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The Green Trilemma of Banks and its Potential Solution: The Green Preferential Capital Requirements

Abstract: The traditional trade-off between banks' safety and income should be amended with a green factor creating the green trilemma. Banks must find the balance between the three mentioned goals. Firstly, we build up a formal model of the green trilemma and point out the need for incentives to support green lending. The introduction of green differentiated capital requirements can be a solution. However, there is little empirical experience about the application of this policy tool. Secondly, we assess the Green Preferential Capital Requirement Program (GPCRP) of the Central Bank of Hungary, which is a pioneer green supporting factor program. We measure the cost efficiency of this program. The cost is prudential, meaning that the benefit of prudential release is distributed between bank owners and green borrowers. The program's unit cost is much below the current EU ETS prices. Our results underline the effectiveness of the program: without material increase in prudential risk, the GPCRP contributes to avoiding significant amounts of carbon emission.

Keywords: climate change, financial stability, capital regulation, green supporting factor, low carbon transition

JEL Classification: E44, G18, Q54, G21, E58.

1. Introduction

Discussions about the relationship between safety and banks' profitability have decades-old roots. However, nowadays it has become increasingly apparent that this trade-off should be with sustainability goals as well. Thus, we would get a trilemma that we refer to as the green trilemma of banks. In our study, we would like to contribute to the argument of this trilemma based on practical experiences stemming from the application of the first green capital supporting factor.

Confidence in the banking system is of utmost importance for a sound economic environment. To build this trust it is necessary to minimize the number of bank failures. The introduction of capital requirements served this goal (Hull, 2018). However, capital regulation has a broader impact on the operation of banks - it influences management decisions, risk-taking, and profitability as well. These factors are highly affected by the prudential treatment of climate change (as one of the most critical global challenges) and assets belonging to the green transition. On one hand, financing the green transition is a big business opportunity for financial institutions. The green shift of the economy is a highly costly process not only at the national but also at the global level. Several estimations on the necessary investments are available: according to the International Energy Agency, $2 trillion annual investment is required until 2050 (IEA, 2021), while Bloomberg New Energy Finance calculated $7 trillion (BloombergNEF, 2022), and the McKinsey consulting company came up with $9.2 trillion per annum (McKinsey & Company, 2022). To ensure the mentioned amounts, the participation of the financial sector is a must, as Sachs, Woo, Yoshino, & Taghizadeh-Hesary (2019) highlight. However, the lack of reliable data means a challenge for banks and investors when they consider financing green projects (Schoenmaker & Schramade, 2019; Zetzsche & Anker-Sørensen, 2022). On the other hand, many risks can stem from climate change or actions related to it. There is a broad consensus on the two main related risk categories (transition and physical risks) which have impacts on financial stability as well (NGFS, 2018, 2019; BCBS, 2021). The connection between financial stability and climate change implies an active role of central banks, which can also cover incentives for the financial sector in order to support the financing of the green transition (Volz, 2017; McDaniels & Robins, 2018; Campiglio, 2016; Campiglio et al., 2018; NGFS, 2018; Martin, 2023). However, the applied approaches of central banks are very different (Dikau & Volz, 2021; Koshel & Thanassoulis, 2024) due to the debate about the importance of environmental aspects in central banking (Deák & Sárvári, 2023). Financial institutions face increasingly complex regulatory and supervisory green expectations shown by the Basel principles (BCBS, 2022) or the supervisory priorities of the European Central Bank (ECB, 2024).

The key question of our study is how regulators can incentivize green financing taking into account the traditional trade-off between safety and income. To answer this issue, we introduce a model to analyze the relationship between income, capital, and green effects from the banking perspective. Optimizing between these factors is a decision problem that we call the green trilemma. Based on this model, preferential treatment of green exposures in capital regulation is a reasonable approach.

