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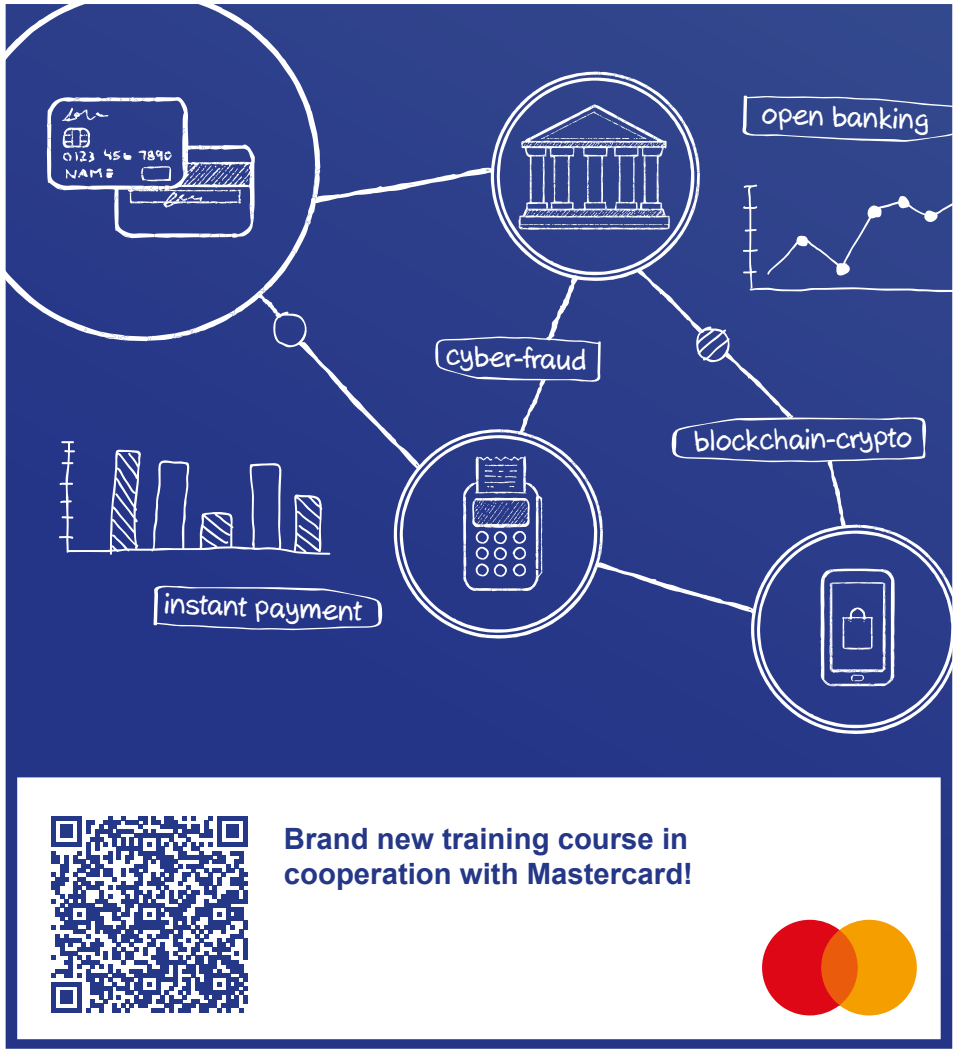

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US BANK FAILURES SPRING 2023

Part Two: Real risks, (mis)diagnoses, (mis)recommendations

Júlia Király – András Mikolasek[1]

ABSTRACT
In March 2023, a banking panic hit the US market and affected Europe. The panic proved short-lived with no lasting real economic consequences, which would justify a complete overhaul of the current banking model. In the first part of our study, we set out the details of the three selected US banks' paths to failure. In the current second part, we analyse the three cases by digging deeper into the risks for banks. We show that the sophisticated risk indicators could not reliably predict such a panic and its consequences. Rather, it was the banks' flawed business models and corporate and risk management cultures that played a key role in the failure, and their inability to manage the risks arising from rapid growth and interconnected customer networks. Future supervisory investigations need to focus on this rather than mechanical indicator analysis.

JEL codes: E4, E5, G21, G28, G33

Keywords: bank crises, bank failures, bank panic, Silicon Valley Bank, Silvergate Bank, First Republic Bank

1 INTRODUCTION

In the first part of this paper, published in *Economy and Finance* 2023, issue 3, we summarised the brief history of the series of bank failures. We highlighted the three major US banks, Silicon Valley Bank (SVB), Signature Bank and First Republic Bank (FRB), which are mainly based in California, and analysed their business models and development history, with a special focus on the last three years. We showed that prior to COVID, the banks were seemingly healthy, profitable and safe. We described the big shift that Covid triggered, the emergence of an abundance of liquidity, accompanied by a rapid increase in bank deposits, followed by the steepest cycle of interest rate rises in forty years, which triggered

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a contraction in liquidity and deposits and a rapid depreciation of fixed rate assets. This surge has also been a major factor in the subsequent stalling of the tech sector recovery. We have analysed the response of the banks under review to the big shift, the unexpected and extremely rapid growth in their size, the surge in deposits and the problems triggered by the surge in interest rates. We showed that, although many of their financial indicators continued to show the picture of a healthy bank, the panic in the markets knocked these banks off their feet because their closed customer base, the concentration and interconnectedness of their customers and the high proportion of uninsured deposits made them the most vulnerable of similarly poorly managed banks.

The series of bank failures in the spring was the first major systemic threat to financial stability since the global financial crisis, so it is not surprising that almost every banking analyst in almost every country reacted immediately. Various diagnoses were made, with a wide range of therapeutic proposals. Almost all the major banking experts have spoken out in one form or another (e.g. *Bair*, 2023; *Cecchetti–Schoenholtz–White*, 2023; *Kelly*, 2023; *Véron*, 2023; *Admati–Hellwig–Portes*, 2023; *Danielsson–Goodhart*, 2023; *Dewatripont–Praet–Sapir*, 2023; *Tucker*, 2023; *Wolf*, 2023a; 2023b). A long debate has unfolded on one of the most popular European economic blogs, VoxEU.org[2] , and the New York Stern Business School has published an online volume on lessons from the crisis with the help of world-renowned banking experts (*Acharya* et al., 2023), and a number of excellent analyses have been published on the Bank Policy Institute, the platform for the most prominent US banks, and on the BanReg blog site, which provides excellent analysis.

In May 2023, the Clark Center, known for its surveys on economics, asked only US academic economists two questions on the essence of banking (CCF, 2023a), and in September 2023 it asked both US and European economists on the economic policy steps needed after the crisis (CCF, 2023b; 2023c). As we will return to the results of the survey several times later, we have summarised the questions and the distribution of responses in a table *(Table 1)*:

2 https://cepr.org/voxeu-debate-lessons-recent-stress-financial-system

Table 1
Clark Center Forum (CCF) survey of academic economists in the US and Europe*

	Where, when	Strongly agree	Agree	Uncertain	Disagree	Strongly disagree	
Since maturity transformation is an inherent feature of commercial banks' business model, some duration mismatch between assets and liabilities is unavoidable.	US 2023 May	22%	45%	4%	28%	0	99%
The response to recent bank failures should be to: Expand central banks' lender of last resort facilities for banks.	US 2023 September	0%	52%	14%	34%	0%	100%
	Europe 2023 September	0%	26%	39%	27%	9%	101%
The response to recent bank failures should be to: Substantially increase the limit on bank deposit insurance.	US 2023 September	0%	46%	22%	33%	0	101%
	Europe 2023 September	2%	29%	14%	42%	13%	100%
The response to recent bank failures should be to: Substantially increase bank capital requirements.	US 2023 September	13%	79%	8%	0	0	100%
	Europe 2023 September	24%	49%	14%	9%	5%	101%
For the purposes of capital regulation, banks should be required to mark their holdings of Treasury and Agency securities to market at all times (even though their loans are not marked to market).	US 2023 May	21%	43%	28%	8%	0%	100%
The response to recent bank failures should be to: Use market values of all traded assets to compute banks' regulatory capital.	US 2023 September	27%	29%	31%	13%	0	100%
	Europe 2023 September	9%	39%	30%	23%	0	101%

Note: * Responses were weighted according to the degree of conviction of the respondents. In total, 30 US and 35 European economists answered the questions.

All the bodies with some interest in the supervision, oversight or evaluation of banks have produced their own reports, which will be quoted several times in later chapters (CRS, 2023; DFPI, 2023; DFS, 2023; FDIC, 2023a; 2023b; Fed, 2023b; GAO, 2023; OIG, 2023). The full transcripts of the hearings held in the US by the relevant Senate and Congressional committees, which were not free of political demagoguery, are available at[3] (a good summary is provided by *Meade*, 2023). The

3 https://www.banking.senate.gov/hearings/examining-the-failures-of-silicon-valley-bank-and-signature-bank; https://www.banking.senate.gov/hearings/strengthening-accountability-at-

testimonies of former bank executives are very instructive (*Becker*, 2023; *Roffler*, 2023; *Shay*, 2023).

Last but not least, there are good analyses in Hungarian that go beyond the newspaper reports (e.g. Király, 2023; *Mérő*, 2023; *Nagy*, 2023; *Zsiday*, 2023a; 2023b). Half a year after the banking crisis, we can see that this panic has remained an isolated phenomenon, has not spread, and has not resulted in measurable losses to the real economy. But it has eaten up taxpayers' money on both sides of the ocean. In the US, the losses are realised by the FDIC (Federal Deposit Insurance Corporation), it is not yet possible to see exactly how large (estimated at around 30 billion Acharya et al., 2023:167). The FRB was bought almost entirely by JPMorgan after a quick tender. SVB's remaining deposits were taken over by First Citizen Bank, and Signature's by a subsidiary bank of New York Community Bancorp. The buyers bought some of SVB's and Signature's assets at a very depressed price (20-30 percent of book value[4]), with the bulk remaining in FDIC custody for the time being[5] . The result of the mergers and acquisitions is quite clear: the purchase at depressed prices has already this year caused the bidding banks to make billions in attributable profits and capital gains, not only for the US banks but also for UBS, which is absorbing the Credit Suisse (*Indaap*, 2023). This has meant billions in losses for the taxpayers. It is therefore not surprising that criticism of the banking system as a whole has intensified.

In this paper, we delve into the history of the three US banks, but avoid delving too deeply into specific US banking market anomalies that are much better known by our US colleagues, such as the inevitably recurring liquidity disruptions in the sovereign debt market (*Duffie*, 2023), the liquidity disruptions affecting the US banking system as a whole (Acharya–*Rajan*, 2023) or the role of the FHLB shadow central bank (Cecchetti et al., 2023).

We do not discuss the debate on deposit insurance, despite the fact that a high proportion of uninsured deposits was one of the reasons for the failure. We do not believe that changing the deposit insurance limit would have resulted in a substantially different situation. We agree with the academic researchers on this point: on neither side of the Atlantic is it considered necessary to raise the deposit

the-federal-reserve-lessons-and-opportunities-for-reform; https://www.banking.senate.gov/hearings/oversight-of-financial-regulators-financial-stability-supervision-and-consumer-protection-in-the-wake-of-recent-bank-failures; https://financialservices.house.gov/calendar/eventsingle.aspx?EventID=408768;

4 Some even suspected that the whole bank run was in fact just a staged prelude to a hostile (cheap) takeover (Indaap 2023).

5 https://www.fdic.gov/news/press-releases/2023/pr23023.html and https://www.fdic.gov/news/press-releases/2023/pr23021.html

insurance limit. In the Clark Center survey, 46% of US economists and only 31% of Europeans thought that raising the limit was a proposal worth considering (despite the much lower limit in Europe, at just €100,000 compared to $250,000). We also do not enter the debate on whether it was a good move to pay off the uninsured deposits of the SVB and Signature, agreeing with the arguments of former FDIC head *Sheila Bair* (Bair, 2023) and two prominent banking researchers (Rajan and *Zingales*, 2023) that it was a bad idea, although it did seem to mitigate panic at the time.

In principle, we will refrain from deeper analysis of the US regulatory and supervisory environment, as our US colleagues who live in it are much more knowledgeable (see for example Acharya et al 2023, Cecchetti–*Schoenholtz*, 2023; or the Bank Reg Blog analyses). However, we should still mention the US regulatory and supervisory environment in the context of risk analysis, and this is the subject of the short *Chapter 2*. We then look at the "two Achilles heels„ of banks: liquidity and interest rate risk. In *Chapter 3,* we look in great detail at the features of liquidity risk measurement, management and mitigation in failed banks' practices, and reflect on what could have been done differently, and then *in Chapter* 4 we do the same with interest rate risk in the banking book (IRRBB). In *Chapter 5, we* discuss the corporate governance issues related to risk management. *Chapter 6* meditates on the size and measurement of regulatory capital and, in this context, the valuation of bank assets. In *Chapter 7* a few proposals that can be called corner solutions will be outlined, which go beyond the nowadays banking model.
Finally, *in Chapter 8* we briefly summarise our main findings.

2 THE US BANKING REGULATORY AND SUPERVISORY ENVIRONMENT COMPARED TO THE EU

In Europe, even the smallest banks are regulated and supervised on the basis of the Basel principles, and within the European Union there are not only more and more *regulations* that cannot be changed by individual countries, but there are also fewer and fewer differences in the implementation of directives between countries. One of the most important lessons of the global financial crisis has been the transformation of the European supervisory system: the European Central Bank supervises the big banks that pose a systemic risk in Europe, the three largest banks the countries that have joined the Banking Union (including all euro area countries). For the other banks and for banks in countries outside the Banking Union, responsibility lies with the national central banks or independent national supervisors. The European Banking Authority (EBA) sets supervisory guidelines uniformly in Europe and these are generally applied uniformly in

all countries. This is not to say that European banking regulation and supervision is flawless, but it is an indication that this time the US banking panic did not spread to the European single banking market, as Credit Suisse was *not* a bank in a member state of the Banking Union. It should be noted here that Hungary is not a member of the Banking Union.

In the US, both regulation and supervision are much more fragmented. The Bank Regulation blog (Bank Reg Blog, 2023a; 2023b) provides an excellent summary of this and the changes that are expected in the near future.

Regarding the regulation, the short point is that the regulation (the famous Dodd-Frank Act), which was introduced uniformly after the global financial crisis, was significantly relaxed for small and regional banks, especially during the *Trump* administration in 2018[6] , as a result of which, for example, none of the banks we examined participated in the federal stress tests, but they did not have to calculate the liquidity and interest rate risk ratios as redefined in the Basel guidelines, and in their case the requirements for the organisational system of risk management were also relaxed. This illustrates the classic theorem of banking theory that the next banking crisis always starts with a relaxation of the rules adopted during the previous crisis. In the wake of the March bank panic, it is expected that the relaxation will be withdrawn, at least for banks with a balance sheet total of more than USD 100 billion.

