Possible Real Economic Consequences of Financial Actors' Attitudes Towards Climate Change and Realized Risks

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Summary

The effects of climate change on the real economy are also reflected in the financial system. In this study, we examine the attitudes of key players in the financial system (central and commercial banks) towards the financial risks of climate change, based on the literature in the field. The key players in the financial system, the climate change-specific relationships of the corporate sector and the main channels connecting them are illustrated using a corporate project evaluation model, partly assessing which variables and risks a company should consider when making an investment decision. The results show that climate change can affect the performance of financial institutions in a number of ways, but these risks cannot yet be clearly identified in Hungarian interest rate spreads.

Keywords: climate change, financial institutions, interest rate spread

JEL codes: H43, Q56

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The changes we can observe in the climate force the actors of the economy to take certain steps. In our study, we approach this issue from the direction of financial institutions. The reason for that, on the one hand, is that this segment is in contact with all the players of the real economy, and, on the other hand, it is able to supply the financial resources required (though not sufficient alone) for sustainable operation to the economic sectors essential for the transition – to some extent, even without the committed support of political decision-makers. It is primarily the central and the commercial banks that we examine in respect of climate change.

Owing to the fact that the financial system is in contact with practically all other players of the economy, we consider it necessary to determine how the risks affecting them and their attitudes influence the players of the real economy, and the channels through which these impacts are realised in the operation of the companies. We will demonstrate all that with a macro-level model, in which the various aspects are built into a corporate project assessment situation that is based on true data, although inevitably simplified. Besides, we examine at macro level whether or not these risks appear in the pricing of loans and in the growth of interest rate spreads in Hungary.

The study has three objectives. Firstly, to systematize the quickly expanding literature that analyses the role played by financial institutions in climate change, and to present the trends that can be observed. Secondly, with a theoretical approach and the use of a model, to cast light on the aspects of realisation of risks and the attitude of the financial intermediary system to climate change, and the way they are able to influence the operation of companies. Thirdly, using an empirical approach, to examine the extent to which these risks have been built into the interest rate spreads of loans in Hungary so far.

Based on the above points, our research questions are as follows:

- What roles are played or could be played by the central banks and commercial banks in slowing down the process of climate change?
- Are the risks related to climate change detected in the pricing of loan products, and do borrowers have to face higher spreads in carbon-intensive industries?

In the next chapter of the study, we will review the conceptual framework of climate change relevant to our research, then present the methodology used in the study, and finally, we will examine the role of the banking system on both theoretical and empirical bases, and summarise our key findings.

KEY CHARACTERISTICS OF CLIMATE CHANGE

In the comprehensive report of the UN Intergovernmental Panel on Climate Change (IPCC), a summary aimed at decision-makers was published about the causes and consequences of climate change, seeking to draw attention to the fact that it would make a big difference if we made efforts to limit global warming to 1.5 degrees Celsius, instead of the 2 degrees Celsius accepted by the majority of the countries worldwide in the Paris Climate Agreement (IPCC, 2018).

Findings of the report relevant from the aspect of this study:

- warming up in a range over 1.5 degrees Celsius would probably cause extreme weather phenomena unprecedented under the present climate conditions, and in parallel with the rising sea levels, it would lead to major damage in the built infrastructure;
- the impacts of climate change may have a direct influence on human health, food

supply and agricultural activity, and these would lead to a measurable decline in the performance of the entire world economy;

- assuming glasshouse gas emissions maintained at the present rate, there is a fairly limited period of time that separates mankind from reaching the emission level that causes a warming of 1.5 degrees Celsius.

Although climate change is a truly complex process, its solution – at least in theory – is less complex: in order to ensure that global warming stays within the limits accepted in the Paris Climate Agreement, it is necessary to reduce the emission of glasshouse gases. Consequently, all activities that are the primary sources of emission, hereafter referred to as carbon-intensive activities, should be replaced with alternatives of lower carbon intensity, while maintaining the security of supply. From an economic point of view, climate change is an external phenomenon that presents a global problem, and in addition to the fact that the damage is not done intentionally, the injured parties cannot be directly identified either, as the negative consequences will be borne by the future generations, according to the forecasts (Stern, 2006). We have to make a distinction between future energy developments:

a green energy producers (e.g. wind and solar power plants, even nuclear energy);

b investments that are essential in the transition period (e.g. natural gas power plants, LNG terminals, gas pipelines);

c investments based on other fossil energy sources (e.g. coal-fired power plants, coal mines).

