of the HEA, *Réka Vörös*, Member of the Board of UniCredit Bank Hungary Zrt., Head of the Retail and Small Business Division, *Radován Jelasity*, Member of the Board of ERSTE Bank Hungary Zrt., *Antal Martzy*, Deputy CEO of Hungarian Bankholding, *Pál Simák*, CEO and Chairman of the Board at CIB Bank Zrt. and *László Wolf*, Deputy CEO of OTP Bank Nyrt. and Vice President of the HEA.

In his introductory presentation "*Banking system 2022: In continuous preparedness*", *Barnabás Virág* stressed that we are preparing for a difficult period, but in the first half of 2022 the banking system was in a better position than it was before

* The papers in this issue contain the views of the authors which are not necessarily the same as the official views of the Magyar Nemzeti Bank.

Ferenc Tóth is a Senior Economic Expert at the Magyar Nemzeti Bank. Email: tothf@mnb.hu
András Zsolt Szabics is an Economic Analyst at the Magyar Nemzeti Bank. Email: szabicsa@mnb.hu
Szabolcs Párkányi is a Junior Analyst at the Magyar Nemzeti Bank. Email: parkanyisz@mnb.hu

[1] Available on the HEA's YouTube page: Opening plenary session: https://www.youtube.com/watch?v=53T-tV-UW84

the global financial crisis in all indicators: lending is healthier, the banking system is more resilient and stable. At the same time, the energy price surge, the rising interest rate environment, lower profitability, deteriorating credit portfolio quality, real estate market risks and overvaluation pose serious risks. As a result, credit demand is expected to fall in the latter half of 2022, also due to the tightening of credit conditions and adjustment by borrowers, further slowed by the higher effectiveness of the debt service-to-income ratio. A slowdown in retail lending has already been visible since June 2022. As regards bank deposits, while the interest rate on corporate deposits has steadily followed the increase in the base rate of the central bank, the average interest rate on retail deposits is only two per cent, far below the base rate which is over ten per cent. Retail credit risks are rising and tightening credit conditions should be expected. Consumers in small settlements are more affected. Businesses will have to operate in an environment of multiple risks: on the one hand, energy bills will rise significantly, and on the other hand, the demand side will also tighten, and thus the corporate sector will come under pressure on both the cost and revenue side. However, the magnitude of the cost shocks may vary from sector to sector, and the question is who can pass on the current higher costs to their customers and to what extent. The likelihood of default is expected to increase significantly as a result of the many shocks.

Among the challenges ahead, the *green transition* is to be highlighted. Supporting this transition is of great importance for the banking sector as well. Climate risks may lead to significant losses in the banking sector as well (e.g. in relation to the agricultural sector), but green collateral and credit risks for customers seeking green loans could become lower, and financing the green transition could increase investor demand and reduce borrowing costs. The central bank has been and remains very active in the green transition. The MNB will help the banks to develop dedicated green loan products and differentiate their pricing decisions to take climate risk into account. At the macroeconomic level, a higher share of green energy investments could be a key factor for both the government, the central bank and the banking sector, which will require an increased mobilisation of financing resources.

Finally, he underlined that there is a consensus that it is important to move forward with *digitalisation* as quickly as possible. The good news is that the Hungarian banking system has made steady and significant progress in this area, especially in terms of digital strategies and solutions for management and workforce. However, it is still worth accelerating the digital transition in the product range. Overall, the sector's digital maturity is still only at a medium level and thus future improvements are still needed.

The first topic of the roundtable discussion was the expected path of growth, i.e. whether a temporary, short *recession* or a prolonged, massive recession can be expected in 2023. According to commercial bankers, there is now a state of "calm

before the storm". The biggest problem is inflation and its persistence, which is pushing the economy towards recession in an environment of rising interest rates. Growth is projected to be close to zero in the first two quarters of 2023, followed by a slight increase and a gradual decline in inflation after a peak in the first quarter of 2023. The key questions are: a) how the balance of payments, which may exceed even 8 per cent of GDP, will develop and this will have to be financed; b) whether an agreement with the European Union can be reached as soon as possible; c) when the Russia-Ukraine war will end. Fiscal adjustment may also be needed to preserve the balance. Household consumption is expected to slow down significantly.

Regarding *bank profitability*, it was said that although interest income had increased, profitability had been negatively affected to a large extent by, for example, the extra profit tax, the moratorium, the interest rate freeze, the impairments or the one-off cost of Sberbank as a payment to the National Deposit Insurance Fund. The banks accept that the economic situation is difficult and that they have to share the burden because of their social responsibility, but they believe that their burden should not be increased, and that the banking system should not be overstressed, as it moves along with the economy. *Barnabás Virág* pointed out that the banking system has about HUF 10,000 billion in deposits with the MNB, on which it receives interest of the order of HUF 1,000 billion, contributing significantly to the profitability of the banking system.