The weaknesses in regulation may be counterbalanced by a very strong professional supervision. However, in the US, the work of banking supervision is even more complex than regulation, and despite efforts to simplify and concentrate after the global financial crisis, it remains fragmented among several supervisory bodies. Among the banks we examined, Signature Bank and FRB were federally chartered banks (essential: not bank holding companies) that were not part of the federal banking system by choice, and thus were supervised not by the Fed, but by the FDIC. Accordingly, it was the FDIC, not the Fed, that prepared the examination report on the failure of these banks (FDIC, 2023a and 2023b). Although SVB was originally a regional bank, also incorporated in the State of California, it was subject to supervision by the Fed as a major bank holding company with foreign (British) interests, and the Fed prepared the examination report on its failure (Fed 2023b). Banks supervised by the Fed are divided into four groups by size, and as banks grow in size they face increasingly rigorous supervisory procedures. This is similar to the organizational structure of the ECB's Supervision Department. The SVB was transferred at the end of 2021 from the Fed's RBO (Regional bank-

6 https://www.congress.gov/bill/115th-congress/senate-bill/2155. The law was signed into law by President *Trump* on 24 May 2018.

ing organizations) department, which supervises regional banks, to the LFBO (Large and foreign banking organizations) department, which is responsible for large banks. The supervisory requirements for the SVB have changed radically, to the extent that the SVB has hired an advisor (E&Y) to meet the changed requirements. The fragmentation of supervision is also characterised by the secondary supervisory powers of special state institutions[7], which have the take possession of banks and appoint the FDIC as receiver for sale or liquidation.

Both the Fed's RBO department and the FDIC still rely on the traditional CAMELS analysis for rating banking risk. This rating system (although still often the only one used in textbooks) generally indicates a lower level of risk than reality, so it is no coincidence that 97 percent of the supervised banks have consistently satisfactory or excellent supervisory ratings (Bank Reg Blog, 2023a). It is therefore not surprising that the CAMELS ratings of all three banks under review were satisfactory, or even excellent, until the very last moment: until SVB was transferred to LFBO, i.e. until 2022, Signature until Q3 2022 and FRB until the moment of failure, spring 2023(!). SVB had virtually no supervisory warning before 2021.[8] Looking at the supervisory reports of the individual banks, it is striking how different the supervisory culture is from the Fed LFBO department, which has the expertise and resources to examine the big banks. If the failed banks had been examined with the same thoroughness and professionalism as the SVB in its last year, it is possible that problems would have been detected earlier.

The US practice of having local businessmen, including bank executives, on the boards of Federal Reserve Banks is unusual, at least from a European perspective. It is odd, to say the least, that SVB CEO Greg Becker, representing the sector, sat on the FRBSF (Federal Reserve Bank of San Francisco) board from 2019 until the bank's demise, and *Jim Herbert*, the founding president of the FRB who resigned shortly before the crisis, has been a member of the advisory board since 2019. While neither function allows for interference in supervisory work, or even insight into supervisory investigations, there is some conflict of interest in the practice, as the OIG report (OIG, 2023) points out.

Before we consider the supervisors to be completely irresponsible and incompetent, it is worth pointing out that on 14 February 2023, the supervisors presented a summary to the Fed Board on the possible negative effects of sudden interest rate hikes on the banking system and the expected financial turbulence, in which

7 The California Department of Financial Protection and Innovation (DFPI) for SVB and FRB, and the New York State Department of Financial Services (DFS) for Signature.

8 After 2019, the number of supervisory recommendations requiring immediate or non-immediate „attention" (54 in total), MRAs and MRIAs (MRIA - measures requiring immediate attention, MRA - measures requiring attention.

they specifically drew attention to the seriousness of the situation around the SVB (Fed, 2023a:5).

3 MEASUREMENT, MANAGEMENT AND MITIGATION OF LIQUIDITY RISK

Indeed, the simplest way to *measure liquidity risk* is to define the simple liquidity ratios known from CAMELS – liquid asset ratio, deposit funding ratio, external funding, cash ratio, etc. As the banks under examination had a high ratio of liquid assets, were essentially deposit-funded, had a negligible reliance on the money market and a cash ratio in line with the sector average, it is not surprising that they received an excellent rating from their supervisors. There is no risk threshold for these indicators, it cannot be said that 70 per cent deposit funding is "less risky" while 60 per cent "risky". It is possible to compare the indicator to the average of the sector or peer group, but then all that can be said is that the bank is riskier or less risky on the basis of the indicator. This comparison is meaningless if the benchmark group or the banking sector as a whole has built up severe liquidity risks, e.g. such as before the global financial crisis.

In the CAMELS rating, banks are generally rated better or worse according to band limits defined as a rule of thumb, but this is not supported by deeper mathematical statistical analysis. The traditional CAMELS-based risk measure is therefore imperfect in two respects: a bank's liquidity risk can be high even for so-called 'good' values, and there is no statistical or other analysis to determine what is a 'good' value. In other words, these indicators give an indication, but only a very imprecise indication.

The share of uninsured deposits is not included in the CAMELS analysis measuring simple liquidity risk. If it were, the question arises – as with traditional CAMELS indicators – what is a "good" value. The sector average? In the US, the sector average for large banks was 41 percent in 2022 (Fed, 2023b) – how much liquidity risk does this indicate for the sector as a whole? There is no doubt that the ratio was high for SVB and Signature, as it was more than double of the sector average, but does this indicate twice as much risk or a little more? As with uninsured deposits, the ratio of the largest one, three, five or ten deposits to total deposits is an indicator of liquidity risk, but not well calibrated.

There is no need to throw out the ratio indicators, it is just clear that they alone cannot be used to calibrate or manage risk well. One classic liquidity indicator is the loan-to-deposit ratio, which had a rule-of-thumb limit of 90 percent in the 1980s (it was even in textbooks), and then in the 2000s, under the spell of modern liquidity management, this limit rocketed to as high as 150 percent. After the

global financial crisis, no textbook limit was set but banks are trying to keep the ratio much below 90 percent to achieve a good credit rating, and to ensure an adequate volume of long-term customer funding.

Let's look at more sophisticated liquidity risk measures that go beyond simple ratio indicators.

One of the simplest "models" to measure liquidity risk is the so-called *maturity ladder*, which measures banks' short-term and longer-term liquidity needs under very simple assumptions. The maturity ladder is the simplest static model, at its core a cash flow forecast: it predicts how much liquidity the bank will need or have in surplus the next day, week or month if it does nothing. The liquidity demand – to which the treasury must respond in any case – can also be assessed according to a kind of rule of thumb, whether it is "small" or "large" relative to the bank's balance sheet as a whole or to the expected bank activity in the coming days. If the maturity ladder of the three banks for any day in 2022 were available, we would probably not see any liquidity risk, as normal business entry does not assume that banks will be run. When the maturity ladder is compiled, 80-90% of the bank's demand deposits are normally considered stable deposits, they are not accidentally included in the "liabilities maturing tomorrow" category, and are more often than not considered to be of infinite maturity. The model gives an indication of the liquidity position in a stress-free situation, and does not include the assumptions of a withdrawal of deposits in a stress situation or a shutdown of financial markets.

The global financial crisis, in particular the severe liquidity shortage after Lehman Brothers led to a rethinking of the way liquidity risk is understood and measured: it became clear that bank liquidity should be examined in stress situations. Banks' reliance on the money market should be reduced, stable funds should be relied on, and liquidity squeeze should be covered by high quality liquid assets. Mandatory liquidity stress tests for banks and new liquidity risk indicators have been introduced. This led to the development of the two basic risk measures in use today, the LCR (Liquidity Coverage Ratio) and the NSFR (Net Stable Funding Ratio). The LCR is supposed to show whether banks have sufficient high-quality liquid assets to survive a 30-day stress situation, and the NFSR is supposed to show whether they have sufficient stable funding to finance their longer exposures.

The NSFR could have been a problem for FRB, which is stuck in long mortgage loans, if it had mattered, but it probably would not have been a serious funding problem for it either, given its stable deposit base. In the case of Signature Bank, which has mostly short-term securities and bonds, and SVB, which has significant customer funding, it is unlikely that the NSFR would have indicated a long-term liquidity risk. However, this is only an assumption, as there is insufficient

data in the financial reports to calculate the NSFR, and to our knowledge no one has reconstructed the NSFR ratios.

From a construction point of view, the LCR can even be seen as the inverse of the well-known capital adequacy ratio. In the case of the capital adequacy ratio, certain capital elements, defined by the regulator and classified in different categories, are divided by some risk-weighted value of the assets, where the risk weights can be considered as a loss of value in an extreme scenario. The LCR is calculated by dividing certain liquid assets of different categories, defined by the regulator as high quality, by the weighted value of the liability side (adjusted by expected cash inflows), where the *run-off ratio is* in principle a measure of the rate of outflow of funds in a stressed situation. However, while the risk weights used in the calculation of the capital adequacy ratio are now backed up by empirical research using sound statistical methods, the calculations behind the determination of the run-off factors used in the LCR calculation are not – as yet – based on such calculations, which are much more tentative. The calculation seems to be sophisticated, taking into account that the household behaves differently from the firm, the outflow rate of insured and uninsured deposits is different, but on what basis has the regulator determined that in a stress situation the outflow factor for stable, fully insured household deposits is 3-5 percent, while for uninsured deposits it is more than 10 percent? In the case of SVB, for example, the outflow rate of insured deposits was also well above 10 percent, i.e. the outflow parameters calibrated for the LCR calculation seem to be rather *ad hoc* values. Liquidity indicators are unable to measure the rate of deposit outflows during a banking panic, if they did, they would show all banks as being in a liquidity crisis all the time. In other words, a bank panic is worse than a simple market stress situation. And even the LCR indicator does not take into account the closed, interconnected nature of the deposit base.

In calculating the indicator, there is a wide margin for interpretation by banks and supervisors. This is illustrated by the fact that, although the SVB was not required to calculate the LCR, two US researchers tried to reconstruct the calculations based on the December 2022 public statements and obtained quite different results. Both researchers' estimate of high-grade assets was $53 billion based on cash, government securities and the proportion of mortgage-backed securities. The difference came from the net cash flow estimates, where there was a huge difference between the two calculations: 50.3 billion *versus* 71 billion, due to different assumptions on the outflow factors applicable to different types of deposits and the calculation of revolving loans, which was again based on *ad hoc* assumptions. Thus, for one researcher (*Nelson*, 2023), the SVB would not have violated the LCR rule (LCR = 53/50.3 = 106 percent), while the other researcher (*Feldberg*, 2023) would have reported a severe liquid asset shortage (LCR = 53/71= 75 percent). The

latter is more in line with the Fed final report, which finds that the high-quality assets (HQLA) shortage was 9 percent in December 2022 and had reached 17 percent in February 2023 (Fed, 2023b). However, the supervisory follow-up report itself highlighted that even if the SVB had passed the LCR test, it would not have had sufficient liquidity to withstand the effects of the banking panic, as its deposits would have declined at a much higher rate than the assumed outflow rates for the LCR outflow weights in response to the panic. The LCR, which in principle assumes a stressed market situation, is also not suitable for predicting the impact of a bank run.

The liquidity stress tests assess, under different scenarios, whether the bank has sufficient liquidity and its ability to raise funds from the market (quality of collateral). From 2021, when the SVB moved to the large banks group, it was required to perform internal liquidity stress tests. The supervisory follow-up highlights that SVB failed its own internal liquidity stress test, but instead of implementing the liquidity risk mitigation measures required by the supervisor, it modified the boundary conditions of the stress test – arbitrarily increasing the probability of cash inflows and decreasing the probability of cash outflows – and tried to get this new result accepted by the supervisor. The supervisor was then more critical, but did not yet consider the liquidity risk in SVB to be tragic. In any event, it ordered further risk-mitigation measures. However, before this dialogue between the two had come to an end, SVB was swept away by the panic.

Regulators will most certainly step in; liquidity ratios will improve and expand. Some researchers have linked the evolution of branch density in the US to the size and speed of deposit withdrawals (*Benmelech* et al.. 2023), pointing out that if a bank has a small branch density, it is more likely to have digitally banked customers and to accumulate uninsured deposits. *Claudia Buch*, the new chair of the European Banking Authority, alluded to this at a conference in Stockholm at the end of August, in the context of a survey on the impact of high-quality liquid assets and social media and digital banking. She also mentioned the need to monitor the concentration of deposits – and we hope that this will include the interconnectedness of depositors too – using appropriate indicators and more frequently. However, network theory measures of depositor concentration and interconnectedness have not yet been proposed.

We fear that even the most perfect measure of liquidity risk, with the fewest ad hoc assumptions and case-by-case calibrations, cannot predict a bank run. The bank, as a maturity transformer, always has and always will have liquidity risk – this is a fundamental characteristic of banking. If it is hit, it will always be perceived as insufficient. Banks can be required to have a money stock equal to their total deposits, i.e. at least as large as their central bank deposits (Tucker, 2023), but meeting this condition would mean the demise of the current money-crea-

tion banking model that performs maturity transformation. We return to this in *Chapter 7* when we discuss corner solutions.

4 MEASUREMENT, MANAGEMENT AND MITIGATION OF INTEREST RATE RISK

The interest rate risk in the banking book (IRRBB) has always been measured in two ways: through the impact of interest rate changes, or more precisely the shift in the yield curve, on the bank's short term (interest) income and on the economic value of bank equity. Accordingly, the indicators ΔNII (change in net interest income, or ΔNI, change in net total income) and DEVE (change in the economic value of equity) are used.

In the case of a static balance sheet and parallel yield curve changes, the calculations are extremely simplified. It is then sufficient to calculate the balance sheet gap, i.e. the difference between the volume of interest-sensitive assets and liabilities, or to calculate the duration gap, i.e. the difference in the duration of assets and liabilities. ΔNII and DEVE will be proportional to the balance sheet gap and the duration gap.

Over time, the measurement has changed in that different yield curve scenarios (parallel and non-parallel shifts) are used to determine the expected change in income or value. In order to do this, bank risk managers, regulators and supervisors try to develop scenarios that are stressful but not fatal. Following the global financial crisis, the latest Basel guidelines (Mérő, 2023; BIS, 2016; BIS, 2019) have been developed along these lines. In general, the simple gap method can no longer be applied, but the change in income or value of a balance sheet item must be shown on a line-by-line basis using the corresponding point on the yield curves for the different scenarios. It can be seen that this does not require any more complex mathematics than the four basic operations and the net present value formula to show the change in value. However, it is also conceivable that the more detailed the procedure is, the longer the methodological manual describing this relatively simple calculation will be; for example, the BIS 2016 manual details the exact procedure in 50 pages (BIS, 2016).

While ΔNII, the change in short-term net interest income, is a well understood indicator, DEVE, the change in the economic value of equity, is less so. The EVE is intended to express the long-term income generating capacity of the bank, "the higher the EVE the greater the potential for future earnings generated from the

equity base".[9] If, for example, a bank holds a fixed rate asset and interest rates rise, that asset will generate less income, which is most easily measured by the change in the net present value, or fair market value, of the asset – in the market today, that security or loan is worth less because its income-generating capacity has declined. For deposits, the interpretation is more difficult: when interest rates rise, the cost of an unchanged interest-bearing deposit alternative does fall, but is this really well measured by the net present value of the deposit's cash flow? Net present value can of course be calculated for all cash flows, but what is the theoretical meaning of the net present value of a deposit? Is it the fair market value of that deposit? No, because the *fair market value* of the deposit is always the *nominal value* of the deposit. Calculating the net present value of a deposit is a mathematical operation that does not make much economic sense. Thus, the EVE cannot express the fair market value of the bank. The logic of calculating the EVE derives from a kind of link between interest rate risk and liquidity risk: the value of the bank's license implies that a significant part of its demand deposits do not move, so that their (non-existent) change in value can be contrasted with the change in value of fixed rate assets, i.e. in a way the value of the bank's license is estimated by calculating the net present value of deposits (*Drechsler* et al., 2023). Even if we accept EVE in theory as an approximation of the long-term income-generating capacity (and the value of the banking licence), its practical definition is difficult to establish because banking operations are fraught with a number of hidden risks (e.g. early loan repayments, premature withdrawal of fixed deposits, etc.), that the regulator has to come up with new ad hoc parameterised approximations to deal with (e.g. the BIS (2016) IRRBB Handbook contains a number of such ad hoc approximations). Of course, this does not exempt banks from determining the change in the value of economic equity (DEVE) required by regulators using the methodology prescribed at the time.