Regulators should offer incentives to the banking system so that banks could help group *a)*, limit developments of type *c)*, and, at the same time, finance the establishment of capacities required for safe supply in case of group *b)*.

METHODOLOGY OF MODELLING

Objective of modelling and theoretical approach

The impact of the adjustments by financial institutions (central and commercial banks) on economic players is modelled in the already described way, through the decision-making position of a company (in the oil industry). The objective of the model is to use a realistic example to demonstrate the channels through which the examined phenomena may influence the operation of companies. The model that was built by us and that inevitably simplifies reality demonstrates a methodology that can be used in real decision-making, too, if adjusted to the characteristics of the given company.

In our example, a profit-maximising company with a single activity (oil processing) has to make a decision about a project. Within the project, the company is planning to commission an *oil-refinery plant* of high carbon intensity, related to traditional oil industry activity. The plant is expected to operate for 10 years, during which period it will be depreciated linearly, without residual value. As a decision-making criterion, the company uses the net present value (NPV) calculated by discounting the cash flows generated as a result of the project. If this value is positive in the examined period, they will decide to implement the project, otherwise they will reject it.

Our objective is not just to model the decision but to identify the events that could potentially influence it. So, the question is not the general 'Is the investment worthwhile for the company?', but 'How would the company decide about the investment if it knew these changes were coming?'. Besides, we use the following assumptions:

❶ The capital structure of the company is stable, and it will not change in the examined period. In order to simplify calculations, in the model we did not consider any changes in net working capital (inventories, current assets etc.), either. The rationality of company management can be assumed, and they decide about the investment only on the basis of the NPV; also, there is a single universal tax rate in the model environment. The financial expenses of the company are due to the difference between interests paid and received only, with no other factors considered.

❷ The project data are based on the industry, without fully reflecting reality. Accordingly, the 10-year project period is also a simplification for the sake of the clarity of the project.

❸ As to the individual impacts, we assumed their occurrence *ceteris paribus* (with everything else unchanged), so that the individual channels could be well separated, with revenues and costs permanent during the specific period. Changes in the individual scenarios have direct impact on the decision; compensation, such as increasing the price of the product, and thus increasing revenues is not possible, as the demand is very price-sensitive.

Process of calculation and initial parameters

The net present value (NPV), that is the basis of the decision, originates from the usual equation:

$$NPV=\sum_{t=0}^{10} FCFF_t \times \left(\frac{1}{1+WACC_{project}}\right)^t$$

It can be calculated on the basis of the weighted average capital cost of the project

$$WACC_{project}=WACC_{company}+\alpha=$$
$$=\left[\frac{E}{V}\times r_e+\frac{D}{V}\times r_d\times(1-T)\right]+\alpha$$

(Modigliani, Miller, 1958), in the usual way.

- r_e: the yield on the company's equity based on the CAPM (Sharpe, 1964). The risk-free yield is the yield of the 10-year HUF bond as of 24 March 2021 (Trading Economics, 2021), β the MOL risk compliant beta compared to S&P500 (Erste, 2021), the market yield is the expected average yield of S&P500 in 2021–2030 (Scheid, 2020);
- α: is the compensation element of the project. The purpose of this value is to bring the corporate WACC value calculated from the data in the MOL report as a model company close to the typical value mentioned in the report for oil refining projects.

The financial data of the company are based on the MOL 2019 report (MOL 2019). The initial values of the individual parameters in the model can be seen in *Table 1*.

The investment costs of the company in year zero amount to USD 5.5 billion. We estimated all that on the basis of the arithmetic mean of the intervals by *Tuttle* (2019), who mentioned in his paper that the establishment of an oil-refinery capable of producing 100 thousand barrels of oil per day would cost USD 6.9–8.6 billion in Canada, and USD 2.9–3.6 billion in China (Tuttle, 2019).

The capacity of the oil refinery is 100 thousand barrels per day, and in the long term, the unit price per barrel is estimated to be USD 53 (Fitch, 2021), while the annual cost of raw material is USD 1,908 million in the case of operation for 360 days. Based on the cost distribution that is typical for oil-refineries – 85 per cent crude oil, 15 per cent operating cost (Robinson, 2006) – the operating cost is USD 337 million per year, and the sum of

Table 1

PARAMETERS OF THE MODEL COMPANY

	millió Ft	%
E	2,451,369	
D	2,680,918	
V	5,132,287	
Profit before taxation	275,699	
Tax expenses	47,318	
T		17.16
Total loans	909,039	
Total interests	19,946	
r_d		2.19
r_f		2.71
r_m		6.00
β	1.23	
r_e		6.76
α		3.00

Source: own calculation based on the data of MOL (2019).

these two make up the total annual cost (USD 2,245 million).