After the theoretical aspects, we perform the first empirical analysis of a Green Supporting Factor program's results. Some details of the Hungarian Green Preferential Capital Requirement Program (GPCRP) have already been published (e.g. Magyar Nemzeti Bank – MNB, 2023a, 2024a). However, an impact study focusing on its environmental effect is still missing. Hence, our main question is how the GPCRP contributes to the climate goals in terms of carbon emission? Furthermore, we aim to assess the effectiveness of the program. Firstly, we examine the characteristics of GPCRP loans based on the anonymized supervisory database. Secondly, we estimate the quantity of the annual carbon emission avoidance of GPCRP loans. For this, we use benchmarks. The difference between the GPCRP and benchmark emissions defines the avoided carbon emission. Finally, we analyze the effectiveness of GPCRP by calculating the unit cost of avoided carbon emission and comparing it with the EU ETS prices.

The study is organized as follows. Section 2 contains the literature review. Section 3 presents the model. Section 4 outlines the Hungarian GSF program. Section 5 describes the impact of GPCRP on financial stability and carbon emissions, which is followed by the evaluation of the program in terms of carbon emission reduction and effectiveness. Section 6 concludes with policy implications.

2. Literature review

We can analyze the connection between the level of capital and profitability from different perspectives. Mishkin (2018) applies an accounting approach when he states, that supposing the same return on assets, the amount of the capital reduces the return of equity holders. In other words, the higher the bank capital, the lower the return on equity (ROE) which is a trade-off between safety and profit rates of owners. Berger (1995) also focused on the ROE. He assumes perfect capital markets with symmetric information and uses a standard one-period model. With these conditions, the relation between capital adequacy and ROE should be negative. Blum (1999) uses a dynamic model to show that tighter capital requirements decrease the expected profits of the bank. Hellmann, Murdock

& Stiglitz (2000) recognize that capital requirements are costly due to the obligation of banks holding expensive capital. Furthermore, the impact on profitability can depend on the quality of the capital (Ogunmola, Chien, Chau & Li, 2022). However, empirical results are not fully in line with the theory. Berger's (1995) investigation demonstrates the opposite result: the capital-earnings relationship is positive in most cases of his sample. Extending the results of Berger (1995), other studies argue that the relationship between capital and profitability depends on the investigated time period (crisis or normal stage) and the characteristics of the given bank, especially its size (Osborne, Fuertes & Milne, 2012; Berger & Bouwman, 2013; Khan, 2022). A more recent study by Coccorese & Girardone (2020) describes a relatively weak positive relationship between capital level and profitability. It also highlights the importance of the environmental cycle and the size of the balance sheet related to the examined link. As we can see, the literature offers differing perspectives on this issue.

Besides the capital-profit debate, we briefly summarize the background of potential green finance supporting tools. Without scaling up green finances the availability of the necessary amount for the net-zero transition is questionable. One possible solution is the use of capital regulation to promote green finance, a logic that is not unfamiliar within existing regulation. In Europe, some adjustments on prudential capital requirements were introduced because of different policy objectives in CRR/CRD regulations. Firstly, the Small and Medium Enterprise (SME) supporting factor was created.[1] This preferential treatment was supported by at least two arguments: a) SME portfolios are, in general, diversified compared with large corporate ones; b) SMEs have a significant share in employment and production, but they do not have alternative financing channels; they are heavily bank dependent. Secondly, the infrastructure supporting factor (ISF) was introduced ensuring a reduction in capital requirement. The main motive of IFS is to support long-term infrastructure finance in Europe. Despite their importance, we found hardly any studies in the literature that would measure the impact of SME and infrastructure-supporting factors. According to Binder (2022), both initiatives are based on political motives and macroeconomic interests instead of risk considerations. However, Jobst (2018) stated better credit performance of long-term infrastructure projects stemming from stable and resilient cash flows based on international data collection. Bethlendi & Naszódi (2003) found, based on Hungarian data, that although lending to SMEs is a riskier activity in itself, loan portfolios can significantly reduce the risk justifying the preferential capital

[1] According to the IRB approach, SME loans can be reclassified from corporate to retail portfolio categories, where the risk weight function is more favorable.

treatment. As we can see, notwithstanding the risk-based approach of capital requirement regulation, other aspects can play a substantial role in the legislation.