A further problem with interest rate risk indicators is that ΔNII and DEVE may have different signs. Consider a bank that finances its long-term fixed-rate loans or securities with short term deposits (as in the case of the SVB or the FRB). At first sight, both risk measures may have the same sign: if interest rates rise, the net interest income of the banks fall, since their interest expense increases, while their net interest income remains unchanged. The economic value of equity also decreases, as the net present value of short-term deposits is approximately equal to their nominal value, while the value of long-term fixed-rate assets decreases due to high duration. However, what happens if the beta of the bank's deposits is low, i.e. the interest expense on deposits does not increase in line with the increase

9 https://www.investopedia.com/terms/e/economicvalueofequity.asp

in market interest rates, which is typically the case at the beginning of the interest rate hike cycles. ΔNII will show that the bank's net interest income does not change, or even increases, if the balance sheet is not static. However, the EVE will decline stubbornly. The situation is further complicated by the fact that ΔNII is calculated using a dynamic balance sheet, while DEVE is calculated using a static one. Thus, it is not surprising that, banks rather focus on ΔNII than on DEVE, taking the opposite view to their regulators (see, for example, BIS, 2016).

Once the bank has finally calculated the IRRBB, it must be compared with some predetermined limits. If either ΔNII or DEVE exceeds this predetermined limit, the bank's management must intervene in some way. However, limits usually are rather arbitrary indicators, no matter whether the bank or the regulator sets it up. There is no mathematical statistical method that provides a 'good' limit. Not surprisingly, the reaction of bank management to a limit-breach is very often to change the limits. If a bank's lines of defence are well in place, this is not easy: such a limit change requires the approval of several committees, and it is not always easy to prove them, why the original limit was „wrong". The best defence is the bank's risk management culture, a business-wide risk management system.

The banks under review calculated both ΔNII and DEVE indicators, however, ignored, in part or in full, the Fed's recommendations for IRRBB. The Fed guidelines were elaborated after the global financial crisis (Fed, 2010), and are very close to the most recent Basel guidelines. In fact, banks have tried to make the calculations as simple as possible based on a moderate stress scenario and supervisors have not objected.

The FRB had a mature risk measurement system, according to the FDIC report (2023b), with internal risk limits applied to both ΔNII and DEVE under different scenarios. The income-based limits were not violated by the bank. The problem was with the limits on the DEVE, which the bank had already breached in the second half of 2022 (FDIC, 2023b), but neither the management nor the Board of Directors considered any additional measures were necessary in that regard.

Signature Bank's interest rate risk measurement system was deemed inadequate by the regulator, but the FDIC report contains only very vague findings on this (FDIC, 2023a). The bank's annual report shows that it examined the impact of interest rate changes both on NII and EVE, but limits or breaches of limits or hedging techniques were not mentioned.

According to the supervisory report, the SVB measured the interest rate risk by both ΔNII and DEVE, but in its decision making they took into account only the internal limits on ΔNII, and ignored the limits on DEVE (Fed, 2023b). The interest rate risk measured in this way showed that the increase in interest rates had a markedly positive impact on the bank's income. The SVB's strategy from

then on was based on fear of a fall in interest rates. This implied that although the ΔEVE repeatedly exceeded the bank's internal limit, the bank did not take this into account in its decision-making (Fed, 2023b:64). The two measures suggested a contradictory strategy. The SRB focused exclusively on short-term changes in income and ignored the risk of asset depreciation, which is particularly risky in the case of large uninsured deposit holdings, because the probability of a bank failure increases (Drechsler et al., 2023).

It cannot be ruled out that the supervisory warning about the limit violation was also ignored because the supervisory authority did not have the right to convert the warning into a request for additional capital. Suppose that the supervisor had the right to increase the bank's capital requirement under Pillar 2 in accordance with the Basel guidelines! However, it would not have made a material difference because of the *lag*: by the time the supervisor reacts, by the time it warns the bank of the need to increase capital, it will probably be too late, especially if a market panic has already developed.

Finally, let's talk about banks' strategies to mitigate interest rate risk. For a long time, the FRB has tried to manage interest rate risk by increasing the growth of loans and thus lending at higher rates. This particular risk management strategy has not been challenged by the supervisor. And why were interest rate derivatives not used to hedge the risk? This is explained in a very strange way in the FDIC report (2023b:18): 'consistent with its overall philosophy of not engaging in overly complex strategies or transactions, FRB did not engage in hedging activity'. This explanation was accepted by the supervisors, as hedging interest rate risk would have been complex and expensive for the bank.

The SVB was aware of and used interest rate swaps (IRS) to hedge interest rate risk, as it entered into IRS for the AFS portfolio in 2020. In 2022, however, the bank unwound the hedge, assuming that the interest rate risk was over-hedged, and the interest rate swaps could have a significant negative impact on the bank's income (Acharya et al., 2023).

It is likely that if the supervisory analysis had been more rigorous, if the supervisor had been able to better explain why the EVE measure is important and why exceeding the limit is a problem, or if the excess over the limit had led to an increase in capital requirements (as is the case with the application of the Basel principles), banks would have hedged their open positions more accurately.

Suppose banks had reacted sensitively to the EVA overshooting and hedged their interest rate risk very prudently. However, we know that, on the one hand, there is no perfect hedge and, on the other hand, even if hedge accounting is used by the bank, the different accounting treatment of the underlying transaction and the hedge could cause – albeit temporary – income shocks. The combined risk meas-

urement of the underlying and hedging positions under current Basel principles is also problematic. Let us take a simple example. Suppose that our imaginary bank is extremely prudent and risk-conscious, i.e. it performs a total cash flow match (as if the SVB had hedged its HTM portfolio, or the FRB its total loan portfolio, etc.). According to the EBA recommendation, the capital requirement under the second pillar is a kind of weighted sum of the change in net income sensitivity and ΔEVE. ΔEVE is obviously zero in this case, since there is full coverage, the net cash flow position is zero in each maturity band, and it remains zero no matter how it is revalued. In the net income sensitivity calculation, however, there is a significant excess risk, and hence a significant excess capital requirement under the second pillar. Indeed, if the interest rate level is low, the net interest income is low and the calculation of the IRRBB will be determined by the revaluation margin of the interest rate swaps subject to fair valuation, which could be significant. The management of the hypothetical bank may therefore be surprised to find that, although it assumes that the bank's interest rate position is perfectly matched, it may nevertheless incur a capital charge, which may even exceed the value of the hedging transactions. This anomaly can only be eliminated if the bank introduces hedge accounting both for each item in its balance sheet and for the interest rate swaps, as well. This is extremely cumbersome, almost impracticable, especially for a large loan / security portfolio consisting of many elements. The bank may also choose to reduce the interest rate swap portfolio, which does take on a risk on the EVE side, but as long as this is less than the income effect of the revaluation, the interest rate risk on the bank's books will be reduced. Although this sophisticated approach was not the reason why SVB Bank terminated the swaps on its AFS portfolio, our example shows that the more sophisticated the risk and capital calculation, the more pitfalls and anomalies can be introduced into the system.

Most studies have identified interest rate risk, poorly managed by banks, as the root cause of failure. Indeed, the interest rate risk of all banks has increased, but this has not led to losses that would have caused banks to fail in the absence of a bank run.

5 CORPORATE GOVERNANCE

A bank's culture is key both for measuring and managing liquidity and interest rate risk. A risk-sensitive, long-term thinking bank management will seek to adhere to the spirit, not the letter, of regulation, not merely to comply with the rules, but even to impose stricter internal rules if it deems it the bank norm. It sets risk limits not because it is compulsory but because it seeks to avoid excessive risk-taking and, although the limits are *ad hoc* figures, it seeks to avoid limit changes.

In a risk-sensitive responsible bank, three lines of defense for risk management[10] are in place: risk management built into the business process, appropriate control units (risk management, controlling) and, of course, risk management at the executive (management and board) level. The Basel guidelines have sought to bring risk managers on a par with business decision-makers in the wake of the global financial crisis, but the formal implementation of an organisational solution may not at all be in the spirit of the law.

According to the FDIC report (FDIC, 2023b), the FRB had an organisationally sophisticated risk management system, with appropriate risk management committees and a multi-level decision-making process. At Signature, risk management was not an integral part of the business culture, and in congressional hearings the bank's founding chairman emphasized customer orientation rather than risk sensitivity (Shay, 2023). At SVB, a restructuring of the risk management system began in 2021, when it was transferred to LFBO. This was accompanied, among other things, by the dismissal of the former senior risk manager (CRO), who had an inadequate professional background, and the bank was without a senior risk manager for almost a year. The CEO deflected all questions about risk at the congressional hearing, saying it was the responsibility of the 'competent risk committee', claiming to have been unaware of the hedge decisions taken by the ALCO committee, namely the hedging of the AFS portfolio and its subsequent termination. Clearly, the bank lacked the three lines of defence of risk management.

The inadequacy of the banks' risk management systems is illustrated by the fact that none of the banks' annual reports mention the three lines of defence for risk management, and there was no real built-in-process risk management. Public reporting by banks has not been very helpful in understanding internal operations and in providing insight into the details of risk measurement and management, i.e. disclosure is not a strong requirement in the US system. While there is a section of the report where they list the most important bank risks, all three banks do so in almost verbatim the same order of risks, in effect providing an irrelevant list. The banks' management did not react adequately to the risks that emerged, and risk management in their decision-making systems remained in the 'back room', with no clear responsibility for who should take the risk and how much. The inadequacy of the bank's risk management systems was aligned with weaknesses in supervisory controls.

10 See for example: https://www2.deloitte.com/us/en/pages/advisory/articles/modernizing-the-three-lines-of-defense-model.html

In all three banks risk sensitivity was not properly incorporated into the bonus system. In all banks the management bonuses for 2022, the year after a so-called successful year, were paid in full, in the SVB just on the day of the bank run.

Overall, weaknesses in corporate governance and risk management systems, and the lack of a risk management culture, were a key factor in banks' mismanagement of the rapid deposit during the pandemic and their failure to consider the additional risks arising from their specific, concentrated business model. The OIG report analysing the role of supervisors highlighted the same point, suggesting that by redesigning supervisory work, supervisors should be able to properly analyse the specialised or concentrated business model of supervised institutions and the additional risks arising from rapid growth (OIG, 2023)

6 IS THERE A GOOD DEFINITION OF SUFFICIENT BANK CAPITAL?

Based on the previous chapters, it cannot be ruled out that there is no reliable risk measure that works well in all cases and yet is simple and easy to interpret. Risk measurement often has to rely on highly *ad hoc* parameters and procedures and complex approximations. At the end of the 1990s, it seemed that a perfect solution had been found: the concept of value at risk was born. The concept itself was conceived to measure market risk in the trading book, but it had attractive features beyond that: it did not require the examination of different scenarios, but allowed the potential loss to be determined with a predefined probability. If the potential loss threatens the available capital, the risk is severe and steps must be taken to mitigate it. The new capital adequacy requirement in Basel II guidelines was based on this concept: a bank must have at least as much capital as necessary to cover its losses from credit risk, market risk and operational risk with a given probability (99.9 per cent).

The illusion that potential losses can be measured accurately, that the measurement itself can be left to the bank and that it is only necessary to check that banks are measuring correctly, has led to a radical reduction in bank capital requirements and a loss of stability in the banking system. This has been one of the key lessons of the global financial crisis. The value at risk turned out to be determined by calibrating equally ad hoc parameters and procedures. It has proved to be a theoretically imperfect concept, as it is not a coherent measure of risk, i.e. it only gives a reliable result in the case of a normal distribution and cannot be used in the case of exceptionally large losses ('black swans'). It also turned out that the interest rate risk in the banking book and many other risks happened to be excluded from Basel II. It is quite certain that Basel II would have been revised even if there

had not been a global financial crisis. But it did, so the review clearly pointed in one direction: Basel III should be one that imposes substantially higher capital requirements on banks. This added even more ad hoc parameters to the calculations and made the guidelines and handbooks even longer.

Since real economic losses caused by a crisis are fairly high, thus, after the crisis there is always a cry for higher regulatory capital. This was no different this time, even though the 2023 March banking crisis did not turn into a systemic crisis and no real economic losses could be identified. Because of their position, the regulators, *mutatis mutandis*, have drawn the conclusion that capital adequacy requirements must be raised – as you can see in the comments made, for instance, by a Fed executive responsible for bank supervision (Barr 2023). The same conclusion can be drawn from the survey of academic economists mentioned in the introduction: 92%(!) of Americans and 73% of Europeans think it is time to radically raise capital requirements.

According to the supervisory report "while the proximate cause of SVB's failure was a liquidity run, the underlying issue was concern about its solvency" (Fed, 2023b:2). Why did this "solvency concern" arise? Why did many analysts write that the March banking crisis was clearly caused by banks insolvency? Why do many analysts treat it as almost conclusive that the failed banks were undercapitalised and that is why they went under? The market panic, as we recall (see Part I of the paper), was heightened after an article in the Financial Times which claimed that many banks, including the SVB, had huge *unrealised losses that were* eating up their capital. The term 'unrealised losses' has entered the public discourse and professional analyses as a shuddering catchword. This is why the capital purist Admati et al. (2023), analysing the causes of failure, have described how bank failures are in fact all due to insolvency and the only solution is to radically increase capital requirements.

If only the unrealised losses on the banks' AFS portfolios had been considered, the word insolvency would not have been used, because none of the banks had such a large AFS portfolio that any loss of value would have jeopardised their capital. But analysts did not only mean AFS bonds when talking about unrealised losses, but also fixed rate HTM bonds booked at nominal value (or to be more exact, amortised value). What is more, they later included all fixed rate assets including fixed rate loans in their calculations of so called "hidden losses" – which was bad luck for FRB.

If one wanted to consider all the loss on the market value of all assets, then deposit holders would have had a run not only on those banks but also on the Bank of America, for instance (Kelly, 2023), or, on the whole sector of Hungarian banks considering their peculiar balance sheet structure.

An economic policy proposal to include all non-realised losses on securities in the regulatory capital requirement would meet with almost unanimous approval on both sides of the ocean. The Clark Center Forum asked US economists this question (a little bit rephrasing) in both May and September (CCF 2023a; 2023b): 64% in May and 56% in September agreed with the proposal (with a slight increase in the undecided camp). Europeans were asked only in September, with only 48% agreeing and 13% rejecting the proposal. The Americans are not as confident as the numerical results suggest, with some commenting that it would only make sense if there were sufficient capital to cover losses from currency fluctuations, and others noting that it is not a panacea either, as only securities that are actually traded on the market have a real valuation, and the 2008 crisis was caused by the unexpected loss of value of CDOs that were not actually traded on the market but had a high rating and were therefore highly valued. In an exciting study, some US researchers (Drechsler et al., 2023) have pointed out that the probability of a bank failure is multiplied by the presence of large uninsured deposits on the liability side as opposed to fixed-rate assets. In such a case, interest rate risk is more easily converted into liquidity risk and the bank becomes truly insolvent in the event of a bank run. This is the situation that the Fed sought to address when, following the collapse of the SVB, it introduced its new liquidity facility (BTFP), which accepts bonds at par as eligible collateral. The programme is in place until March 2024 – we will see if there is an extension. If so, it will greatly simplify the 'unrealised loss' debate – interest rate risk cannot be converted into liquidity risk.