Oil and gas companies in the USA in 2014–2019 had an average gross margin of 30 per cent (Avdeey & Co, 2021), so the calculated annual revenue would be USD 3,207 million (see *Table 2* for the initial model parameters). In the initial model $NPV = 445$ (million USD), so a rational company management would decide to implement the project, based on its present knowledge.

THE ROLE OF THE BANKING SYSTEM IN THE MANAGEMENT OF FINANCIAL RISKS STEMMING FROM CLIMATE CHANGE

In this chapter, with the help of the relevant literature, we will first review the role that can be played by central banks in promoting funding to fight climate change. Following that, we will present the relevant commercial bank practice and the underlying main driving forces and, finally, we will model the elements of the observed trends that are relevant from the aspect of corporate decision-making.

Review of literature

Several studies point out that it is basically decision-makers with political legitimacy who can take proper measures and contribute to a transition to a less carbon-intensive economic structure (UN, 201; Breitenfellner et al., 2019). In order to reduce the intensity of carbon dioxide emission, it is necessary to establish proper incentives, essentially a uniform price, tax or quota system on emissions,

Table 2

INITIAL MODEL PARAMETERS

Description	Year										
	0	1	2	3	4	5	6	7	8	9	10
(1) Sales	0	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7	3,206.7
(2) Cost of raw materials	0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0	1,908.0
(3) Cost of operation	0	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7	336.7
(4) EBITDA (1)-[(2)+(3)]	**0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**	**962.0**
(5) Depreciation	0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
(6) EBIT(4)-(5)	**0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**	**412.0**
(7) Profit on financial transactions	0	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9	37.9
(8) Taxes	0	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7	70.7
(9) NOPLAT (6)-(7)-(8)	**0**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**	**303.4**
(5) Depreciation	0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0	550.0
(10) Operating CF (9)+(5)	**0**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**
(11) TE purchase	5,500	0	0	0	0	0	0	0	0	0	0
(12) Investment CF (9)+(11)]	**–5,500**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
(13) FCFF(10)+(12)	**–5,500**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**	**853.4**
(14) Discount rate	1	0.93	0.87	0.81	0.76	0.7	0.66	0.62	0.57	0.54	0.50
(15) PV(13)*(14)	–5,500	796.24	742.92	693.18	646.76	603.45	563.04	525.34	490.16	457.34	426.72
NPV [(15) amount]						**445.0**					

Source: own calculation

the practical implementation of which is often discussed in analyses (cf. Martin, 2014). There is a study on the relevant aspects of such regulations from the point of view of central banks, too: the nature of the climate protection regulation basically determines what monetary policy response is justified, therefore cooperation between regulators and central banks is extremely important (McKibbin et al., 2017).

Among the experts on the subject there is no consensus about the role of monetary policy in combating climate change. Some researchers believe that central banks have the capacity to become leaders in this field, taking the place of political decision-makers and other relevant players. As the pricing of carbon dioxide emission is not feasible for political and social considerations, the regulatory activities of central banks become more valuable (Campiglio, 2016). As another argument for the involvement of central banks, Campiglio mentioned that since the introduction of regulations after the 2008–2009 financial crisis, there has been a secondary market failure on the credit markets too, which means that since then commercial banks have been avoiding holding and lending risky, particularly longer-term less liquid assets, and therefore they do not take the price indications originating from carbon tax into consideration, and do not prefer 'green' projects that usually require long-term investment either. Because of all that, the author is of the opinion that a tax-like approach which influences prices would be impractical, so central banks should have an essential role as they are able to promote transition with rules of different types.

The above points are consistent with the statement that central banks should take part in combating climate change because that is the best scenario by far, i.e. political regulation does not work (UN, 2017). This, however, obviously depends on the scope of competence of the given central bank, as specified by the law of the specific country.

Based on this, it is possible to identify some analysts and professional players who think that if climate protection regulations are not successful from the political side, the central banks should also intervene. As to the depth of this intervention, it is the subject of debate as there is a concern that active involvement in climate issues will damage the 'original' central bank competences.