Some studies (Dafermos & Nikolaidi, 2021; Oehmke & Opp, 2022) deal with the significance of the possible green capital requirements. However, the legislation limits the potential policy actions since the Pillar 1 capital requirements are regulated by the EU's Capital Requirements Regulation (CRR). Therefore, there is no discretion at the national level. In Pillar 2, capital rules can be adjusted by the relevant national authorities. The above-mentioned supporting factors belonging to SMEs and infrastructure investments are defined by CRR and covered by Pillar 1. Since the CRR currently does not contain any green-related capital relief, only Pillar II approaches are possible.

Dafermos & Nikolaidi (2021) identify two types of green differentiated capital requirements: the green supporting factor (GSF) and the dirty penalizing factor (DPF). While the GSF reduces the capital requirements of eligible green loans, DPF results in higher capital for brown loans. They find that GSF and DPF can reduce the pace of global warming and thereby decrease the physical and financial risks. However, Dunz, Naqvi & Monasterolo (2021) underline the possible disadvantages of the GSF application. They state that GSF could be an effective tool to enhance green investments only in the short term. Moreover, they identify a potential trade-off between financial stability and supporting green transition in line with a recent study (Meng, Wang & Ding, 2023). The Prudential Regulation Authority (2021) also highlights that problem: lower capital requirements for green loans could deteriorate solvency. According to Dankert, van Doorn, Reinders, Sleijpen & De Nederlandsche Bank (2018), GSF might not be the right policy instrument due to financial stability issues and the questionable effect of green lending. As we can see, the picture is not black and white; the application of GSF can have both pros and cons, as the European Banking Authority summarized (EBA, 2022). In this paper, we do not intend to evaluate this question in general. We are focusing on the Hungarian implementation of GSF and its consequences.

3. The model

Consequently, we can identify a new decision situation where banks take into account green aspects as well besides traditional goals of income and capital optimization. That we call the green trilemma. In other words, banks should solve the following optimization problem: how can they maximize their financial value and their green effect at the same time?

In a formalized way

$$V_0 = FV_0(a_0; c_0; g_0) \quad (1)$$

$$max\, V_1 = \beta * FV_1(a_1; c_1; g_1) + (1 - \beta) * GV \quad (2)$$

where

Equation (1) illustrates the traditional, while equation (2) the new decision situation of banks.

$g_1 > g_0$ and $\beta <= 0.5$

V denotes the value of the bank

FV denotes financial value determined by *a* (profitability), *c* (level of capital), and *g* (green effect).

GV denotes the green value determined by *g* (green effect).

At first, we investigate the relationship between the "traditional" factors and the bank's financial value. Profitability is considered the main driver of financial value. It can be justified by one of the possible determinations of FV, which is the discounted value of future profits. Profitability can hide extreme risk-taking in the short run; therefore, it is worth examining the source of earnings (Xu, Hu & Das, 2019). However, in the longer run, the relationship is positive (Caparusso, Lewrick & Tarashev, 2023). Therefore $\frac{\Delta FV}{\Delta a} > 0$.

In the case of capital level, the direction is not obvious. As we describe in Section 2, higher capital can have both positive and negative impacts on profitability mainly depending on the given bank's circumstances and the economic cycle. Therefore, $\frac{\Delta FV}{\Delta c} > 0$ or $\frac{\Delta FV}{\Delta c} < 0$.

The key question is the nature of the relationship between these two traditional factors and the green one. For the answer, we introduce some attributions of green lending.