We believe including the loss on AFS securities in regulatory capital is a proposal increasing clarity. However, if the change in value of the HTM portfolio should be included in regulatory capital, why not the entire fixed rate loan portfolio? If we consider this argument consistently, the safest solution seems to be for the bank not to issue deposits that can be withdrawn at any time at nominal value, i.e. not to create money. This can certainly be easily solved by imposing a 100 percent capital requirement (Admati and Hellwig 2010), but this solution is already a corner solution, which we will return to in *Chapter 7*.

Higher capital requirements are not only protested by banks, but also by academics, who are concerned that too high capital requirements discourage lending, make financial intermediation more expensive and hamper economic recovery. This was recently summed up in a thoughtful and reflective paper by Danielsson and Goodhart (2023), who cannot be accused of being capital-unfriendly.

For the three banks we examined, we saw that all three banks were adequately capitalised under the existing rules immediately before the panic (note that the capital adequacy of Credit Suisse, which failed in Switzerland, was perfectly in line with that of UBS, which absorbed it). If the Basel principles had been applied, supervisors might have required some additional capital to be held under the sec-

ond pillar because of interest rate risk, and might have required an increase in the level of liquid assets, but in essence there would not have been much more capital or much more liquid assets available to banks. As noted crisis scholar Stephen Kelly[11] put it, "Say it with us: More capital would not have saved the SVB!" (Kelly, 2023). These banks failed not because of a lack of capital, but because of their flawed business models and the resulting market panic. If the business model had been capitalised, i.e. credible, there would have been no run. As the outgoing chairman of the Single Supervisory Council of the European Banking Union (the ECB's Banking Supervisory Council), André Enria, put it, "Capital cannot fix a broken business model, nor can it remedy deficient internal governance" (Enria, 2023).

7 CORNER SOLUTIONS

When analysing the banks in crisis, the vast majority of experts made recommendations for improving the risk management culture, improving regulation, improving supervision, etc., within the framework of the current banking model. Several of these suggestions have been discussed in previous chapters.

After major banking crises, such as the Great Depression (1929–33) or the global financial crisis (2007–2010), the need for radical institutional reform always arises (e.g. *King*, 2016; Admati and Hellwig, 2013). Although the current crisis is nowhere near them in depth, scope and real economic impact, different corner solutions have again emerged. Indeed, most of the analyses were carried out in the immediate aftermath of the crisis, when it was not yet possible to see that the March wave of bank failures would be an isolated series of events rather than an explosion similar to the global financial crisis. These solutions have been referred to in earlier chapters of this thesis. At the end of *Chapter 3 on liquidity risk,* we referred to the former UK central bank vice-president who suggested that banks should hold their deposits exclusively in central bank money, which is essentially the equivalent of a 100 per cent reserve ratio requirement (Tucker, 2023). *In Chapter 6 on capital,* we referred to Admati and Hellwig's book (2010), in which the 100 per cent capital requirement is seriously mooted. If proposals like this were adopted, the banking system would change substantially, creating a financial intermediation system fundamentally different from today's. The institution that would emerge in this type of solution is commonly referred to as a "narrow bank".

11 *Steven Kelly* is associate director of research at the Yale Program on Financial Stability. The program based on deep personal interview with decision makers summarizes the lessons from the previous crises, as e.g. the global financial crisis.

An excellent overview of similar proposals after the March 2023 banking panic is provided by *Martin Wolf* (Wolf, 2023a; 2023b), but readers can also consult a number of blogs and websites.[12]

The narrow bank proposals were first formulated in the so-called Chicago Plan following the Great Depression (*Bossone*, 2001). At that time *Irving Fisher*'s book *"100% Money"* (Fisher, 1937), which compiled the proposals into a consistent theory, was published. Fisher had already sketched a beautiful vision on the title page of his book, stating that his system is "designed to keep checking banks 100%; to prevent both inflation and deflation, largely zo or prevent depressions; and to wipe much of the National Debt".[13] Despite Fisher's grand vision and the Chicago Plan, no narrow bank system has been established in the United States or elsewhere. Perhaps not by accident.[14]

It is not difficult to see that the narrow bank idea is actually much older: it appeared as early as the 19th century in England in the debate between the banking and currency schools, where the latter insisted on the need for 100 per cent reserve banking.

Narrow bank keeps its customers' deposits one-to-one in the central bank, in central bank reserve, i.e. it has a reserve ratio of 100 percent, there is no money creation outside the central bank. Narrow bank only provides payment services.

Side by side with a narrow bank a la Fisher, there is in the economy a financial enterprise offering loans whose potential failure will not result in a bank panic, there will be no bank run as there are no deposits. There are some who identify narrow banks like that (e.g. capital purists). This financial enterprise has only equity capital in strict cases, and can issue bonds in more lenient cases.

There are views that can imagine these two institutions (the deposit taker and the lender) even within a single narrow bank but separating the two types of activity with a strict Chinese wall. Strict followers of the narrow bank idea would

12 For example: http://www.narrowbanking.org/; https://www.cato.org/regulation/summer-2023/it-finally-time-narrow-banking#; https://www.marketplace.org/2023/05/12/one-way-to-make-banks-safer-make-them-narrower/; https://marginalrevolution.com/marginalrevolution/2023/05/are-we-evolving-toward-narrow-banking.html.

13 Much later, after the GFC, two US researchers, mesmerised by Fisher's theory, tried to prove in a DSGE model that *'100% money'* works, i.e. assuming only narrow banks, the economy will be more balanced, there will be no banking crises and even the average level of inflation will be lower (Benes and Kumhof, 2012).

14 *John Cochrane* describes an interesting case: in 2017, a bank in the United States was intended to be established specifically as a narrow bank (TNB Bank – The Narrow Bank) but was ultimately denied a license by the Fed, so it submitted an appeal against the Fed decision (Cochrane, 2018). Unfortunately, we do not know the sequel, but TNB Bank is not yet operational, according to the internet.

not allow a narrow bank to invest into securities, and would not let the narrow bank any external funding, i.e. these institutions would provide loans from their equity.

Finally, there are more lenient narrow bank concepts (often called *core bank*) that allow the bank to invest in ultra-safe government securities in addition to central bank reserves (for an excellent overview of the different approaches, see Bossone, 2001).

In all cases, the essence of the narrow bank is the same: *lending and money creation should be separated, and private banks should not have the right to create money.* There is no money-creating lending, only money-redistributing lending, in the terminology used in Hungarian textbooks.

Ironically, the SVB happened to be a lenient narrow bank, it hardly created money through lending, and its customer deposits financed "super-safe" bonds and central bank reserve. Its holdings of highly liquid, marketable government securities exceeded its loan portfolio by almost 50%. Thus, the SVB was not really creating money, it was operating as a classical financial intermediary, it was rather redistributing money. Yet it was attacked, yet it triggered a wave of bankruptcies. Remember: money market funds, which do not create private money at all, were attacked in 2008 in the same way as the SVB in 2023, and only effective government intervention could stop the panic then. So, only 100% Money, the extreme narrow bank concept would have been the solution during the SVB run.

In a banking system consisting only from narrow banks, maturity transformation is eliminated, which undoubtedly reduces the chances of a bank run. In this case, it is also advisable to eliminate maturity transformation in the economy as a whole, i.e., the regulation of investment funds and money market funds should probably be reviewed, because in a narrow bank system the probability of a run on investment funds (especially money market funds) will increases, as already experienced during the global financial crisis. The question is how and by what institution the problem raised in the Nobel prize-winning *Diamond–Dybvig* study (1983) of matching the immediate (and unpredictable) liquidity needs of depositors with the long-time requirements of investment will be addressed, and whether this tendency will lead to under-investment.

The modern version of the narrow bank vision is based on the Central Bank Digital Currency (CBDC).[15] If there is central bank digital currency available to everyone, there is little need for a narrow bank, as payment services are instantaneous through the central bank. Lending will remain a task for financial companies

15 For example: https://www.google.com/search?client=firefox-b-d&q=cbdc+is+the+solution+for+bankgin+crisis; http://www.zsiday.hu/blog/mikor-lesz-már-digitális-jegybankpénz

using only equity, but it is easy to see that central banks can do it more effectively, themselves. The CBDC can make both the banking systems as we know them and the narrow banks redundant. There are few advocates of this corner solution today: the single-tier banking system in the so-called socialist systems has proved neither to provide sustainable growth nor an efficient solution.

In his famous book, Fisher cites as a major advantage that narrow banks significantly restrain lending compared to the nowadays banking intermediation, and indeed, narrow banks would not generate large amplitude credit cycles with huge real economic losses. The only question to be answered is: who will provide the economy's financing needs and how. This is not usually addressed by proponents of the narrow bank system. We do not know who, and in what way, assumes the role of delegated observer in this 100% reserve – 100% capital system, and how the asymmetric information problems can be resolved (Diamond, 1984). It is not clear how the proponents of the corner solution can answer the question of the efficiency loss and social cost of not having the two sides of the liquidity provision (private credit and private money) on the two sides of the balance sheet of the same institution (Diamond–Rajan, 2001).
So, in fact, the risks are not going down, they are going up.

8 SUMMARY

A strange banking panic emerged in the US in March 2023. At the beginning of the year, market analysts focused on a specific side-effect of the Fed's determined interest rate hikes, the so-called unrealised losses of banks' assets. Newspaper articles and analyses reporting on the frightening figures were reflected not only in the fall in the share price of banks suffering such unrealised losses, but also in the growing sense of panic among depositors. Three banks in California, SVB, Signature Bank and FRB, were particularly vulnerable and the panic that ensued led to a severe liquidity crisis within days, resulting in insolvency.

We argue that the failure of the three banks under review was not caused by the so-called unrealised losses (i.e. interest rate risk) often mentioned in earlier studies, nor by their perceived liquidity risk. Neither one nor the other were outliers compared to the sector as a whole. While the risk metrics did indicate a risk, the magnitude of the measured risk was not blatant for any of the banks examined. The three failures were also special in that the credit risk, which is the most important factor in banking crises, was not present at all.

We have shown in line with the supervisors' reports (Fed 2023b;, OIG, 2023), that banks' broken business models, weak corporate governance and risk management systems have led to their failure. In this they differed from other banks

with similar interest rate and liquidity risks. All three banks were characterised by a closed and concentrated customer base, a close network of depositors and a high proportion of uninsured deposits, which posed a continuous liquidity risk that was heightened in times of panic. The business model made possible the extremely rapid growth of deposits during the pandemic, during which the banks did not prepare prepared themselves for the equally rapid withdrawal of deposits. Inadequate risk management systems, corporate governance, business and risk management cultures contributed to the failures. Supervision of banks was also weak, but the reasons for and consequences of this are not discussed in detail in this paper.

In parallel with the analysis of banks, we examined the liquidity and interest rate risk indicators currently in use. We have found that reliable risk measures that work well in all cases, that anticipate risks in good time and yet are simple and easy to interpret have not yet been developed. Measuring risk often requires the use of highly *ad hoc* parameters and procedures, and complex approximations. The definition of risk limits at both banking and supervisory level tends to follow rules of thumb. However, risk management and supervision that fully assesses risks according to their weight and content can prevent the emergence of exposures that are in themselves sufficient to trigger a bank run. This conclusion has serious implications for supervisory examination methodology, as is well reflected in the OIG report (OIG, 2023).

The capital adequacy ratio of the banks examined was adequate. Even if they had perfect risk measurement systems, and if the excess capital and excess liquidity needs had been captured in time, they would not have been able to withstand the run that occurred in a few days. The market's confidence in the business model is shaky, there is no protection for banks with a narrow, concentrated, interconnected customer base in times of panic.

In the analyses following the crisis of March 2023, the need for a radical transformation of the current banking models was implicitly or explicitly expressed, and the corner solutions, the various narrow-banking models, which were always used during crises, reappeared. The perfectly liquid bank is the one that does not create money and keeps all its deposits in central bank reserve. There is no maturity transformation, no money creation – but there is evidence that many of the investments needed to make the economy work are not made.

In our view, the bank failures of March 2023 do not justify a focus on corner solutions, and there are few economic arguments in favour of corner solutions at the moment.

REFERENCES

Acharya, V. – Richardson, M. P. – Schoenholtz, K. L. – Tuckman, B. (eds.) (2023): *SVB and beyond: The banking stress of 2023*. NYU Stern School of Business. https://drive.google.com/file/d/1M067WVIlogboJtrsl33ggpbHIAtVjlR6/view (last accessed 18.08.2023).

Admati, A. – Hellwig, M. (2013): *The banker's new clothes. What's wrong with banking and what to do about it*. Princeton University Press.

Admati, A. – Hellwig, M. – Portes, R. (2023): When will they ever learn? The US banking crisis of 2023. VoxEU.org, 2023.05.18., https://cepr.org/voxeu/columns/when-will-they-ever-learn-us-banking-crisis-2023 (last accessed 23.08.2023).

Bair, S. (2023): US regulators are setting a dangerous precedent on SVB. *Financial Times*, 2023.03.14. https://www.ft.com/content/b860ebb6-f202-4ec6-a80c-8b1527c949f4 (last accessed 28.08.2023).

Bank Reg Blog (2023a): Assorted Thoughts on SVB. 14.03.2023, https://bankregblog.substack.com/p/assorted-thoughts-on-svb (last accessed 08.09.2023).

Bank Reg Blog (2023b): The Biden Administration's Fact Sheet on the Regulation of Large Regional Banks. 2023.04.01., https://bankregblog.substack.com/p/the-biden-administrations-fact-sheet (last accessed 08.09.2023).

Barr, M. (2023): Holistic Capital Review. Remarks at the Bipartisan Policy Center. Washington DC, 10.07.2023., https://www.federalreserve.gov/newsevents/speech/files/barr20230710a.pdf (last accessed 28.08.2023).

Becker, G. W. (2023): Written Testimony before the U.S. Senate Committee on Banking, Housing, and Urban Affairs. Silicon Valley Bank. 16.05.2023, https://www.banking.senate.gov/imo/media/doc/Becker%20Testimony%205-16-23.pdf (last accessed 28.08.2023).

Benes J. – Kumhof, M. (2012): The Chicago Plan revisited. IMF Working Paper WP12/202, https://www.imf.org/external/pubs/ft/wp/2012/wp12202.PDF (last accessed 12.09.2023).

Benmelech, E. – Yang, J. – Zator, M. (2023): Bank branch density and bank runs. NBER Working paper 31462, 2023 July, http://www.nber.org/papers/w31462 (last accessed 12.09.2023).

BIS (Bank of International Settlements) (2016): Standards. Interest rate risk in the banking book. https://www.bis.org/bcbs/publ/d368.pdf (last accessed 12.09.2023).