It was also discussed that the Hungarian banking system is not cost-efficient compared to European banks. But there is an important breakthrough potential here, because if a bank can be put on a more cost-efficient path, its profit-making capacity can be sustained in the long term. Labour shortages could also be a problem, making operations difficult and even affecting profitability, although this could change next year.

The *pro-cyclical behaviour of banks*, whereby they over-lend in times of economic growth and over-reduce the amount of lending during recessions, deepening the downturn, was also addressed. In the retail *credit market*, mortgage interest rates are above 10 per cent, which puts a heavy strain on household budgets, and therefore demand for credit is expected to fall. Personal loans are less price-sensitive, but there is a sort of wait-and-see attitude in case of home renovations and car purchases, although green renovations are still expected. Overall, this segment is less likely to experience a downturn. As regards corporate loans, it is seen that many firms are postponing or suspending their investments, which means that less investment borrowing is expected and the average maturity of the loan portfolio will be shorter. Exceptions to this may be the green loans that improve energy efficiency with state support. Many companies are doing well without external funding, and lower interest rates would be needed to increase investment loans.

Guarantee institutions can also play an important role, as it is not possible to finance investments on a market basis. Working capital loans, on the other hand, tend to increase as firms try to build up inventories to service their customers. In addition, many firms are reducing their outstanding debt. For the time being, the Széchenyi Programme meets the credit needs of small and medium enterprises at low interest rates. Banks will only grant foreign currency loans to export-oriented firms, as they have foreign currency earnings.

The corporate sector has never had such high *deposits*. The interest rate on these has risen in line with the base rate, as companies have a strong bargaining position. Interest rates on retail deposits, on the other hand, are far below the central bank base rate, except for the latest special products of a few banks. As a reason for this, bank managers stressed that there are savings opportunities available on the market that offer much higher returns than deposits, such as recently issued sovereign debt instruments. The public can always achieve higher returns on alternative investments than on bank deposits. According to the banks, their role is to help their customers navigate the investment options to find the best form for their risk tolerance. They believe that as long as they have to pay a special tax, this acts against raising deposit rates. The consumption habits of the Hungarian population also contribute to low interest rates, as they are attached to deposits, safety and liquidity. It was said that only about 30 per cent of the population is considered financially aware; they have savings and they pay attention to returns. Virág also noted that the lack of competition plays a role in the fact that banks do not raise the interest rates on retail deposits sufficiently.

Regarding *credit risks* in the household segment, the increased utility bills and higher food prices should also be taken into account, especially for those with low incomes. Fortunately, the portfolio is of very good quality, especially in real estate, and the loans are largely fixed-rate, with fewer and fewer people remaining in the moratorium. In addition, the population is prepared for the extra costs that energy price changes will entail, and wages have increased significantly. In terms of corporate credit risks, some sectors, such as hotels or energy-intensive sectors, need particular attention, but the companies engaged in energy production and energy saving are good debtors. For customers in difficulty, the banks are preparing credit relief packages.

The last topic was the issue of *digitalisation*. Banks are constantly digitalising their operations, and the pandemic has given a huge boost to this as well as to the social attitude that people can not only shop, but also bank online. Digitalisation first appeared in the area of payment services, but will continue to spread to all product areas. Digitalisation is also urgently needed in the internal processes of banks, including risk management and lending processes, to make the whole banking system simpler and cheaper. Banks are starting to build an ecosystem

where financial transactions have to be delivered quickly, flexibly and cheaply. There are banks that are building their own IT competencies as a major pillar of digital transformation, and this requires the direct employment of talented professionals who worked for suppliers so far, because the key issue of digital transformation is workforce.

In conclusion, Virág noted that we are facing a very difficult year and a challenging period for the economy, families, companies, banks and decision-makers, but hopefully in a year's time more positive developments can be reported.

New sustainable economics

The session, organised by the Competitiveness Section of the HEA, focused on the book "*New sustainable economics – A global discussion paper*", which was released in May 2022. The main message of the publication is that a sustainability turnaround is needed in all areas of life, but that this requires a fundamental transformation of economic thinking. In order to share ideas and experiences as widely as possible, the central bank has launched a lively dialogue on the subject. This also included a session where renowned economists gave their views on the fundamental issues of sustainable economics.