Frisari, Hervè-Mignucci, Micale & Mazza (2016) describe why investors and banks could consider green infrastructure investments risky. They mention, among others, high initial costs, long investment horizon, lack of knowledge of banks, and technology risk. The last two are also identified by Degryse, Roukny & Tielens (2020) when they analyze green finance as investments in new technologies. Campiglio (2016) also highlights the time-horizon problem amended with other challenges originating from the possible illiquidity of green assets. Others (Berensmann & Lindenberg, 2016; Sachs, Woo, Yoshino, & Taghizadeh-Hesary, 2019) recognize the altering duration of banks' liabilities (short and mid-term deposits) and the long-term nature of green infrastructure projects as a key burden in the development of green lending. They state that this maturity mismatch discourages banks from green financing. These circumstances, together with the above-mentioned data gap, result in more uncertainty for banks which causes difficulties, especially in pricing. The possible negative profit effect limits the potential green lending.

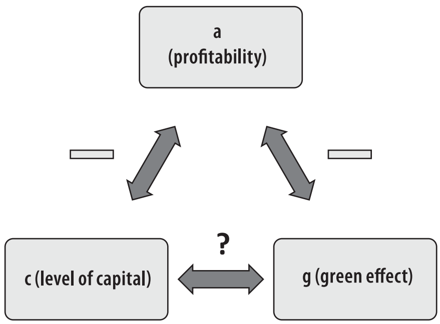
Besides high upfront expenses and long recovery, Frisari et al. (2016) mention technology and policy risks as potential difficulties for project developers (borrowers). Furthermore, the probable higher financing cost deteriorates the financial ratios of the environment-friendly developments as well. These unfavourable conditions can hinder the realization of green projects. Banks could influence only the financial component of the mentioned burdens: if they intend to improve green lending and support environmental goals, they should ensure advantageous loan interests. Lower interest rates mean less income, therefore, there is a negative relation between *a* and *g*:

$$\frac{\Delta a}{\Delta g} < 0 \tag{3}$$

Nonetheless, there are several studies stating less credit risk of green loans which could be the basis of the statement $\frac{\Delta a}{\Delta g} > 0$. The so-called green hypothesis of lower credit risk originates from the mortgage market (UNC Center for Community Capital, 2013; Guin & Korhonen, 2020; Billio, Costola, Pelizzon & Riedel, 2022a, 2022b; European Commission Directorate-General for Energy, 2022). Energy efficiency investment would decrease utility costs due to energy savings, which would result in higher remaining income for credit payments, decreasing the probability of default. Moreover, the value of properties with better energy performance would mean a more stable market price and lower loss-given default. Capasso, Gianfrate & Spinelli (2020) found that higher carbon emissions resulted in a lower distance to default on corporate loans. However, there is not a broad consensus on the positive risk differential of green loans in general. If it existed, incentives by governments and central banks to promote green lending would not be necessary. But this support is a must, as we discussed in the previous sections, which underpins equation (3).

However, during the described optimization problem, we would like to maximize the financial value and the green effect of the bank at the same time. When *c* is independent of *g*, it is not possible, since the bigger the g and therefore *GV*, the smaller the a and therefore *FV*. Similarly, when $\frac{\Delta c}{\Delta g} > 0$, so more capital is necessary in case of increasing green lending, ceteris paribus *GV* will rise while *FV* will reduce due to the lower a and higher c. If $\frac{\Delta c}{\Delta g} > 0$, i.e. less capital is needed in the case of green loans compared to not green loans, the decreasing cost of capital can counterbalance the reduction in *a*. Lower capital requirements for green exposures have the same impact on banks. This statement is underpinned by the introduction of incentives for central banks to promote green finance.

Figure 1: The Green Trilemma



Source: own edition

We can see that there are trade-offs between the factors – all of them cannot be improved at the same time. Based on our model, the solution of the green trilemma must be the negative relationship between capital level and the green effect (Figure 1). Thus, the green effect should have some preferential treatment in capital requirements. The current neutrality of capital regulation toward sustainability does not support the spread of green lending.