Bossone, B. (2001): Should banks be narrowed? IMF Working Paper WP01/159, https://www.imf.org/external/pubs/ft/wp/2001/wp01159.pdf (last accessed 12.09.2023).

Buch, C. (2023): Rethinking the prudential regulation of banks. Panel remarks prepared for the DNB – Riksbank _Bundesbank Macroprudential Conference. Stockholm, 2023.08.31., https://www.bis.org/review/r230901h.pdf (last accessed 12.09.2023).

Cecchetti, S. G. – Schoenholtz, K. L. (2023): Making banking safe. CEPR Discussion Paper 18302, https://cepr.org/publications/dp18302 (last accessed 2023. 28.08.2023).

Cecchetti, S. G. – Schoenholtz, K. L. – White, L. (2023): The dangerous role of America's weird lenders-of-next-to-last resort. Inside a byzantine corner of the US financial system. *Financial Times*, 17.08.2023, https://www.ft.com/content/1ca4240b-e1c3-44ec-9033-f9217ddd4fae (last accessed 18.08.2023).

Clark Center Forum (CCF): (2023a): Banks' business model. US survey. 2023.05.17., https://www.kentclarkcenter.org/surveys/banks-business-model/ (last accessed 2023.08.18.).

Clark Center Forum (CCF): (2023b): Policy Responses to Recent Bank Failures. US survey. 2023.09.14., https://www.kentclarkcenter.org/surveys/policy-responses-to-recent-bank-failures/ (last accessed 16.09.2023).

Clark Center Forum (CCF): (2023c): Policy Responses to Recent Bank Failures. Europe survey. 14.09.2023, https://www.kentclarkcenter.org/surveys/policy-responses-to-recent-bank-failures-2/ (last accessed 16.09.2023).

Cochrane, J. H. (2018): The Safest Bank the Fed Won't Sanction ChicagoBooth.edu. 2018.11.30., https://www.chicagobooth.edu/review/safest-bank-fed-wont-sanction.

Danielsson, J. – Goodhart, C. (2023): What Silicon Valley Bank and Credit Suisse tell us about financial regulations. VOXEU/CEPR, 2023.03.25., https://cepr.org/voxeu/columns/what-silicon-valley-bank-and-credit-suisse-tell-us-about-financial-regulations (last accessed 18.08.2023).

Dewatripont, M. – Praet, P. – Sapir, A. (2023): The Silicon Valley Bank collapse: Prudential regulation lessons for Europe and the world. VoxEU, 2023.03.20., https://cepr.org/voxeu/columns/silicon-valley-bank-collapse-prudential-regulation-lessons-europe-and-world (last accessed 28.08.2023).

DFPI (California Department of Financial Protection and Innovation) (2023): Review of DFPI's Oversight and Regulation of Silicon Valley Bank. 08.05.2023, https://dfpi.ca.gov/wp-content/uploads/sites/337/2023/05/Review-of-DFPIs-Oversight-and-Regulation-of-Silicon-Valley-Bank.pdf (last accessed 08.09.2023).

DFS (New York State Department of Financial Services) (2023): Internal review of the supervision and closure of Signature Bank. 28.04.2023, https://www.dfs.ny.gov/system/files/documents/2023/04/nydfs_internal_review_rpt_signature_bank_20230428.pdf (last accessed 07.09.2023).

Diamond, D. W. (1984): Financial Intermediation and Delegated Monitoring. *Rev. Econ. Studies*, 51(3), 393–414. DOI: 10.2307/2297430, https://www.richmondfed.org/-/media/RichmondFedOrg/publications/research/economic_quarterly/1996/summer/pdf/diamond.pdf (last accessed 18.11.2022).

Diamond, D. W. – Dybvig, P. H. (1983): Bank runs, deposit insurance, and liquidity. *Journal of Political Economy,* 91, 401–419. DOI: 10.1086/261155, https://www.journals.uchicago.edu/doi/epdf/10.1086/261155 (last accessed 18.11.2022).

Diamond, D. W. – Rajan, R. G. (2001): Liquidity risk, liquidity creation, and financial fragility: A theory of banking. *Journal of Political Economy,* 109, 287–327. DOI: 10.1086/319552, https://www.journals.uchicago.edu/doi/epdf/10.1086/319552 (last accessed 18.11.2022).

Drechsler, I. – Savov, A. – Schnabl, P. – Wang, O. (2023): Banking on uninsured deposits. NBER Working Paper 31138, 2023 June, https://www.nber.org/system/files/working_papers/w31138/w31138.pdf.

Duffie, D. (2023): Resilience redux in the US Treasury market. paper presented at the Jackson Hole Symposium. 13.08.2023, https://www.kansascityfed.org/Jackson%20Hole/documents/9726/JH_Paper_Duffie.pdf (last accessed 31.08.2023).

Enria, A. (2023): Banking supervision beyond capital. Speech at the EUROFI 2023 Financial Forum organised in association with the Spanish Presidency of the Council of the EU. Santiago de Compostela, 14.09.2023, https://www.bankingsupervision.europa.eu/press/speeches/date/2023/html/ssm.sp230914~c6c0be0cc6.en.html (last accessed 16.09.2023).

FDIC (2023a): FDIC Supervision of Signature Bank. 28.04.2023,https://www.fdic.gov/news/press-releases/2023/pr23033a.pdf (last accessed 18.08.2023).

FDIC (2023b): FDIC Supervision of First Republic Bank. 08.09.2023, https://www.fdic.gov/news/press-releases/2023/pr23073a.pdf (last accessed 18.09.2023).

Fed (2010): Advisory of interest rate risk management. https://www.ffiec.gov/pdf/pr010710.pdf (last accessed 12.09.2023).

Fed (2023a): Impact of Rising Rates on Certain Banks and Supervisory Approach. S&R Quarterly Presentation. February 14, 2023, https://www.federalreserve.gov/supervisionreg/files/board-briefing-on-impact-of-rising-interest-rates-and-supervisory-approach-20230214.pdf.

Fed (2023b): Review of the Federal Reserve's Supervision and Regulation of Silicon Valley Bank. 28.04.2023, https://www.federalreserve.gov/publications/files/svb-review-20230428.pdf (last accessed 18.08.2023).

Feldberg, G. (2023): Lessons from Applying the Liquidity Coverage Ratio to Silicon Valley Bank. 2023.03.27., https://som.yale.edu/story/2023/lessons-applying-liquidity-coverage-ratio-silicon-valley-bank (last accessed 28.08.2023).

Fisher, I. (1936): *100% Money*. New York: The Adelphi Company. Revised version. https://cdn.mises.org/100%20Percent%20Money_Fisher.pdf.

GAO (Government Accountability Office) (2023): Bank regulation: Preliminary review of agency actions related to March 2023 bank failures. 11.05.2023, https://www.gao.gov/products/gao-23-106834 (last accessed 28.08.2023).

Indaap, S. (2023): The $44bn bank bailout bonanza. *Financial Times*, 05.09.2023, https://www.ft.com/content/fe55c9d0-31de-44b8-840d-f972fcdefob9?shareType=nongift.

Jacklin, C. J. (1987): Demand deposits, trading restrictions and risk sharing. In Prescott, E. – Wallace, N. (eds.) (1987): *Contractual arrangements for intertemporal trade*. University of Minnesota Press.

Kelly, S. (2023): SVB and bank capital, revisited. Wihout Warning Blog, 31.08.2023, https://www.withoutwarningresearch.com/p/svb-and-bank-capital-revisited (last accessed 01.09.2023).

King, M. (2016): *The end of alchemy. Money, banking, and the future of the global economy.* W. W. Norton & Company.

Király, J. (2023): Ahol a pénz terem. Pánik a bankvilágban: a Silicon Valley Bank és a Credit Suisse csődje [Where money grows. Panic in banking: the bankruptcy of Silicon Valley Bank and Credit Suisse.] *Magyar Narancs*, 29.03.2023, https://magyarnarancs.hu/kulpol/ahol-a-penz-terem-257463 (last accessed 28.08.2023).

Meade, D. (2023): Congressional Hearings On Bank Failures. Mondaq.com, 23.05.2023, https://www.mondaq.com/unitedstates/financial-services/1318796/more-congressional-hearings-on-bank-failures- (last accessed 28.08.2023).

Mérő, K. (2023): Shall we reconsider banking regulations? Some lessons drawn from the failure of Silicon Valley Bank and Credit Suisse. *Economy and Finance*, 10(2), 101–119, https://bankszovetseg.hu/Public/gep/2023/101-119%20Mero%20E.pdf (last accessed 26.08.2023).

Nagy, A. (2023): Bankcsődök 2023: események, a bankrendszer kockázatai. Elemzési Központ blog [Bank failures 2023: events, risks to the banking system. Analysis Centre blog]23.05.2023, https://elemzeskozpont.hu/bankcsodok-2023-esemenyek-bankrendszer-kockazatai (last accessed 28.08.2023).

Nelson, B. (2023): Silicon Valley Bank Would Have Passed The Liquidity Coverage Ratio Requirement. Bank Policy Institute Blog, 14.03.2023, https://bpi.com/silicon-valley-bank-would-have-passed-the-liquidity-coverage-ratio-requirement/.

OIG (Office of Inspector General) (2023): Material loss review of Silicon Valley Bank. Evaluation Report. 2023-SR-B-013, https://oig.federalreserve.gov/reports/board-material-loss-review-silicon-valley-bank-sep2023.pdf (last accessed 01.10.2023).

Rajan. R. – Zingales, L. (2023): Riskless Capitalism? IMF Finance and Development. 2023. június, https://www.imf.org/en/Publications/fandd/issues/2023/06/POV-riskless-capitalism-rajan-zingales?utm_medium=email&utm_source=govdelivery (last accessed 28.08.2023).

Roffler, M. (2023): Written Testimony before the U.S. Senate Committee on Banking, Housing, and Urban Affairs. First Republic Bank, 17.05.2023, https://democrats-financialservices.house.gov/uploadedfiles/hhrg-118-ba20-wstate-rofflerm-20230517.pdf (last accessed 28.08.2023).

Shay, S. A. (2023): Written Testimony before the U.S. Senate Committee on Banking, Housing, and Urban Affairs. Signature Bank, 16.05.2023, https://www.banking.senate.gov/imo/media/doc/Shay%20Testimony%205-16-23.pdf (last accessed 28.08.2023).

Tucker, P. (2023): Former BoE deputy calls for radical overhaul of bank funding. Laura Noonan interview with Paul Tucker. *Financial Times*, 08.05.2023, https://www.ft.com/content/fofe6555-7929-4b4d-8739-028b3b0aad4e (last accessed 31.08.2023).

Véron, N. (2023): The US and Swiss banking collapses could lead to better compliance with international bank capital standards in the European Union. PIIE blog, 27.04.2023, https://www.piie.com/blogs/realtime-economics/us-and-swiss-banking-collapses-could-lead-better-compliance-international (last accessed 31.08.2023).

Wolf, M. (2023a): Banks are designed to fail – and they do. *Financial Times*, 14.03.2023, https://www.ft.com/content/09bfbb8d-22f5-4c70-9d85-2df7ed5c516e (last accessed 31.05.2023).

Wolf, M. (2023.b): Four ways to fix the bank problem. *Financial Times*, 21.03.2023, https://www.ft.com/content/70ce4b8a-1310-4e3c-a891-3c34cd313841 (last accessed 31.05.2023).

Zsiday, V. (2023a): Narancsvidék. Zsiday Viktor blogja [Orange Region. Zsiday Viktor's blog], 11.03.2023, http://www.zsiday.hu/blog/narancsvid%C3%A9k (last accessed 28.08.2023).

Zsiday, V. (2023b): Mikor lesz már digitális jegybankpénz? Zsiday Viktor blogja [When will we have digital money? Viktor Zsiday's blog], 23.03.2023, http://www.zsiday.hu/blog/mikor-lesz-mar-digitális-jegybankpénz.

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A SNAPSHOT OF SALES AND RISK RELATIONS AT HUNGARIAN BANKS IN 2022

József Koltai – Eleonóra Tarpataki[1]

ABSTRACT
Banks' corporate lending strategy changes from time to time, but in any case, the implementation of that strategy requires cooperation between two functions, namely the business (corporate/project contact persons, sales) and the credit approval (risk management or risk) team. Smooth cooperation may foster optimised decision-making, and improve the efficiency of banks' processes, employee satisfaction and commitment, which, in turn, may reduce employee turnover. The benefits on the client's side are transparency, reliability and predictability, which may increase confidence in, and satisfaction with, the bank.
Therefore, it is worthwhile to review periodically how the two functions get along. We have taken such a 'snapshot' in our exploratory study of 2021/2022. In this study, we collected answers from 16 respondents working at banks in Hungary through an anonymous questionnaire and written in-depth interviews. The results show that the relations under scrutiny 'leave room for improvement'. Our survey also focused on how cooperation between the two functions could be made better and more efficient. Setting up transparent and well-regulated internal processes at banks and reinforcing risk-awareness in employees proved decisive in responding to the challenges of the future.

JEL codes: G21, G28, G29

Keywords: corporate lending, risk management, business function, cooperation

1 INTRODUCTION

Lending for corporate and project finance purposes, when it works properly, plays a substantial role also in economic development (*Bodnár, Katalin* et al., 2014). Banks face the challenge of adapting and reviewing their product portfolio to meet constantly changing market conditions, regulation, technological develop-

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ment and customer needs (*Csiszárik–Kocsir*, 2017). They cannot rise up to that challenge without efficient and constructive cooperation between different functions within the bank. Demand for improvement and adjustments may arise at all divisions, including front-end, risk management, legal, accounting, IT and others, and an appropriate response can only be devised with the contribution and collaboration of those divisions.

Research from around the world and in different economic sectors has revealed that corporate culture has a major impact on the functioning of organisations. But what does the term 'corporate culture' mean? It is a very broad concept that refers to implicit and explicit contracts governing behaviour within an organisation (*Carretta* et al., 2015)the harmonization of supervisory styles (regulation being equal. According to *Pesuth*'s definition, 'banking culture is the sum of those norms and types of behaviour – which are the internal and external features of the banks – which account for the needed – fair – business practices'(Pesuth, 2016:119). Our study focuses on a very narrow subsection of that vast topic, investigating the relationship and cooperation between sales and risk within lending for corporate and project financing.

Stricter regulations introduced in the aftermath of the 2008 crisis have already pointed to a need to increase risk-awareness, primarily among managers and direct risk-takers, and then at a basic level to all bank employees (*Móra*, 2019). That meant a marked shift away from a lending- and sales-orientation towards the importance and role of risk management, and might have launched a new dynamics in interfunctional cooperation. However, as *Dancsik* notes, the problems that led to the crisis are complex and multifaceted, and the macroeconomic effects of the respective transactions could simply not have been anticipated, assessed or reckoned with by individual banking employees taking part in the credit process (Dancsik, 2020). However, increased awareness to risks may ease the natural conflict of interest between the two functions.

We begin our study with a brief overview of the regulatory background, which illustrates the necessity of separating the two banking functions, also corroborated by references from the literature. Finally, we explain how separation is implemented in practice. After a presentation of our research methods we summarise and evaluate responses to our questionnaire and then reflect on the conclusions and insights of the in-depth interviews. It is our aim to highlight best practices – as a reinforcement to the organisations and managers applying them – as well as the activities that need improvement to facilitate their identification and adjustments. While our survey is not representative, we consider it a useful snapshot of the current practices followed by banks in Hungary in the above-mentioned segment.