However, central banks around the world have recognised the risks of climate change to financial stability. At the end of 2017, 18 central banks and supervisory bodies and 5 international organisations cooperated in setting up the 'Network of Central Banks and Supervisors for Greening the Financial System' (NGFS) (NGFS, 2018), which had 98 active members and 16 members with observer status in October 2021 (NGFS, 2021), seeking to to help central banks and supervisory bodies through recommendations. In a recently issued publication, the NGFS invites its members to explore the exposure of financial institutions under their supervision in those sectors that could be most affected by transition risks and to make sure that these institutions manage their risks properly and intervene in the process if necessary (NGFS, 2020). The extensive geographical distribution of climate-relevant central bank involvement has also been observed recently. A fairly symbolic example is the fact that the Federal Reserve, which issues the US dollar that serves as the primary global reserve currency, integrated the risks of climate origin in its stability report for the first time at the end of 2020 (FED, 2020), and joined the NGFS, too (Brainard, 2020).

Based on a review of the practices of various central banks, it is worth separating 2 main intervention methods (Campiglio et al., 2018). One of them approaches the

issue from the direction of risk assessment, with contents very similar to the NGFS recommendation described above. Of the practical implementations it is worth highlighting the procedure called *climate stress test* (Boros, 2020), in which the banks (at each level of the banking system) model the impact of the realisation of individual climate change risks on individual banks and on the whole banking system. In practice, similar procedures are already under development in several countries (ACPR, 2019; BoE, 2019), and the National Bank of Hungary (Magyar Nemzeti Bank, MNB) is also planning its introduction (Gyura, 2020a), while the Dutch National Bank has actually completed it, and it is often referenced as a benchmark in literature. Here they examined the macroeconomic aspects of two types of transition shock scenarios, then examined the impacts on 56 industries, and finally modelled the impacts on the financial system, depending on the exposure of the individual financial intermediaries in the carbon-intensive industries affected by the shock. The research found that if the banks conduct tests for themselves too, they can use the results to draw conclusions that will fundamentally influence their investment decisions (Vermeulen et al., 2018).

The second group of central bank interventions covers the inclusion of environmental protection aspects in the regulatory method (Campiglio et al., 2018). It is mainly in developing countries where we can see some examples that the central bank provides extra liquidity to commercial banks financing projects of low carbon intensity, or they stipulate minimum requirements that are mandatory to invest in such projects. The Chinese regulation is similar to that, as their central bank defined a principle that financial intermediaries should give preference to projects of lower carbon intensity in their investment decisions (CBRC, 2012). Another example is the practice followed by the European Central Bank, seeking to invest its pension fund and the reserves managed by it in ways that meet the sustainability criteria (Cœuré, 2018).

Another option could be a dynamic determination of capital requirements depending on what kind of company is financed by the bank from an environmental point of view (Rozenberg et al., 2013). This is similar to the MNB's recently introduced programme to improve the energy efficiency of residential buildings, which offers preferential capital requirement to credit institutions that provide loans for such purposes (MNB, 2021).

The instrument that is in the hands of central banks and is probably the most debated one is the application of quantitative easing according to climate protection aspects, which in this case means that the central bank purchases bonds issued by companies that pursue activities with low carbon intensity (Mihálovits & Tapaszti, 2018). After the crisis of 2008–2009, there was a possibility, especially in Great Britain, that this non-conventional central bank instrument could be used to promote the green rebuilding of the economy (Harvey, 2012). However, this idea has been criticised, too: *Rudebusch* (2019) used an American example to argue that pursuant to effective regulations, the Federal Reserve could purchase the bonds of government bodies only, so this instrument could not be utilised for 'green' purposes (Rudebusch, 2019). *Matikainen et al.* (2017), on the other hand, used the examples of the European Central Bank (ECB) and the Bank of England to show that these two institutions, in their bond purchase programmes, buy much more bonds from companies involved in carbon-intensive activities. This practically results in the fact that they become deeply embedded in the economic structure, which makes their replacement with alternatives that

are better from climate aspects more difficult (Matikainen et al., 2017).