4. The Hungarian example for GSF

In 2020, the Central Bank of Hungary (MNB) launched the GPCRP, which ensures lower capital requirements for green loans. The program, as a real example of a GSF, is considered a pioneer at the international level (Climate Bonds Initiative, 2020; Gyura, Holczinger & Kim, 2023). The main goals of the GPCRP are supporting green financing and improving the risk profile of the banking sector through addressing transition risk. To reach these objectives, GPCRP gives capital relief in Pillar II. The discount depends on the attributes of the loan[2], especially the level of compliance with the EU Taxonomy. If the loan is fully compliant with the EU Taxonomy, the discount is 7% of the gross exposure. In case of partial compliance, but meeting the requirements defined by MNB, a 5% discount is available. The lower solvency is expected to be counterbalanced by the lower transition risk and the so-called green hypothesis of lower credit risk (MNB, 2019).

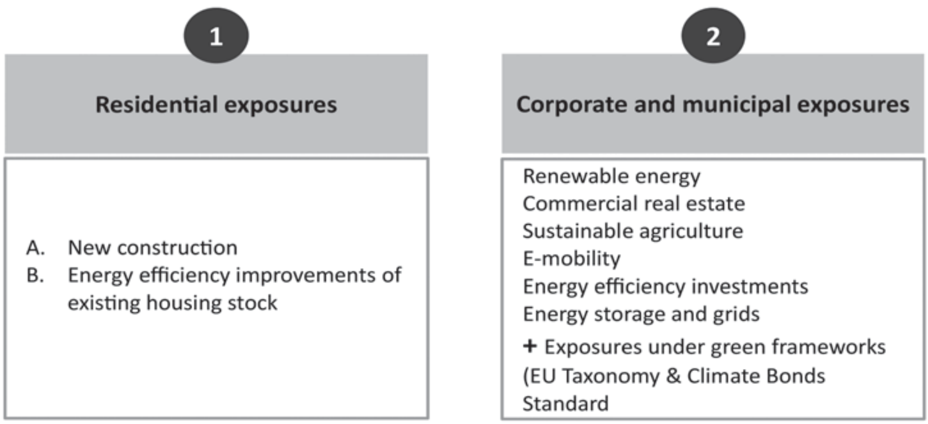
[2] The GPCRP ensures capital relief for holding green corporate bonds as well. However, this part of the program is not in the scope of this study.

However, MNB wanted to limit the effect of the trade-off between solvency and supporting the green transition. Therefore, the amount of capital relief is maximized. The first restriction is that the Pillar 2 capital requirement on the relevant green portfolio may not be negative, which ensures the safety stemming from the Pillar 1 capital requirement. The second limitation refers to the total risk exposure amount (TREA). The overall discount amount (mortgage, corporate, and municipality loans) may not exceed 1.5% or the TREA.

The lower credit risk justifies lower capital requirements, which is transferable to lending prices. If banks must hold less capital, their cost of capital would decrease. This reduced capital cost makes it possible to offer loans at a lower cost. Based on interviews with banks, in the case of corporate loans, the available discount on interest rates is typically between 50-70 bps depending on the specificities of the contract. Another example is the Green Certified Consumer-Friendly Housing Loan, where banks offer an additional interest rate reduction of 25-50 bps (MNB, 2023a). The cheaper credit can increase the demand for green loans. On the other hand, the announcement of green loan definition and the available lower capital requirements can incentivize the product development of credit institutions, increasing the credit supply as well.

The initiative consists of two pillars. The first pillar refers to residential mortgage loans, while the other pillar covers corporate and municipal loans (Figure 2).