1.1 The evolution of the current organisational structure

From the point of view of economics, the preservation of financial stability rests partly on banks and financial institutions inasmuch they keep up economic balance by efficiently managing (among others credit) risks. Zooming out, the responsibility obviously lies with the regulatory environment hosting the activities of financial institutions and bankers and providing the framework of banks' operational conditions and for individual (management) incentives and roles and responsibilities (*Lentner*, 2013). Neither the regulatory environment nor the institutional system are a constant, but change continuously (*Várhegyi*, 2010). Regulation is beneficial for the economy if it cushions the effect of economic cycles and meets the criteria of transparency, consistency, cost-efficiency and conditionality (*Botos*, 2012).

In terms of the regulation of financial activities, it was laid down already in Section 13 of Act CXII of 1996 on Credit Institutions and Financial Enterprises (as amended several times) that '[f]inancial service activities may only be taken up and pursued based on existing *internal rules and regulations in accordance with prudent operation*, (...) *controlling procedures and systems*.' Furthermore, Section 77 clearly provides that 'financial institutions shall draw up and apply internal rules and regulations that ensure the substantiality and transparency of placements and exposures as well as the controlled assessment and the mitigation of risks.'

It is also laid down in Recommendation No. 1/2000 of the Hungarian Financial Supervisory Authority that a system of embedded controls should be established among others in credit, credit approval and credit administration procedures. Attention is called to regular controls by the management, and the recommendation also proposes that 'credit institutions should preferably establish double reporting lines in business functions. Reports relating to positions and risks should preferably be received also by the head of risk management in addition to functional managers. The reporting and service lines are documented in the credit institution's relevant policies.'

In addition to causing contraction in the real economy, the world economic crisis of 2008 also cast serious doubt on the effectiveness of the then-current risk management practices of banks (*Tamásné*, 2018; *Bánfi* et al., 2010). Apart from introducing stringent capital adequacy and liquidity ratios as well as other quantifiable indicators, the subsequent revision of the EU regulatory framework placed special emphasis on the role of executives in strengthening the position of risk management and improving the efficiency of risk controls (*Tajti*, 2011). That was partly the basis for a change in banking culture, discussed in detail in Pesuth's Ph.D. dissertation, establishing that 'banking culture, fair banking

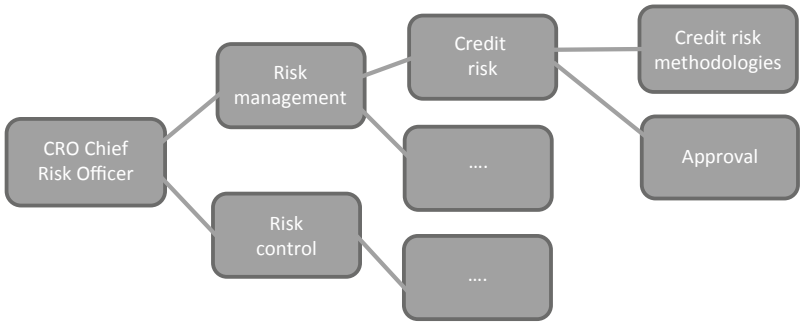
behaviour and conduct should be fundamental elements of the business model' (Pesuth, 2016a:93). The prudential regulation introduced after the crisis of 2008 have significantly improved capital and liquidity in banking, however, as Móra also points out '[a]ppropriate risk management (banking function) and competent supervision (function of the authority) cannot be simply replaced by the capital adequacy ratio' (Móra, 2019:381).

Today, Directive 2013/36/EU (or CRD IV) does not provide specifically for the separation of the two functions, only for a general requirement of independent risk management, which, however, entails the obligation of separation. The EBA Guidelines on internal governance promote a strong risk culture in which employees have a clear idea of their tasks and responsibilities, thereby fostering risk-awareness. Recommendation No. 12/2022 of 11 August 2022 of Magyar Nemzeti Bank on setting up and using internal safeguards and on the management and control functions of financial organisations reinforces these goals, and also discusses the setting up of risk acceptance and risk management committees and the management of conflicts of interest arising during operation.

Upon drawing up and at each subsequent revision of their loan policies, banks should clearly define the various responsibilities and limits of discretion of the persons involved in credit risk management and lending. These should be made clear and the scope of responsibilities unambiguously laid out, inter alia, so that potential conflicts of interest during operation can be handled. There is a natural conflict of interest between those who profit on generating new transactions (sales) and those who control the risks associated therewith (risk). Therefore, proper lines of responsibility and awareness of these issues should lead to the separation of the credit appraisal and credit management functions. There should be rules also on who finally signs off on credit decisions, and who has the authority to override criteria and the last word on acceptance or rejection in the case of non-standard transactions (Brown - Moles 2014). Refusing a credit application, reducing/withdrawing an existing credit line, or terminating an already disbursed loan has significant consequences for both customers and bank employees who have spent time and effort on the deal. It is therefore of utmost importance to properly regulate the matter in banks' loan policy and also at organisational level.

As Figure 1 shows, managing credit risk is only one of the tasks of the risk management function.

Figure 1
Separation of the risk management function within the organisation



Source: authors' elaboration based on the figure of *Kovács L.–Marsi*, 2018

Credit risk stands for the possibility that loans disbursed by the bank will not be or will not be completely or timely repaid by debtors (*Juhász*–Kovács R., 2016). The purpose of credit risk management is to investigate and analyse factors behind defaults, as credit losses may cause severe harm to banks and may eventually jeopardise their profitability and liquidity. To adapt to the changing economic environment, the risk appetite of banks and the optimum level of credit risk in view of profit targets should be re-determined from time to time. An organisational structure and governance where the separation of risk management and front-end functions is ensured and endogenous conflicts of interest are addressed is a compulsory element of any risk management framework (Juhász–Kovács R., 2016)..

The study of Kalfmann confirms that bank executives grow increasingly risk-aware in times of crises, and reveals that these periods are especially suitable for reviewing the characteristics of existing risk management systems, to introduce risk considerations into management incentive schemes even in sales, and to clearly define the directions of improvement (*Kalfmann*, 2010).

The four-eyes principle is one of the most basic risk management methods, which is applied frequently even outside the banking sector by economic operators in any matter where risk management is relevant. The four-eyes principle is typically implemented in all stages of the credit process (client credit rating, specification of credit conditions, credit decision and disbursement) (Kovács L.–Marsi, 2018).

Initially, some banks designed the operation of their credit approval and risk management functions in a way that no contact was allowed between the staff of these functions and the client during the preparatory and the decision-making phase. After the credit decision, when all or part of the credit had already been

disbursed, there was more room for personal contact with credit approval staff (e.g. on-site visits during the term of the project, material amendments to the agreement). That practice has changed significantly at most commercial banks in the last 15 years. While front-end employees continue be the first points of contact, at most banks, credit approval staff also participates actively in the preparations. They are allowed to be present at negotiations, and credit conditions are agreed at an early stage.

5-10 years ago, a new element was introduced into the decision-making mechanism to provide early access for credit approval staff. It is a pre-screening in the case of non-standard transactions with the involvement of managers from sales and risk. The result of their consultations is a guidance, which may be a rejection or indicative terms for the transaction. This practice has been adopted first at banks where credit approval had been involved only in later stages of client and transaction rating. Its objective is to minimise unnecessary work for more efficient cooperation. Timely acceptance of a prior guidance may also pre-empt many potential conflicts later.

2 RESEARCH METHODS

Our (Google Forms) survey questionnaire, comprised of 14 questions, was launched in the second half of 2021 by direct contact to respondents (via e-mail). The written interviews were conducted in 2022. The contact details (company e-mail addresses) of target respondents were obtained from the authors' own database (training). We reached out to the employees of 16 banks in total (MKB and BB were separate entities at the time of our survey). At 12 banks, we approached several employees, while only 1-2 people were invited from the remaining 4 banks. A total of 410 employees and 81 managers, i.e. almost 500 potential respondents were contacted in e-mail, of which 124 replied by completing the questionnaire attached to the e-mail. The responses were collected online, ensuring respondent anonymity.

For the written interviews, we have asked 5 managers and 6 employees from sales and credit approval, respectively (altogether 22 respondents). None of the samples is representative, but may be regarded as an assessment of the current state of affairs and as the groundwork for a subsequent representative study.

2.1 Evaluation and presentation of questionnaire results

The survey contained 14 questions, the first of which served the purpose of segmenting respondents along the business and credit approval functions (hereinafter 'sales' and 'risk'). For two questions, answers had to be provided in quantified form on a 10-point scale, where 1 was the weakest and 10 the strongest. For two other questions, predefined criteria or items had to be ranked. Half of the questions were open-ended, requiring respondents to share their ideas with their own words. In this case, the answers were quantified during survey evaluation by examining and ranking the words used by respondents by frequency.

Answers were grouped and analysed in three categories:

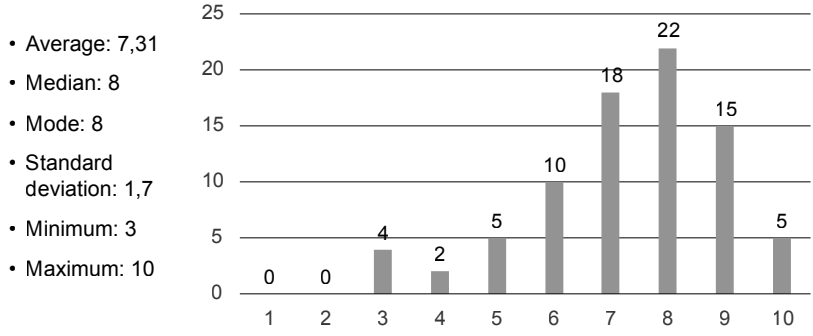
- rating of cooperation;
- other quantifiable answers;
- non-quantifiable descriptive answers.

The survey was evaluated separately for the risk and the sales function, analysing both similarities and differences. As the name of the respective functions may differ from bank to bank depending on whether they deal in corporate or project finance, the terms 'credit approval', 'risk management' and 'risk', on the one hand, and 'front-end', 'business' and 'sales', on the other, are used synonymously.

2.1.1 Rating of cooperation

We asked first for a quantitative assessment of cooperation with the other function, the results and evaluation of which are summarised in *Figures 2* and *3*.

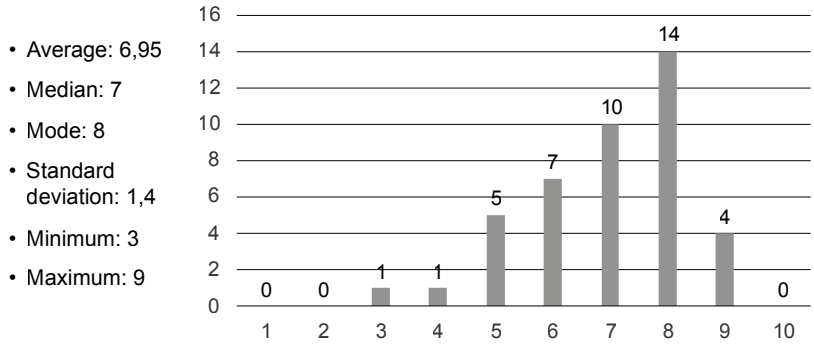
Figure 2
Rating of cooperation with the credit approval function by sales



Source: authors' elaboration based on respondent input

Figure 2 displays relatively low standard deviation, with 68% of the respondents rating cooperation with their colleagues from risk with a score between 7 and 9. That corresponds to a median value and mode of 8, and an average of 7.31. Less than 8% of the respondents gave a very low rating below 5.

Figure 3
Rating of cooperation with the sales function by credit approval



Source: authors' elaboration based on respondent input

While only two respondents from credit approval rated cooperation with sales with a score below 5, the average rating was almost four tenths lower, at 6.95. Here again, we recorded a mode of 8, but the median value was only 7.

As a cross-check, survey respondents were asked to provide three words that come to mind about the other function. The words mentioned most frequently by the two functions are collected in Table 1.

Table 1

Of sales (42 responses)	Number of responses	Share of responses	Of credit approval (82 responses)	Number of responses	Share of responses
Not thorough, sloppy	*11*	*26%*	**Cooperation**	**20**	**24%**
Aggressive	*10*	*24%*	Risk mitigation	17	21%
Sales	9	21%	*Slow, cumbersome*	*15*	*18%*
Pressure	*9*	*21%*	**Thorough**	**15**	**18%**
Customer-oriented	**8**	**19%**	*Nerd*	*12*	*15%*

Source: authors' elaboration based on respondent input

It is obvious that sales is described more often by phrases carrying negative overtones, which is in line with their lower average rating received in the quantitative assessment. 'Not thorough, sloppy' was mentioned by 26% of the respondents, but the word 'inaccurate' signifying a similar trait or behaviour also came up in a few instances. We also analysed the answers having in mind that the same quality may be described by different terms. The most frequent terms for risk approval were 'rigid', 'inflexible', 'nerd' with a share of 25 to 30%.

That high figure may be explained also by the fact that negative experiences are 'harboured' and easier recalled by many people.

We also had a look at the share of negative, neutral and positive words in the responses. We observed that as high as 50% of the vocabulary used to describe sales was comprised of negative words, neutral words constituted more than 25%, while the share of positive words was the lowest. Risk received a more favourable rating with neutral and negative words making up 31-45% of the vocabulary. The share of positive words was the lowest in this case, too.

In our next question, we asked survey participants what characteristics colleagues working at the respective functions should have (who is the ideal sales, credit approval, risk management colleague?). The preferred behaviours are summarised in *Table 2.*

Table 2

Of sales	Share of responses	Of credit approval	Share of responses
Qualified, well-prepared	60%	Cooperative	40%
Thorough	43%	Expert, competent	39%
Cooperative	36%	Supportive	26%
Accurate	33%	Thorough	17%
Risk-averse	24%	Fast	16%

Source: authors' elaboration based on respondent input

Sales colleagues are first and foremost expected to be qualified, well-prepared and thorough in their work, while the most important criterion for colleagues from credit approval is a cooperative attitude, but expertise and competence were almost just as important. Cooperative attitude was a common preference, which was mentioned not only as an expectation but also as a value in both the questionnaire and the interviews.

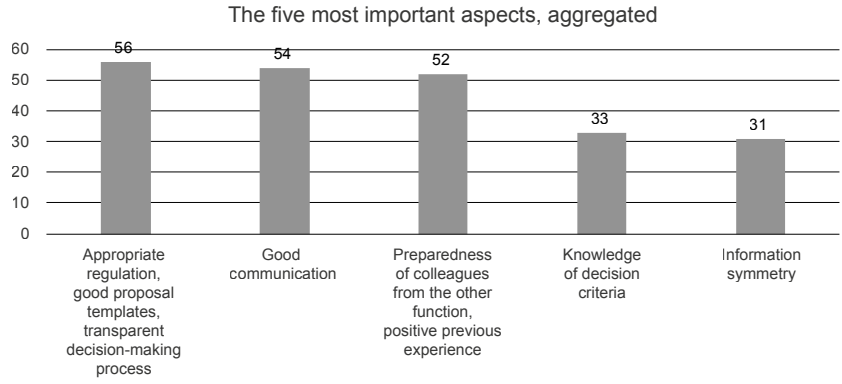
2.1.2 Other quantifiable answers

Respondents were asked to rate their workload on a scale of 1 to 10. High workload was reported by both functions, with an 8.6 average and a value of 9 calculated for medians and modes. Standard deviation was even lower than in the inter-functional rating of cooperation; only 4% of the 124 respondents assigned a rating lower than 7.