Cœuré's (2018) response given to this criticism highlights two problems. He argued that the ECB buys the bonds of these companies because their liquid nature makes them suitable for use in foreign exchange transactions, which is necessary for the ECB to achieve its primary objective: the maintenance of price stability in the Eurozone. On the one hand, this proves that the ECB's mandate primarily covers the achievement of price stability, and any other goal may be desirable only as long as it does not hinder the achievement of the primary objective (EU, 2016). Therefore, on the whole, the central banks cannot be expected to play an active role in combating climate change at this level. Cœuré's position is actually the main argument for the side that opposes a central bank involvement that would be much more active then at present.

On the other hand, the issue of the liquidity of assets indicates one of the most important problems for the commercial banks in the transition to an economic model of lower carbon intensity; and this takes us to the discussion of commercial banks.

Spence and Stevenson (2013) pointed out that the 2008–2009 crisis and the subsequent agreements to strengthen the stability of the banking system (e.g. Basel III) created an environment in the financial markets which encouraged banks to refrain from keeping long-term, high-risk and less liquid assets. Considering the fact that the financing of low carbon intensity projects basically falls into this category, this makes the supply of capital for them much more difficult. This way the practice followed by commercial banks and the reason why they do not allocate more funds to industries that are more favourable from climate protection aspects are primarily justified by credit market and regulatory conditions. In spite of that, the role of banks keeps growing in the financing of industries that are active in combating climate change (Buchner et al., 2019), and they try to express their commitment to a more sustainable financial system even more extensively (Gyura, 2020b). A recently growing segment of bank involvement is the appearance of loans tied to sustainability, where the point is that the interest rate depends on whether or not the borrower meets the assumed sustainability objective – be it the improvement of energy efficiency, the reduction of carbon dioxide emission or water consumption (LMA, 2019).

The reason why this may be advantageous for companies is that they are able to give evidence to external parties affected by their operation about the fact that the aspects of sustainability are enforced in their operation. As it is indicated in *Figure 1*, the market of these loans has been actually operating since 2017, and it has developed quickly ever since: the allocated total volume increased 24 times from 2017 to 2019 (Statista, 2020). In addition, *Tóth et al.* (2021) pointed out that the application of environmental, social and governance (ESG) performance is already a key consideration, and has a favourable influence on financial stability.

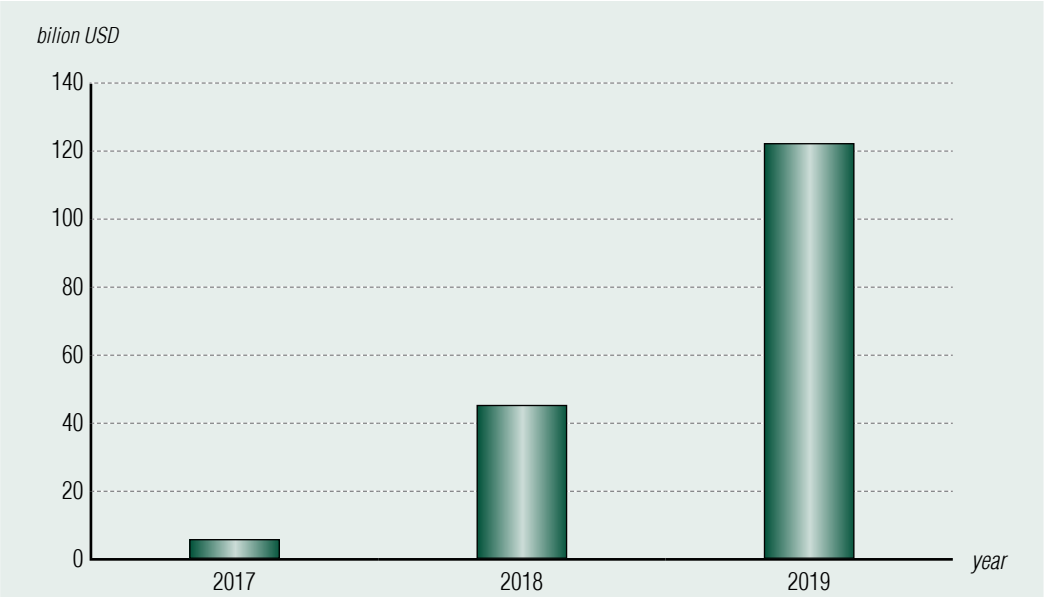
Involvement of the banking system, modelling of the impact on corporate project assessment

It is an important presupposition of this part of the analysis (modelling) that the same specifications apply to all external obligations of the company, and the bank can modify the terms. In the scenario we assume that the return on loans would increase, and the related causes and impact mechanisms are summarised in *Table 3*.