Figure 2: Loan purposes in the GPCRP

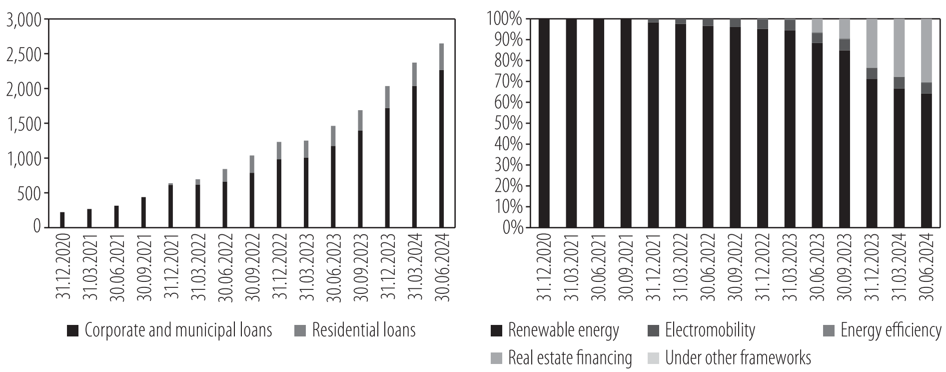


Source: own edition based on MNB (2023c, 2023d)

Before the analysis of the program from a quantitative perspective, it is worth introducing the terms and conditions of the GPCRP to better understand the connection with Taxonomy regulation. As we mentioned, the participating credit institutions can receive 5% or 7% capital relief based on gross exposure, depending on the level of compliance with the EU Taxonomy. From a sustainability point of view, the EU Taxonomy criteria are very ambitious and beneficial, but in fact, complete fulfilment is a big challenge due to the (partial) lack of available data and high expenses (Och, 2021). The MNB intended to incentivize the Hungarian financial system to achieve as ambitious sustainable financing targets as possible but did not want to exclude “light green” approaches because every step in the green transition is important. The light green term covers activities that do not fully meet the EU Taxonomy, but most of the conditions are satisfied and they could receive a 5% discount in Pillar 2. On the other hand, the availability of green loan definition has incentivized the product development of credit institutions, increasing the credit supply as well.

Since the beginning of the program, it has expanded significantly both in terms of volume and accepted loan purposes. The loan volume participating in the program increased to 1 036 billion HUF (2.5 billion EUR) by the end of Q2 2024. In the residential program, only purchasing and constructing loans of new buildings are participating, while in the corporate leg, financing of renewable energy projects is dominant (Figure 3).

Figure 3: Evolution of GPCRP in million EUR (left hand) and the composition of corporate loans (right hand)



Source: own edition based on MNB (2024b)

5. Results: Impact on financial stability and carbon emissions

We analyze the results of GPCRP from two policy perspectives.

5.1. Financial stability

Although the development is visible, further improvement is possible based on the distance from the prudential (TREA) limits. The ratio of individual capital relief to TREA threshold can be found between 6.4% and 23.5%, while the average is below 15%. We note that from a lending point of view, the GPCRP faced disadvantageous circumstances. The COVID-19 pandemic, the energy crisis, and rising interest rates weakened the lending activity of banks, including green lending.

On the other hand, we examine the GPCRP's effect on the solvency position of banks both at individual and sector levels. The GPCRP resulted in a slight decrease in the level of Total SREP Capital Requirement (TSCR): the average reduction is 0.13 percentage points, while the range is between 0.03 and 0.30 percentage points. Taking into account the solid value of TSCR at the sector level (14.96%), meaning a robust capital position of the Hungarian banking system, we can see that the current impact of GPCRP is not significant.

5.2. Carbon emissions

Besides the effect on the transition risk of credit institutions and product development, the GPCRP has one more crucial impact. The financing of environment-friendly projects contributes to Hungary's climate goals due to lower carbon emissions. We estimated the avoided carbon emission. During calculations, we faced some problems stemming from a lack of exact data. Therefore, we assessed those types of green loans, where we could use expert judgments based on industrial averages. We selected renewable energy loans for solar power plants as the most significant part of the program, electromobility credits, and residential mortgages. We modelled only financed activities located in Hungary since we would like to measure the effect of the GPCRP on Hungarian carbon emissions. The selected credit exposures cover 76% of those loans.