Our study had two main objectives: (i) to provide a detailed description of the current state of affairs from several aspects, (ii) to find out what would facilitate cooperation and make work between the functions better, more efficient and enjoyable. We included a targeted question for the second objective, providing 14 possible answers to respondents on how cooperation could be improved, of which they had to select and rank the five most important.

We analysed the ranking also by aggregating how many times each answer option was ranked in the top five by the respective functions. The results obtained on how cooperation could be enhanced are presented in the figures below:

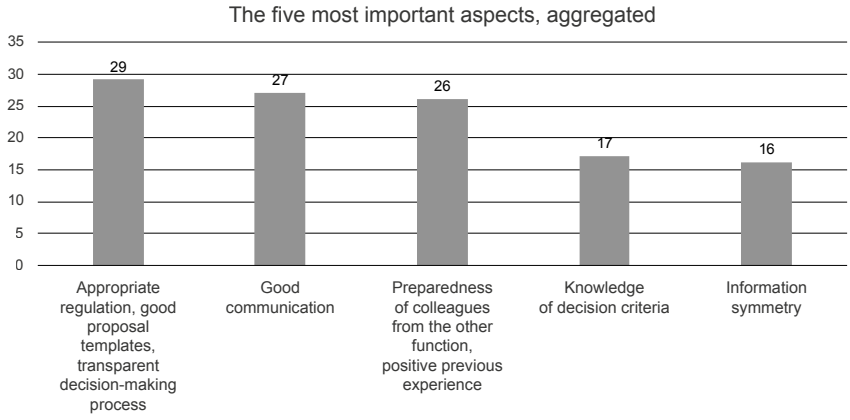
Figure 4
Answer options selected by sales on the improvement of cooperation



Source: authors' elaboration based on respondent input

Figures 4 and *5* show that, in aggregate, appropriate regulation and good proposal templates were ranked first by sales the most often. Both functions considered the same propositions the five most important, with an almost identical number of votes which was well above the number of votes cast for other 'remedies'. Reduction of workload, elimination of turnover, harmonisation of incentives for the two functions and good relations between managers did not make it in the top five, but each of these options received at least on vote.

Figure 5
Answer options selected by credit approval on the improvement of cooperation



Source: authors' elaboration based on respondent input

As this was a cardinal question in our study, in the next survey item we provided an opportunity to respondents to share their additional suggestions for the improvement of cooperation in descriptive form. Of the input received, special note should be made of the need to get a better understanding of each other's perspective, mutual respect, personal interactions and a previous history of cooperation, i.e. a closer personal relationship. With reference to the last point mentioned, several respondents suggested that more activities, workshops and trainings should be organised for the two functions. That need reappeared also in the interviews (to be discussed later) in answers to the question 'What could managers do?'. As a highlight, both functions felt that reduced workload would increase the efficiency and quality of cooperation significantly, as there would be more time for a careful preparation of proposals and for making informed decisions.

Another survey question requiring ranking and ordering concerned preferred channels of communication. Communication by telephone and meeting in person were the most preferred channels of representatives of sales and risk, respectively. E-mail correspondence, of course, was also marked by many respondents. If online consultation through Zoom/Teams/Skype, where participants see each other face-to-face, is considered physical, in-person communication is the top preferred communications channel. This preference is also reflected in descriptive answers to the survey item asking respondents to list valuable aspects of cooperation between the two functions, to be presented under the next heading.

2.1.3 Other non-quantifiable, descriptive answers

The question *'What are the most annoying aspects of cooperation to you?'* was asked after the '*What could facilitate cooperation?*' unit, assuming that identifying the most annoying aspects would automatically improve cooperation.

Answers from sales were grouped by frequency of occurrence. Lack of consultation (when new terms or items are incorporated without prior consultation) was a frequently reported problem. Some criticism was directed at over-securitisation or excessive caution. Many mentioned lack of trust and (apparently) conflicting interests in their answers. Several respondents reported that 'risk and credit approval colleagues treat us as if we were the ones giving them extra work and not the client'. On the side of risk approval, lack of cooperation and hiding information were raised repeatedly. Based on the answers, the primary source of annoyance is a trust deficit due to a failure of sales colleagues to reveal the whole truth, and to the alleged practice of risk colleagues to 'smuggle in' new terms without prior notice, as described above.

Our next question was *'What do you value most in cooperation with the other function?'*. Respondents from sales indicated joint work, searching for solutions, common achievement and success as the most valuable aspects in their answers. The opportunity to learn, to understand different perspectives and complementarity of the two functions were other important aspects. The most frequently occurring phrases in descriptions of the values of the credit approval or risk function were 'communication', 'joint' and 'trust'. Fairness in personal relationships, treating each other as partners, a supportive and a solution-oriented attitude, creative work, brainstorming and thinking together were listed among valuable features by both functions.

Respondents were invited to self-reflection by the question '*What could you do to improve cooperation?*'. The answers of both functions clustered around 4-5 themes. Many respondents from sales referred to the improvement of the quality of proposals and reserving more time for the decision. Respondents consider participation at professional trainings and courses, 'more and better communication' as well as greater attention and openness to colleagues important. Some risk representatives also mentioned providing an explanation for 'what and why' and a reasoning for queries/requests.

Our next question was *'What elements do you consider superfluous or over-regulated in the credit process?'*. Since the questionnaire was sent to associates of more than 15 banks, each having their own internal rules, the identification of similarities was more complicated. And yet we detected a few reoccurring points, such as the intricacy and over-regulation of the decision-making hierarchy, too much

paperwork and too detailed approvals, which often require extra rounds with decision-makers for no good reason, resulting in additional effort and loss of time.

At the end of the questionnaire, respondents were asked to recall cases in which they were very satisfied or very unsatisfied. This is a highly subjective question which invited the most divergent answers. Therefore, we cite below some of the most definite, intriguing and insightful answers:

'When there is feedback from risk on what they disagree with and what they are expecting for the decision, and there is still time for us to respond.' (+)

'After the credit process had been closed, my sales colleague called me and thanked me for my work.' (+)

'In a potential financing deal, representatives of both risk and sales were delegated to the on-site inspection and meeting with the client, so colleagues from risk could also see the "human face" of funding.' (+)

'In decision-making applying the four-eyes principle, risk inserted completely irrelevant and out-of-touch additional terms.' (–)

'When sales does not know their client well enough, and they do not even show willingness or competence to notice red flags. Risk is not involved in due time and depth, and eventually we have to reject the transaction.' (–)

2.2 Evaluation and presentation of interview results

Although the majority of our survey questions involved open-ended, i.e. exploratory questions, we considered based on the input received that we should collect more information to make our research, results and conclusions sufficiently well-founded and widely applicable. We therefore compiled an interview draft with 8 questions and sent it to a pool of respondents, half of whom worked at sales and half of whom at credit approval in management positions (5 each) or as employees (6 each). The selected respondents worked at 10 different banks as we aimed at diversity in sampling, just as with the questionnaire.

We started the study with the presumption that cooperation between the two functions has an impact on banks' operation. This hypothesis was confirmed by answers to the first two questions (*Which factors may be positively vs negatively affected by improved and more efficient cooperation between the two functions?*). Turnaround time was the most frequent answer for positive effects, as the credit process could be accelerated and the same result could be achieved with less effort. 50% of the respondents mentioned employee satisfaction, and a lower share of them featured team spirit, higher quality of customer service, better and optimised decision-making and more ideal funding structures in their answers. Al-

though the aspects listed above indirectly include lower losses and higher profits, 25% of respondents addressed these aspects also directly. Answers concerning adverse effects mirrored positive answers, only negatively rephrased. Deceleration of processes, protracted decision-making, 'non-cooperation', negative customer experience or loss of clients in the worst case were the most frequent adverse effects. Several respondents referred to employee frustration and a negative workplace atmosphere.

We asked also how the current economic circumstances (war, energy crisis, inflation, etc.) influence cooperation between the functions. Answers reveal a potentially twofold effect. One third of the respondents perceived a positive effect and an equal share of them a negative effect. 20% of the respondents referred to a twofold effect in their answers. Among positive effects, several respondents cited that joint portfolio reviews are carried out more frequently in order to mitigate funding risks. Closer cooperation and greater cohesion ('the crisis has increased interdependence') were also included in several answers. The negative effects identified by the most respondents were intensification of conflicts and amplification of basic problems as well as potential tension due to the extra work and data requests.

In times of crises, banks tend to update and introduce more stringent industrial and sectoral lending guidelines. Stricter regulation leaves less room for debate, and the number and volume of deals also decreases.

Answers suggested that the regulation of roles and responsibilities contributes greatly to better cooperation, thereby confirming our own hypothesis and the propriety of regulatory provisions. It was expressed by respondents already in this interview item – and later repeated by others – that employees should be given more freedom and competence. A manager highlighted that the business function is banks' 'first line of defence', so rational risk-taking is also in their best interest.

Powers and responsibilities, in any event, are not necessarily indicators of the strength and dominance of the respective bank functions. The case may be that although more powers and responsibilities are conferred on credit approval, it is the business function that has the last word. This was also noted by some of the respondents, stressing that managers play an important role in this respect, too.

The structure of decision-making was found appropriate by half of the respondents. However, one third of the answers argued that decisions are escalated to higher levels for no good reason and greater individual responsibility in decision-making would be welcome by extending scopes of authority. That would improve processes and turnaround time. As one of the managers phrased it: 'We need more flexible decision-making platforms in addition to reduced bureaucracy.

Decisions should be delegated to the level where the available information can be processed the most efficiently subject to the complexity of the request and its impact on the funding structure.'

While the answers of managers and employees to the four previous interview items did not differ significantly, answers to this item revealed satisfaction with decision-making mechanisms primarily on managers' side, while bank employees would prefer greater freedom and discretion in decision-making, and consequently, greater responsibility.

Our next question was '*What could managers do to improve cooperation?*'. 'Being a role model', 'giving guidance' were the most recurrent phrases. It is highly important for a manager to be able to cooperate, not only within their function, but also with managers of the other function to communicate the same credit standards. Several respondents mentioned better and open communication both between managers and between managers and employees. One third of the respondents called for more frequent consultation and dialogue between risk and sales. Due to the pandemic, many were forced to switch to online communication in the last two years, which, however, is no substitute for in-person meetings.

A demand for addressing and discussing problems on managers' initiative and listening to complaints from the other function were also voiced in the answers. Respondents stressed the importance of being motivated, striving for good relations and organising team-building and common activities (also for the two functions) to that end. In addition to the above – as suggested by several respondents – it is managers' responsibility to clearly define roles and responsibilities, not only within the respective functions but also between the business and the credit approval/risk function. Clear rules will eliminate much of the tension at the level of employees. Interestingly, the answers of managers (i.e. what they should do on their part) and employers to this item did not show major discrepancies apart from the phrases 'being a role model' and 'giving guidance', as discussed earlier, which featured mainly in employee responses on main expectations for managers.

To the question *'What do you enjoy in your work?'* many manager respondents replied that they relished solving complex and difficult transactions (in cooperation). Meeting business KPIs (approvals, execution of credit agreements, completed projects) is also a source of joy, just as much as client satisfaction and appreciative feedback. Several managers mentioned the success, satisfaction and good mood of their colleagues. Joyful aspects cited by the highest share of employee respondents were getting to know new things and diversity in work. They treasure positive feedback, satisfaction of the other party, and appreciation – not only from direct colleagues but also from associates from adjacent functions, which has a positive effect also on cooperation between the two functions. Teamwork,

good company and a pleasant workplace atmosphere are also important to bank employees. Of course, the enjoyable aspects of work, which are a strong motivating factor, are specific to each individual and are highly dependent on personal mindset and character.

3 SUMMARY AND CONCLUSIONS

Our 'snapshot' aimed to capture what bankers at Hungarian institutions think today about cooperation between the two main functions responsible for credit activities. Answers to the questionnaire and our more in-depth interview questions suggest that sales and risk relations are conflict-prone, but they can and should be improved with some effort, in which managers should play a central role.

Of the answers received to our set of questions on ways to improve cooperation, good and open communication should be highlighted as a facilitator of fast and efficient business processes and as a basis for trust. Loss of trust is the greatest obstacle to cooperation and is also a main source of dissatisfaction among colleagues. According to study participants, a well-regulated framework, clear guidance, optimised proposal templates and a transparent decision-making mechanism are the prerequisites for efficient cooperation. It rests mainly on managers to create an appropriate environment, bank culture and internal rules, and to communicate them towards the staff. Equally important is the attitude of employees and their readiness to understand, accept and comply with the 'rules of the game'. Designing a good process and following-up on feedback well worth the effort as it may have a major impact on the bank's profits, both directly (better decisions) and indirectly (less labour and time required for decisions, employee satisfaction).

A key question is whether banks consciously attend to developing the individual skills of employees and – to link this question to our study – the quality of cooperation between the sales and risk functions, its efficiency and to addressing problems in general. In his book *The 7 Habits of Highly Effective People*, *Stephen R. Covey* provides a detailed discussion of a matrix of important / not important / urgent / not urgent tasks (Covey, 2022). The most common error managers make is that they ignore the quadrant of not urgent but important tasks. Ignoring cooperation between the two functions does not have any imminent consequences, but could backfire in the long run. Addressing and discussing problems, more frequent – in-person – consultations, team building (also jointly for the two functions), common activities and trainings are all such not urgent but important tasks. The charisma, personality and guidance of managers is especially important in this respect.

The rationale of our study was partly that we are currently exposed to a set of economic and external stimuli which are quite complex and offer both challenges and opportunities. That setting may also influence – very positively or adversely – the joint work of the two studied bank functions, as it is different from what counted as 'business as usual' recently. It may forge a team, making business more open to stricter terms, but it may also give rise to conflicts due to extra tasks and increased workload.

Moreover, we are observing other changes in the economic environment of banks that will probably bring further modifications to the framework defining the *status quo*. As noted in the introduction, studies show that crises provide an opportunity for revising established practices and setting new directions. Back in 2016, *Härle* et al., among others, identified emerging and now already perceptible trends that banks have to be prepared for (Härle et al., 2016). Of those trends the most notable are increasingly extensive and profound regulation, rapid technological progress, constant pressure for cost optimisation and the appearance of new types of risks – to which (credit) risk management tasks should be adapted. Certain tasks are already assisted by and will eventually be replaced by automation and more sophisticated analytical and technological tools, forecasting shifts in the dynamics between the two investigated bank functions. Considering the direction of these changes, it can be expected that the detection, assessment and mitigation of risks will be part of the daily tasks of every bank employee, not only of risk management staff.

It is crucial to develop a solid banking (corporate) culture within banks that provides a sound basis for cooperation, for a sense of 'being in the same boat' and sensitivity to risks among the entire staff. Central rules and regulations set certain limits, but each bank has some room for manoeuvre within those limits. To cite one of the collected answers: 'The rules serve as a basis, but the quality of cooperation depends on how much effort managers are willing to expend on it.'