As you can see in Table 3, both the changes

Figure 1

VALUE OF LOANS ISSUED AND TIED TO SUSTAINABILITY



Source: Statista (2020)

Table 3

IMPACT MECHANISM OF CHANGES OCCURRING AS A RESULT OF THE ROLE PLAYED BY THE BANKING SYSTEM

Event	Root causes	Impact on corporate decision
Increasing return on commercial bank loans	Stricter central bank capital requirements tied to climate impacts;	❶ Expected return on external obligations of the company to increase; present value of cash flows to decrease; ❷ Interest expense of the company to increase, financial expenses to increase, present value of cash flows to decrease
	Introduction of a general mandatory climate disclosure obligation or the result of climate stress test completed in own competence, as a result of which the bank adjusts the interest rate according to the increased risks (connection with the realisation of transition risks)	
	Modification of the bank's lending practice according to market demands (e.g. further increase in loans related to sustainability)	

Source: own editing

in the central bank regulatory environment and the changes made by banks in their own operation may impact corporate decisions. The impact occurs through two channels: it reduces the value of the discount rate and the profit realised by the company. As a result of both factors, the present value of cash flows declines from the first year, but the initial investment cost is realised in year zero, i.e. in the present, so it is not affected by the changes.

In this scenario we model the level of the external obligations of the company where NPV=0 if the impact is felt already from the first year, or from year six only. The results are summarised in *Table 4*.

If the interest rate increases already from the first year, 3.59 per cent is the level where the NPV=0; this means a growth of 1.40 percentage points, i.e. 63.82 per cent. If the change occurs from year six only, it is necessary to have a growth of 2.92 percentage points (132.96 per cent) so that the interest rate could reach the 5.11 per cent annual level that results in the *NPV*=0 level. The latter means a more significant growth, but, in the light of the findings in literature, involves certain risks. Accepting the correctness of the scientific consensus on the existence of the 'carbon dioxide emission limit', this emission limit – in order to avoid the worst consequences – will be much lower in 2026 than today, if we assume a *business as usual* behaviour until then. This way the adjustment due to increased risks would obviously be more significant.

DEVELOPMENT OF INTEREST RATE SPREADS

Our analysis examines the sustainability characteristics of lending also from a different aspect. For our empirical analysis, we use Hungarian loan data from the MNB HITREG data supply, and we compare the interest rate spreads of the instruments of corporate loan agreements disbursed between 2015 and May 2021. As we have no information on the sustainability characteristics of individual loans, we aggregate companies and average interest rate spreads by branches of the national economy, examining their changes over time. It is important to point out that at the possible level of aggregation, i.e. within the branches of the national economy, the companies belonging to individual branches are not homogeneous in respect of carbon intensity,[1]

Table 4

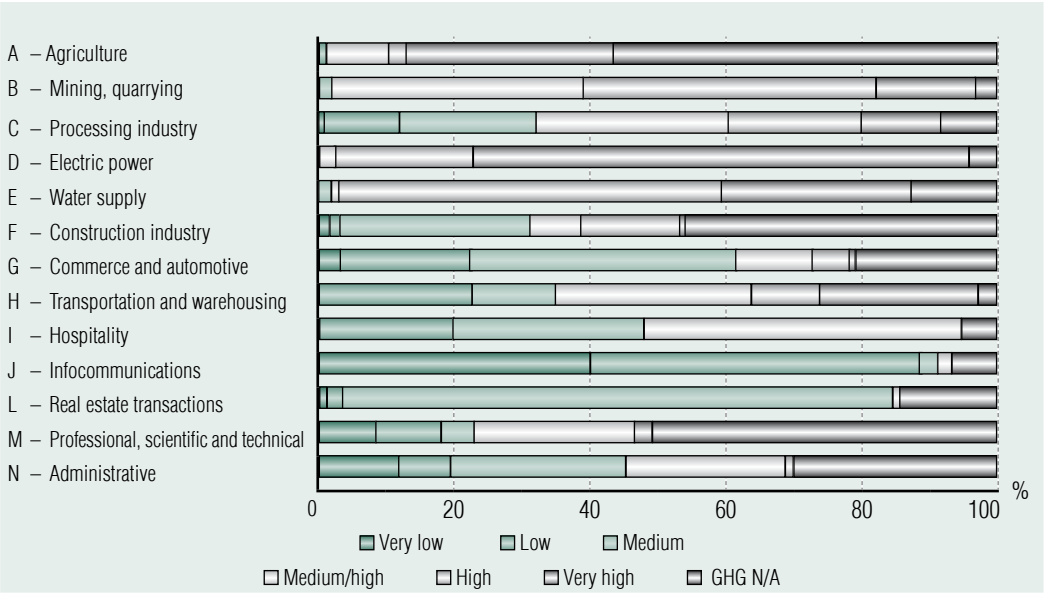
SENSITIVITY OF THE MODEL COMPANY'S PROJECT EVALUATION IN THE CASE OF AN ASSUMED CHANGE IN THE ATTITUDE OF THE BANKING SYSTEM: THE LEVEL LEADING TO ZERO NET PRESENT VALUE