At first, we estimated the annual carbon emission stemming from investments related to GPCRP loans by categories. Then, we defined some benchmarks. Finally, we defined the avoided emission as the difference between the GPCRP estimated and the benchmark emission. We note that green activities financed by GPCRP may also receive other subsidies, not only preferential loans. Thus, the carbon reduction effect of GPCRP is an upper estimation.

For the computation, we used the anonymized individual loan data stemming from the supervisory data submission (Database). The Database covers all GPCRP loans since the condition for participating in the program is to deliver a pre-defined dataset about loans to MNB. The Database was available for us on 30.06.2024, so this is our reference date.

In the case of residential mortgage loans, we assumed that the difference between the GPCRP property and the benchmark property concerns only the energy demand and, therefore, the carbon emission factor (CEF). In other words, we presumed that the average property size is the same. This condition was necessary to compare results properly. We applied the following formula:

$$\begin{gathered} carbon\ emission\ savings = \\ number\ of\ financed\ properties * average\ property\ size * \\ (GPCRP\ carbon\ emission\ factor - benchmark\ carbon\ emission\ factor) \end{gathered} \tag{4}$$

The benchmark emission was calculated in two different ways. First, we estimated the CEF based on the National Building Typologies (TABULA, 2014). This study contains information on carbon emissions by Hungarian residential buildings. Therefore, we defined the benchmark CEF as a weighted average. In the other method, the starting point was a recent study (Bene, Ertl, Horváth, Mónus & Székely, 2023) that approximated the distribution of the Hungarian residential real estate stock in 2020 by energy characteristics. Based on this distribution, the related regulation (NFM, 2008), and the matching of old and new energy categories (MNB, 2023b, Annex 2), we estimated the benchmark CEF, which was very close to the previous result. For the annual carbon emission, we used the arithmetic average of the benchmark values (Annex, Table 1A).

In the case of electromobility loans, the method was equivalent to the previous case: the parameter regarding annual mileage was the same for electric and traditional cars, while the carbon emission varied. The average age of Hungarian passenger cars is 15.8-year according to the Hungarian Central Statistical Office (Hungarian Central Statistical Office – HCSO, 2024a), therefore we applied the carbon emission of new cars in Europe in 2008 (European Environment Agency, 2024) to estimate the annual emission of Hungarian passenger cars. Concerning the carbon emission of electric cars, we followed Csonka, Csiszár & Földes (2021) findings, presuming less than half of the emissions are compared to petrol cars, considering the emission of production as well (like batteries).

$$carbon\ emission\ savings = number\ of\ financed\ electric\ cars * average\ mileage * (GPCRP\ carbon\ emission\ factor - benchmark\ carbon\ emission\ factor) \quad (5)$$

Regarding renewable energy loans for solar power plants, at first, we identified the total contracted loan amount from the Database, then assuming a 70% loan-to-value ratio based on our experiences and discussions with market players, we could guess the financed new solar capacity. We set the investment cost and production coefficients using industry benchmarks (Losonczy, 2021; Németh, 2022) and taking into account the average contract date, namely February 2022. This date is important due to the applied EURHUF rate and also the definition of benchmarking carbon intensity of the Hungarian electricity mix (Nowtricity, 2024).

$$carbon\ emission\ savings = annual\ energy\ production * (GPCRP\ carbon\ intensity - benchmark\ carbon\ intensity) \quad (6)$$

The total carbon emission reduction is the sum of the avoided emission of mortgage, electromobility, and solar energy loans, which is equal to 626 thousand tons (Table 1).