According to *Gergely Baksay*, MNB's Executive Director of Economic Analysis and Competitiveness, the central bank aimed to make the book easy to read, while also providing an overview of how the institution envisages the future of economic thinking.

In the presentation, it was noted that the second half of the last century has seen extraordinary economic growth in the world, with some Asian countries being particularly successful and making exceptional progress in catching up. But the sustainability of economic growth is becoming increasingly questionable as the main drivers of growth reach their limits. The central bank has identified four main constraints. The first is the *demographic constraint*, reflected in the low birth rate in developed countries. The second one is the *ecological constraint*, as we are currently overconsuming natural resources globally, with some estimates suggesting that we are using up nearly 1.8 Earths worth of resources. The third constraint is *fiscal balance*, as public debt in developed countries has risen to levels not seen since the Second World War. The fourth one is the *productivity constraint*, which is reflected in productivity growth in developed countries that has been slowing for decades and converging towards zero. In addition, the cyclical waves of technological innovation since the industrial revolution also require a renewal of economics.

According to Baksay, sustainability issues raised are not sufficiently addressed in economics. The top five economics journals, for example, published analyses on

environmental sustainability, social inequality and digital money in just under 1 per cent of their articles over the last 10 years. According to the Executive Director of the MNB, a fundamental change, a paradigm shift is needed in economics. The new economics must have a number of characteristics and be based on *sustainability*, as the sustainable use of resources is the key to the survival of our civilisation. It is useful if other disciplines are integrated into economics, i.e. economics itself becomes *multidisciplinary*. In the world of digitalisation, the new economics *looks at communities and networks*. *Knowledge and talent* must be valued as the key drivers of economic growth. In this process, *data* is also a new resource. Revolutionary changes are taking place in the world of *money*, where new technology is also emerging, for example in the form of central bank digital currency.

The participants of the panel discussion agreed on the need to renew economics. *Gábor Bartus*, Secretary of the National Council for Sustainable Development (NCSD), said that economics is always changing and no strict limit can be set to the individual trends. The main problem he sees is that there is less and less intersection between economic policy and economics. Often decisions are made that have been repeatedly disproved even by the old economics. *Magdolna Csath*, Professor at the Pázmány Péter Catholic University, agreed with the central bank's suggestions, and she emphasised that economics often uses only economic, quantitative measures, while it should not only deal with the economy, but also with qualitative (social, environmental) factors. This new way of thinking should be made part of mainstream economics. She proposed, among other things, that national wealth should be the decisive factor in judging a country's success, rather than GDP. *György Szapáry*, Chief Advisor to the Governor of the MNB, put the issue in historical perspective, showing that the introduction of the euro was also a paradigm shift. In his opinion, the task of economics is to identify the challenges of the future and to try to find answers to them in all cases. In his view, there have always been paradigm shifts in economics. In particular, he highlighted the demographic situation as a major challenge, which, in his view, has cultural and social causes for the declining population in developed countries. *Csaba Lentner*, Professor at the University of Public Service, highlighted the transformation taking place within mainstream economics. Central banks are a central part of this new type of economics, and their role has been significantly enhanced in the last 15 years or so. For example, before the global financial crisis of 2008, the scope of central bank responsibility was too narrowly interpreted, whereas nowadays central bank decisions in a crisis have become more concerned with growth and financial stability as well as inflation.

According to *Magdolna Csath*, competitiveness must be complemented by agility. Competitiveness is a complex system, just like the immune system, whose point is the same: to be able to prepare for unexpected situations. Resilience has to be

built up for which agility and the ability to react quickly are essential. It is all based on data and data analysis so that we can make projections based on past data. To assess a given event, it is not enough to look at a scenario; a more open approach is needed. For example, the feasibility of an investment needs to be looked at in the long term, not only the investment itself, but also possible alternatives.

György Szapáry explained that Americans think very much like Europeans on economic issues. In his opinion, the IMF has always tried to achieve both balance and growth in the countries it has supported, but this has almost never been achieved. He sees the increase in public debt as a new challenge. Since the 2008 crisis, the ratio of countries in Europe that exceed the Maastricht debt criteria has increased significantly. In a rising interest rate environment, where risks and premiums are also rising, a high public debt may not be manageable and fiscal intervention becomes necessary, but this is made more difficult by the fact that European countries are currently facing several crises at the same time, including migration and the energy crisis.

Csaba Lentner said that if Hungary wants to catch up with the average level of development in the EU, it must invest in knowledge. In the foreseeable future, the Hungarian economy can only catch up if it shows a significant economic growth surplus above the EU average, based on education. For the time being, he says, Hungarian universities can meet the graduate labour needs of large companies, but this is not the case for the SME sector. This means that the share of graduates and skilled workers must be increased. Universities are undergoing a transformation; operation in the form of a foundation has proven that where the owner is closer to the management, performance comes more to the fore.