Level of return expected by creditors	Expected return (r_d), (%)	Financial expenses (million USD)	Growth (percentage points)	Growth (%)
Baseline scenario	2.19	37.92	–	–
Growth from year 1	3.59	79.66	1.40	63.82
Growth from year 6	5.11	124.87	2.92	132.96

Source: own calculation

Figure 2

DISTRIBUTION OF THE GHG INTENSITY OF COMPANIES IN THE INDIVIDUAL BRANCHES OF THE NATIONAL ECONOMY



Source: EBA, 2021

therefore the greenhouse effects of the national economy branches are identified on the basis of a survey conducted by the European Banking Authority in 2021 *(Figure 2)*. Based on the data, the most polluting branches of the national economy include the electric power industry, agriculture, water supply, mining, transportation and warehousing, and the processing industry. Relatively low environmental pollution impacts can be observed in infocommunications, real estate transactions, professional, scientific and artistic activities, and the administrative sectors.

Our analysis primarily examines the changes in the average spreads of disbursed loans over the given years. For the sake of comparison, we had to narrow down the loan contracts to use, and only investment loans not supported by state or central bank schemes and tied to reference interest rates were considered.[2] The reason why we selected investment loans is that we believe that possible interest rate spread increase over the years can be detected mainly in loans of longer terms, which are more relevant for our research. It is important to note that for data access reasons our analysis cannot be considered to have full evidential value, as the composition of companies with loans may be different over the years in the given branches of the national economy, and we are unable to measure the distortion caused by companies without loans. In addition, we have to point out that the definition of the interest rate spread may depend on other conditions too, and as it can be seen in Figure 2; the national economy branches are not homogeneous either, as they include sets of companies with low and high GHG effects, which we combined through aggregation (*Table 5*).

Based on our results, we can observe that in 2016–2020 the national economy branches with higher carbon intensity experienced

Table 5

AVERAGE SPREAD OF DISBURSED CORPORATE LOANS, BROKEN DOWN BY YEAR AND NATIONAL ECONOMY BRANCH

National economy branch	Year of conclusion						Ratio (%)	Change (pp)
	2016	2017	2018	2019	2020	2021	2020/2016	2020/2016
Agriculture	2.52	2.63	2.77	2.73	2.54	2.53	100.93	0.02
Mining and quarrying	2.06	2.23	1.78	2.20	2.65		128.48	0.59
Processing industry	2.82	3.30	3.40	3.75	2.96	2.80	104.96	0.14
Electric power	2.05	2.37	2.15	2.37	2.34	2.32	114.09	0.29
Water supply	1.52	3.85	2.75	2.71	2.54	2.40	167.20	1.02
Construction industry	3.47	4.40	3.81	3.76	3.44	3.71	99.15	–0.03
Commerce and automotive	3.72	3.77	3.73	3.57	3.36	3.18	90.22	–0.36
Transportation and wareh.	3.07	3.73	3.72	3.80	3.43	3.49	111.60	0.36
Hospitality	3.73	4.07	3.71	3.71	3.67	3.11	98.31	–0.06
Infocommunications	3.76	4.43	4.19	4.21	4.21	4.36	111.81	0.44
Fin., insurance activities	2.73	2.38	2.66	2.14	2.42	1.94	88.67	–0.31
Real estate transactions	5.71	4.85	4.25	4.64	4.81	4.78	84.27	–0.90
Professional, scientific and technical	3.75	4.37	4.16	3.95	3.84	3.52	102.43	0.09
Administrative	3.51	4.02	4.06	3.46	3.64	3.38	103.73	0.13
Public administration		2.00	3.75	2.20				0.00
Education	4.48	4.90	4.55	4.29	3.56		79.41	–0.92
Social care	3.72	4.36	4.08	4.00	4.04	3.69	108.48	0.32
Arts, entertainment, leisure	4.54	3.81	4.22	4.97	4.26	2.83	93.74	–0.28
Other	4.15	4.97	4.88	4.05	4.67	2.95	112.49	0.52