Table 1: The estimated avoided carbon emission per loan purposes

	Thousand tons
Solar energy	564.5
Electromobility	6.8
Residential mortgages	55.1
Total	626.4

Source: own calculations

It is worth comparing this value to the total CO_2 emission of Hungary, which was 62.6 million tons in 2022 (HCSO, 2024b). Hence, we can say that GPCRP contributed to avoiding at least[3] 1% of the annual Hungarian carbon emission per year.

Thereafter we examine the efficiency of the GPCRP, which is measured by the unit cost of avoided carbon emission (7). In this case, the cost is prudential, which means that the benefit of prudential release is distributed between bank owners and green borrowers. Based on the avoided emission and considering the capital relief and the banks' cost of capital, we receive 15.2 EUR/tons per unit cost.

$$yearly\ prudential\ cost\ of\ carbon\ emission\ savings = (release\ in\ capital\ requirement * cost\ of\ capital) / annual\ avoided\ carbon\ emission \quad (7)$$

[3] As we mentioned earlier, we modelled 76% of GPCRP related to Hungary-based investments.

The most effective in this term is to finance solar energy plants because the unit price is the lowest in this case (12 EUR/tons). To assess this value, we identified the price of EU carbon permits as a reference since it connects to the European Union Emissions Trading System (EU ETS), the world's largest cap and trade greenhouse gas emissions market. EU ETS prices recently moved between 54 and 84 EUR[4]. The GPCRP unit cost is estimated much below this range.

6. Conclusion and policy implications

Based on our model, the solution of the green trilemma must be the negative relationship between capital level and the green effect. Thus, the green effect should have some preferential treatment in capital requirements. The current neutrality of capital regulation toward sustainability does not support the spread of green lending.

The European prudential capital regulation allows national competent authorities to give some capital relief for green lending under Pillar 2 of CRD. Such policy preference in capital regulation is not unique. SME and long-term infrastructure finance are already recognized in CRR/CRD regulations. However, despite their importance, we found hardly any studies backtesting their effectiveness. In this study, we assessed the experiences of the first preferential capital requirements for green lending program (GPCRP) introduced by the Central Bank of Hungary in 2020.

According to Dafermos & Nikolaidi (2021; 2022) GSF can reduce the pace of global warming and thereby decrease the physical and financial risks. We support this view. Currently, the relatively small-scale GSF program could contribute to avoiding 1% of the annual Hungarian carbon emission per year. We measured the cost efficiency of the GPCRP. The cost is prudential, meaning that the benefit of prudential release is distributed between bank owners and green borrowers. The program's unit cost is much below the current EU ETS prices.

Dunz et al. (2021) stated that GSF could be an effective tool to enhance green investments only in the short term. We dispute this position since the lifetime of activities financed by GPCRP is medium or long-term (solar energy, electromobility, residential mortgages).

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4 https://tradingeconomics.com/commodity/carbon

The literature highlights the potential trade-off between financial stability and supporting green transition as the main disadvantage of the GSF. (Dunz et al., 2021; Meng et al., 2023). The GPCRP limits the decrease of prudential safety. The P1 capital requirements are untouched. The capital requirement reduction could not exceed P2 add-ons and in total 1.5% of TREA. Currently, the program is far from reaching this TREA threshold. The slightly lower level of solvency might be justified by lower credit risk. However, additional evidence is required to substantiate this green hypothesis, suggesting that it could be an avenue for future research.

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Annex

Table 1A: Assumptions for calculation of carbon emission savings

mortgage			electromobility			solar		
	GPCRP property	benchmark property		GPCRP car	benchmark car		GPCRP solar	benchmark electricity power plant
number	13 416	13 416	number	3 546	3 546	new capacity (MW)	1 860	
average size (m^2)	105	105	average mileage (km)	21 717	21 717	investment cost (EUR/MW)	850 000	
carbon emission factor (CO_2/m^2/year)	20	59	carbon emission (gCO_2/km)	66	154	production coefficient (MW/year)	1 200	
						production (MWh/year)	2 231 812	2 231 812
						carbon intensity (gCO_2 / kWh)	0	253

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