Gábor Bartus explained that, in his opinion, we are a long way from representing the desired level of sustainability in economic policy. He argues that in the developed countries the identification of the problem and the setting of relevant targets is appropriate, but the choice of instruments is not always good and achievement of the targets is mostly unsuccessful. The NCSD report, published in 2013, is reviewed every two years and it was found that progress towards implementation is slow, despite the agreed strategy. But this is not unique to Hungary – similar problems can be identified in the EU in general. In his opinion, there are areas where deterioration can be observed. One of these in Hungary is resource productivity, which has weakened over the last decade. We are using more and more resources to produce a unit of GDP, i.e. along with high economic growth, we are increasingly overusing natural resources.

In *György Szapáry'*s opinion, we will only be able to tap the potential of the economy if we focus on education. Higher education is also very important, but the gateway to it is public education, which needs to be developed in Hungary.

The number of people applying for teacher training is falling, and only 70per cent of graduates are employed in the profession. A career in teaching can be made more attractive if earnings prospects improve. In addition, the teachers are overloaded and there are few of them, and so less time is spent on one child.

Speaking about the innovation performance of the Hungarian economy, *Magdolna Csath* said that the only way forward is to make the most of everyone in education and to think systemically. However, education is only one side of the coin, because the knowledge acquired can only be put to good use if the well-educated young persons can find jobs in the labour market. The economist said that when looking at the input and output side of innovation performance, the latter is more of a problem. The very low number of patents, the lack of innovative employment and the lagging status of sustainable ecological products all show that improvements are needed. According to the expert, innovation should not be interfered with from above, but rather the environment should be made supportive.

The final question of the session was how to bring environmental sustainability to the forefront of economic thinking. According to *Gábor Bartus*, crises can bring about great change, although given the current circumstances, he does not wish for more crises for anyone. For example, the direct effect of the current energy crisis is that demand for solar panels has never been so high. So the rising energy prices as a price signal also affected people. In all cases, it is extremely difficult to make a change happen, but incentives can play a great role. On the other hand, if the price signal is too strong at the same time, it also carries a social risk.

Financing issues of sustainability

A presentation by *Csaba Kandrács*, Deputy Governor of the MNB, opened the session "*Financing issues of sustainability"* on the afternoon of 22 September. The opening lecture, titled: "*Financing sustainable economy – The road to sustainability"*, placed the financing issues of the sustainability transition in the context of current global economic challenges.

Among the ideas raised in the presentation, it is worth highlighting that the issues of sustainability and energy efficiency gained momentum in the current turbulent economic environment burdened by the energy crisis. Following the COVID-19 crisis, the world economy faces disruptions in energy and food markets with dwindling reserves. With energy security now a priority in most European countries, the energy crisis could be a catalyst for a sustainability turnaround by forcing the necessary action. This is possible because increasing our energy security and achieving climate neutrality require almost identical steps. Reducing the use of fossil fuels could thus reduce Hungary's exposure and vulnerability as well as its greenhouse gas emissions. It is also worth mentioning that the latest study

by McKinsey, a consultancy firm, argues that climate neutrality can be achieved in Hungary by 2050, but that this would mean a substantial additional cost of EUR 150–200 billion. It should be remembered that investing in the transition is also a business opportunity and can support economic growth. According to the analysis, a large amounts of investments could not only boost GDP growth but also create new jobs for the Hungarian economy. The Vice President also reminded the audience that the tightening monetary policy environment does not mean a scaling back of the central bank's green measures, but only a change in focus. The current period is therefore an excellent time for scientific workshops, for example.

This was followed by a presentation by *Balázs Dobos*, Deputy State Secretary for Business Development at the Ministry of Culture and Innovation, focusing on the government's sustainability plans for business development. The Deputy State Secretary underlined that the government's sustainability targets are of course guided by the EU targets, which aim to achieve climate neutrality at the EU level by 2050. In the green transition, domestic SMEs face both structural and acute challenges. The presentation focused more on the structural problems, which were typically already present in the period before the COVID-19 crisis. Among these the productivity of the domestic SME sector, which is below the EU average, and the need to increase exports and enter new markets due to the open economy have to be highlighted. Meeting the technological challenges of a fast-paced global world is difficult, and the digitalisation efforts have already taken up considerable resources. Addressing these challenges is essential for the sustainable development of domestic businesses. The Deputy State Secretary mentioned that in many cases, the sustainability expectations placed on businesses appear on the demand side. KPMG's 2021 international CEO perceptions survey shows that 58 per cent of executives have already faced higher stakeholder expectations for increased reporting and transparency. These expectations are first formulated for large companies, but the process quickly spills over through the supply chains to SMEs as well. The presentation identified three directions for government intervention: promoting operational sustainability, expanding financing opportunities and supporting customer and regulatory compliance.