Note: Contains data until end of May 2021.
Source: MNB HITREG, 2021

increasing interest rate spreads in a slightly higher ratio, and the growth of spreads was of a relatively higher rate than in the case of branches with low emissions. The average interest rate spread increased between these two dates in the agricultural, mining, processing, electric power, water supply, and transportation and warehousing sectors. Within that, we can see significant growth in water supply, electric power, mining, and transportation and warehousing.[3] In the case of agriculture and the processing industry, significant growth was seen in the interim years, which dropped later, but we could still observe a slight increase in 2020. Among the less polluting branches of the national economy, only the real estate sector was able to experience a drop in interest rate spreads, while in the case of professional, scientific and artistic, as well as administrative activities, a growth of 2–4 per cent can be

seen. In the case of the latter two branches, we can see a similar phenomenon than in the processing industry and in agriculture. The interest rate spread of the infocommunications sector clearly increased during the period, as we saw a 12 per cent increase from 2016 to 2020. Besides, the real estate transactions sector appears to be similarly clear, with a 16 per cent drop in the specified period. Among the sectors not classified according to GHG effect, it is worth highlighting commerce and vehicle repair, where a clearly decreasing trend was detected, and it reached 10% between the two dates. All in all, we do not think that there would be a clear difference between the trends in the average spreads of sectors causing more or less pollution from the aspect of greenhouse gases; in the first set, on average, we found a somewhat higher growth, although insignificant. However, the exploration of a clearer relationship would require high-quality, unique micro-level and more disaggregated loan data, for which the sustainability characteristics are known, and which may allow for the application of a more complex methodology.

SUMMARY

The study examined the financial and economic risks of climate change by reviewing the relevant literature and the investment decision of a company operating in the oil industry. Within that, mainly the attitude of the narrowly defined banking system towards the management of climate risks and the phenomenon of climate change, and the related aspects influencing the operation of companies were examined.

The scientific discourse as to whether central banks should play a role in the solution of climate change problems, and if yes, in what depth, is intensifying. International cooperation between central banks and prudential regulators keeps developing. Some of the researchers and central bankers visualise the tasks of central banks in the field of mapping the risks to the banking system, and they expect the players of the banking system to recognise the risks affecting them and make changes in their operation. Others suggest interventions through regulations, in order to actually encourage commercial banks to give preference to the financing of projects of low carbon intensity. We can already observe a number of regulations around the world, and the introduction of new ones is also considered. One of the most drastic ways is the application of quantitative easing for climate purposes. However, this a highly disputed idea, and it points out that the current central banks tools do not include an active role in climate protection. The commercial banks, whose financing decisions may prove to be a major determining factor in combating climate change, are presently not directly interested in financing alternative solutions to carbon-intensive industries due to the current regulations and the general characteristics of the loan market. In spite of that, the banks seem to be gradually shifting towards capital allocation based on sustainability aspects.

In the decision-making models of companies, the changing attitude of the banking system toward climate change can be seen in the level of return expected from the external liabilities of the company; its growth reduces the cash flow generated by the project and the financial results of the company from the first year, so it increases the payback period. For the time being, Hungarian loan data do not clearly show the realisation of risks related to climate change in interest rate spreads. However, the analysis cannot be considered full scale, and we believe that a truly accurate analysis would be possible through micro data, which are unavailable at the moment. ■

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Notes

[1] A good example for this is electric power generation with areas to be supported in the climate fight (e.g. solar power plants, wind power plants), as well as areas that should be reduced (e.g. coal power plants), and sub-branches to be increased in the transition period (e.g. natural gas power plants to compensate for fluctuations in green electricity production that depends on the weather conditions).

[2] The reliance on the reference interest rate helps the comparison of interest rate spreads, and the lack of support obviously eliminates the distortion caused by supports provided in interest rate spreads from the analysis.

[3] The former three are characterised by quick fluctuations in the period of 2016-2021, because of the low number of elements.

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