The panel discussion was closed by *Richárd Végh*, CEO of the Budapest Stock Exchange (BSE), who also chairs the Sustainability Section of the HEA. In his presentation, he argued that sustainability and capital markets go "hand in hand", as ESG[2] has in fact now become a corporate competitiveness issue. The ESG approach has been present in capital markets for years, mainly as a risk management tool for investors. Responsible investment management should therefore include the consideration of sustainability aspects, which recent experience shows is increasing in frequency. In the view of the BSE's CEO, this trend is a wave that no company can

[2] ESG: Environment, Social and Governance

avoid, so it is worth being prepared to comply. Végh pointed out that the number of investors committed to responsible investment principles and the volume of assets under their management is growing exponentially, so it is expected that in a few years it will be very difficult to find investors in the capital markets for companies that do not comply with ESG principles. The legislative framework to support the sustainability transition is continuously evolving, with an important element being the common taxonomy, which aims to develop a common set of concepts, common indicators and a technical framework for data reporting. The BSE aims to develop ESG awareness in the domestic market through ecosystem development and knowledge sharing. The BSE's vision is to create a domestic ESG hub with the involvement of financial system stakeholders and representative organisations.

The introductory presentations were followed by a roundtable discussion on the corporate and banking side of green finance. The discussion was moderated by *Rita Szalay*, Managing Director of ESG Capital; the panellists were *Gergely Pókos*, Managing Director of the OTP Bank's Green Programme Directorate, *Péter Töreki*, Head of MOL Group Funding, and *Attila Vajda*, Managing Director of Vajda Papír Kft.

The discussion was prompted by the idea that in recent years we have been hit by several crises, sometimes in succession, sometimes in parallel. The economic slowdown caused by the COVID-19 pandemic and the shutdowns was followed by a war-related energy crisis and damage to supply chains. But behind all this, the negative impacts of climate change on the economy, the environment and the population still remain. The companies represented in the discussion naturally face very different challenges. For the MOL, maintaining security of supply is of paramount importance, while at the same time continuously reducing oil exposure to Russia and achieving independence. *Péter Töreki* also stressed the importance of foresight and anticipation. In the case of the MOL, several items were already pre-financed in the much more favourable interest rate environment, which puts the company in a more favourable position. The participants agreed that although demand for green assets has been steadily increasing, the green premium or "greenium" has effectively disappeared from financial markets in recent years. According to *Gergely Pókos*, this is a temporary situation caused by the current poor economic outlook. However, the green premium is not the only attractive factor for green financing, as the need to meet ever more stringent and growing sustainability criteria is also pushing companies in this direction.

With regard to the challenges and opportunities related to the green transition, *Attila Vajda* highlighted the importance and role of self-produced renewable energy in reducing costs and achieving sustainability goals for manufacturing companies. According to *Gergely Pókos*, when it comes to sustainability solutions, it is always worth thinking about what we can do today. What is the practical solution that is tangible and can work today? In his view, the practical green solutions are

currently related to energy supply, energy efficiency and transport, which are worth considering for everyone, both in the corporate and residential sectors. At the moment, everyone is trying to wade through the forest of regulations to get a good ESG rating, as an outstanding rating can give a company a competitive advantage. However, caution is advised with regard to some ESG ratings, as the consensus is that in this segment "wild west" conditions partly still prevail, with some rating agencies issuing ESG ratings without dialogue or consultation and without having all the necessary information. In addition to the environmental pillar, other aspects of ESG—social and corporate governance—highlighted by the panel included healthy lifestyle programmes, integrity and transparency, increasing the proportion of female employees and managers, and cooperation with non-profit and charitable organisations.

The above sessions are available on the HEA YouTube channel (in Hungarian).[3]

[3] Roundtable discussion of bank leaders: https://www.youtube.com/watch?v=VB_GWPM3N_U, New sustainable economics: https://www.youtube.com/watch?v=gom1lSl8BZg, Financing issues of sustainability: https://www.youtube.com/watch?v=sFHBLCoXbXs

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Thank you!

The Editorial Office of the Financial and Economic Review
H-1013 Budapest, Krisztina körút 55.
Phone: +36-1-428-2600
E-mail: szemle@hitelintezetiszemle.hu

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