REFERENCES

Bánfi, T. – Kürthy, G. – Bánfi, A. (2010): Pénzügyi szabályozók a válság után [Financial Regulators After the Crisis]. *Dél-Kelet Európa – South-East Europe International Relations Quarterly*, 1(4), https://docplayer.hu/487545-Penzugyi-szabalyozok-a-valsag-utan.html.

Bodnár, Katalin – Kovalszky, Zsolt – Kreiszné Hudák, Emese (2014): Recovery from crises and lending. *Financial Economic Review*, 13(4), 57–85, https://epa.oszk.hu/02700/02758/00001/pdf/EPA02758_financial_economic_review_2014_4_057-085.pdf.

Botos, K. (2012). Reformok a bankszabályozásban: A „zászlóshajó" elemzése [Reforms in Banking Regulations – An Analysis of the"Flagship' Regulator]. *Hitelintézeti Szemle*, 11(2), 101–110, http://epa.oszk.hu/02700/02722/00058/pdf/EPA02722_hitelintezeti_szemle_2012_2_101-110.pdf.

Brown, K. – Moles, P. (2014). *Credit risk management*, 16. Edinburgh Business School, https://ebs.online.hw.ac.uk/EBS/media/EBS/PDFs/Credit-Risk-Management.pdf.

Carretta, A. – Farina, V. – Fiordelisi, F. – Schwizer, P. – Stentella Lopes, F. S. (2015). Don't Stand So Close to Me: The role of supervisory style in banking stability. *Journal of Banking & Finance*, 52, 180–188, https://doi.org/10.1016/j.jbankfin.2014.09.015.

Csiszárik-Kocsir, Á. (2019): Ügyfeleket megtartó banktermékek és a pénzügyi tudatosság kapcsolata [Correlation Between Customer-Retaining Banking Products and Financial Literacy]. *Polgári Szemle*, 15(1–3), 145–157, https://doi.org/10.24307/psz.2019.0909.

Dancsik, B. (2020). Rendszerszintű kockázat rendszerszintű erkölcs nélkül. Kiegészítések a pénzügyi válságok etikai magyarázatához [Systemic Risk Without Systemic Ethics. Supplements to the Ethical Explanation of Financial Crises]. *Közgazdasági Szemle*, 67(3), 225–243, https://doi.org/10.18414/KSZ.2020.3.225.

Härle, P. – Havas, A. – Samandari, H. (2016): The future of bank risk management. McKinsey&Company, http://dln.jaipuria.ac.in:8080/jspui/bitstream/123456789/3129/1/The-future-of-bank-risk-management.pdf.

Juhász, Z. – Kovács, R. (2016): A banki kockázatmenedzsment új irányai a hazai és a nemzetközi gyakorlatban = New Trends of Banking Risk Management in International and Domestic Practice [New Trends of Banking Risk Management in International and Domestic Practice]. *Gazdaság és Társadalom*, 2016(3), http://real.mtak.hu/50886/.

Kalfmann, P. (2010). Változások a kockázatkezelés gyakorlatában a krízis hatására. *Hitelintézeti Szemle*, 9(4), 309–320, https://www.bankszovetseg.hu/Content/Hitelintezeti/309_320_Kalfmann_HSz4.pdf.

Kovács, L. – Marsi, E. (szerk.) (2018): *Bankmenedzsment, banküzemtan*. Budapest: Magyar Bankszövetség.

Lentner, Cs. (2013): A bankszabályozás tudományos rendszertana és fejlődéstörténete [A Taxonomy and Evolution of Banking Regulation]. In Lentner Cs. (2013): *Bankmenedzsment – Bankszabályozás – Pénzügyi Fogyasztóvédelem* [Bank Management – Banking Regulation – Financial Consumer Protection], 27–86. Budapest: Nemzeti Közszolgálati és Tankönyv Kiadó Dialóg Campus, https://www.researchgate.net/publication/312491072_A_bankszabalyozas_tudomanyos_rendszertana_es_fejlodestortenete_I_fejezet.

Móra, M. (2019): Ten years after the crisis: Thoughts on the reform of financial regulation. *Gazdaság és Pénzügy*, 6(4), 332–385, http://real.mtak.hu/123840/.

Pesuth, T. (2016a): Bankszabályozás a válság után. A 2008-as világgazdasági válság hatása a pénzügyi intézményrendszerre [Banking Regulation After the Crisis. The Effect of the 2008 World Economic Crisis on the Financial Institutions]. PhD, Corvinus University of Budapest, https://doi.org/10.14267/phd.2016019.

Pesuth, T. (2016b): Bankszabályozási változások a válság után – A banki kultúra térnyerése [Changes in Banking Regulation After the Crisis – The Rise of Bank Culture]. *Köz-gazdaság*, 11(1), http://unipub.lib.uni-corvinus.hu/2321/1/Kozg36_Pesuth.pdf.

Tajti, Zsuzsanna (2011): A bázeli ajánlások és a tőkemegfelelési direktíva (CRD) formálódása [Formation of the Basel Recommendations and the Capital Requirements Directive (CRD)]. *Hitelintézeti Szemle*, 10(5), 499–519, https://unipub.lib.uni-corvinus.hu/1201/.

Tamásné Vőneki, Zsuzsanna (2018): Operational risk after the crisis. *Economy and Finance*, 5(4), 315–328, https://bankszovetseg.hu/Public/gep/2018/315-328%20Tamasne%20Voneki%20Zs%20javuj.pdf.

Várhegyi, **É.** (2010): A válság hatása a magyarországi bankversenyre [The Effect of the Crisis on Bank Competition in Hungary]. *Közgazdasági Szemle*, 57, October, 825–846, http://epa.oszk.hu/00000/00017/00174/pdf/01_varhegyi.pdf.

Laws, regulations, recommendations

1996. évi CXII. törvény a hitelintézetekről és a pénzügyi vállalkozásokról [Act CXII of 1996 on Credit Institutions and Financial Enterprises]

A Pénzügyi Szervezetek Állami Felügyeletének 1/2000. számú ajánlása a pénzügyi szervezetek belső ellenőrzési rendszereiről [Recommendation No. 12/2022 of 11 August 2022 of Magyar Nemzeti Bank on setting up and using internal safeguards and on the management and control functions of financial organisations]

European Banking Authority: EBA/GL/2017/11, 21/03/2018, Guidelines on internal governance, https://www.eba.europa.eu/sites/default/documents/files/documents/10180/2164689/531e7d72-d8ff-4a24-a69a-c7884fa3e476/Guidelines%20on%20Internal%20Governance%20%28EBA-GL-2017-11%29_EN.pdf?retry=1.

A Magyar Nemzeti Bank 12/2022. (VIII.11.) számú ajánlása a belső védelmi vonalak kialakításáról és működtetéséről, a pénzügyi szervezetek irányítási és kontroll funkcióiról [Recommendation No. 12/2022 of 11 August 2022 of Magyar Nemzeti Bank on setting up and using internal safeguards and on the management and control functions of financial organisations]

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DEMAND SIDE LIMITATIONS OF FINANCING HOUSEHOLD ENERGY EFFICIENCY INVESTMENTS[1]

A Regional approach

Anikó Dobi-Rózsa – Adrian Balaci[2]

ABSTRACT

The building sector represents 40% of the total energy use in the European Union. Without exploiting the energy efficiency potential of the sector, neither the Paris Agreement nor the related commitments of the European Union can be achieved. This paper takes a comparative regional approach, differentiating between Northern, Western and Central-Eastern Europe and aims to study the drivers for and barriers to residential energy efficiency investments based on the various demand side indicators related to the housing stock and financial capacity of households. This study finds that financing challenges are more striking in Central-Eastern Europe where households are more cost sensitive and risk averse. Although they are strongly motivated by higher energy bills relative to their income, they are often prevented from making the right investment decision by a number of market and behavioral failures. Public policy, meant to facilitate commercial lending activity on this market, should consider aiming at reducing the real or perceived costs of borrowing via grants, interest rate subsidies and portfolio guarantees. It could encourage households with similar risk profiles to form loan borrowing communities to spread, and thus mitigate, the risk of financing. The innovative public policy suggestions, addressing the demand side, presented in this paper and the topic in general require more research.

JEL codes: D1, G21, G28, G51

Keywords: climate finance, energy efficiency finance, energy efficiency in buildings, energy efficiency policy, financial instruments

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1 INTRODUCTION

In Europe significant primary energy saving potential exists in the building sector which accounts for about 40% of the European Union's total energy consumption and for 36% of its energy related greenhouse gas emission (European Commission, 2021; EUR-Lex, 2018). While energy saving potential remains large, there is a particular challenge related to buildings since 75% of the European Union's building stock have poor energy performance despite available incentive policies (European Commission, 2019). Moreover, between 50 and 125 million people are unable to afford proper indoor thermal comfort in Europe due to widespread energy poverty (European Commission, 2009). While the low energy performance of buildings should theoretically create a strong demand for energy efficiency investments, energy and fuel poverty limits the demand as energy poor households cannot afford such investments.

Besides the flawed energy performance of homes, a number of other factors can create a demand for energy efficiency investments. The structural conditions associated with an aging housing stock in general, a lower average size of dwellings, a lower average number of rooms per dwellings, and the presence of leakage, damp and rot can all indicate a demand for energy efficiency investments just as the high running costs of dwellings indicated by consumer expenditure on electricity, gas and other fuels as a share of individual or household level income. In contrast, there are fewer constraints on the demand for energy efficiency investments in regions where households have the necessary financial capacity to pay for energy efficiency investments from savings, where they have a healthy borrowing capacity, where the share of already mortgaged dwellings is lower and where mortgage rates are affordable.

The relevant flagship European policies endeavor that Europe could achieve 32.5% energy savings by 2030 by implementing all cost effective energy saving measures following the previous target of 20% savings by 2020 (European Commission, 2014; 2009). Most recently, the European Green Deal and the 'fit for 55' package, with strong reliance on achieving energy savings aim to make Europe the first climate-neutral continent by 2050 and to reach the target of 55% reduction in greenhouse gas emissions by 2030 compared to the 1990 threshold (European Commission, 2019; 2009). While the European Union is mostly on track with its targets, critical voices are getting stronger saying that the evolving policies and targets are leaving many households behind, deepening the energy efficiency gap in the European society. One of the criticisms is that the cost of carbon permits might be passed onto tenants who cannot afford to pay for the refurbishment of their homes and so household energy bills will go up without achieving significant carbon reductions (Euractive, 2021; Clean Energy Wire, 2020; EEA, 2019). In

response, the European Commission has proposed a new Social Climate Fund to support low-income groups through energy transition from 2025 onwards (European Commission, 2021). However, this policy proposal alone might fail to address various demand side constraints to energy efficiency investments. Even if an energy efficiency measure is cost effective, it can fail to materialize due to the substitution effect of low energy prices, or to the conflict of interest between landlord and tenant in sharing the cost savings post investment, or to the collective action failure experienced by communities of apartment owners in multitenant condominiums, to name just a few demand side constraints.

This line of argument is supported by reality. Refurbishment rates are not at levels they could and are expected to be despite the substantial energy efficiency potential in residential buildings coupled with the theoretically high demand for energy efficiency investments from the customers' side, although owners and tenants should be highly motivated by several expected benefits and positive externalities (*Della Valle, N.* et al., 2022). It seems undeniable that we cannot solely rely on the theoretical premise that cost effective energy efficiency investment plans are put into action because households make rational economic decisions. Furthermore, energy efficiency policies designed over the past decades meant to address the most obvious hurdles, such as access to capital and a lack of information on the expected benefits of energy efficiency improvement of homes. It is clear that even the most successful policies cannot close the energy gap on their own.

Therefore, this study focuses on a better understanding of the demand side limitations in three different regions of Europe in order to provide critical food for thought for policy engineers, financial product designers and other experts to better serve the residential housing market. In this study the research gap is covered by showing that investment drivers and barriers differ region by region based on the state of the housing stock, the prevailing energy prices and the financial capacity of home owners and tenants. Differences and similarities require novel approaches both by policy makers and financiers if upscaling energy efficiency investment volumes in the housing sector is to become a tangible reality and not merely an expectation.

Following the introduction, our research paper will explore the relevant literature on the energy efficiency gap, and will describe the methodology we employ followed by a detailed evaluation of the critical variables we identified as having a strong impact on the demand for energy efficiency improvements in the housing sector. We will discuss the findings and their implications and present our conclusions.

2 DRIVERS FOR AND BARRIERS TO ENERGY EFFICIENCY INVESTMENTS IN THE RESIDENTIAL SECTOR

An energy efficiency gap occurs if optimal energy efficiency investments are not implemented, because households, despite the attractive return on investment, do not employ energy efficiency measures. If the expected economically optimal investments are not carried out, market failures and policy steps in to address them are assumed to be present. At present, it is rather challenging to calculate the actual energy efficiency gap, due in part to regional and national differences. Furthermore, it is equally difficult to measure and quantify the confines which prevent households from implementing energy efficiency measures. The two most cited obstacles are the lack of sufficient economic knowledge and access to capital, both of which have been at least partially addressed by policy makers, nevertheless the volume of energy efficiency investments carried out so far fails to meet expectations. With the building sector making up to 40% of the final energy consumption in the European Union, failing to close the energy gap will prevent most targets of energy efficiency and related climate change mitigation and adaptation to be achieved.

In the same timeframe, both development banks and commercial banks have been active in developing and launching energy efficiency financial instruments, backed by policies, interest rate subsidies, grants and guarantee schemes (Dobi-Rózsa, 2021; *Czakó*, 2021). However, most of these financial instruments failed to reach the level of self-sustainable commercialization and were terminated once the relevant public assistance scheme was withdrawn. Governments were successful at creating assistance schemes and facilitating policies (grants, interest subsidies, guarantees and laws and regulations) in order to (temporarily) address the two main obstacles and to facilitate commercial lending on the market. However, many of the lending programs did not last long enough to become self-sustaining partly because research into and understanding of what financial institutions face during financing such projects from the demand side was insufficient.

2.1 Related research

A great number of studies are available that describe many of the technical and non-technical obstacles to energy efficiency investments and focus on closing the aforementioned energy efficiency gap (*Carlander–Thollander*, 2023; *Palm–Reindl*, 2018; Thollander–Palm, 2013; *Backlund* et al., 2012; *O'Malley* et al., 2004; *Brown*, 2001; *Weber*, 1997; etc.). The main idea behind our line of research is the assumption that if the various constraints are identified, the stakeholders themselves can work towards overcoming them both jointly and individually and, as a result, the energy efficiency gap can be bridged. Thollander et al., (2020) provide a compre-

hensive theoretical framework for such classification. The theories of imperfect information (*Howarth–Anderson*, 1993), adverse selection (*Sanstad*–Howarth, 1994),split incentives (*Jaffe–Stavins*, 1994), access to capital (*Hirst*–Brown, 1990), hidden cost (*Ostertag*, 1999) etc., can all add valuable insight to our understanding of both the gap itself and how to potentially address it. In the same vein, *Cristino* et al. (2021) reviews 450 publications and collects a list of 105 potential issues to describe the obstacles and drivers of energy efficiency retrofit projects. The most frequently discussed financial obstacles in the literature are the high costs of investment, long payback periods and access to capital, which can be overcome by reducing investment costs, provide economic incentives and easy access to financing by governments. Tax reductions, non-refundable grants, interest rate subsidies are recommended as suitable tools for policy makers to achieve their goals.

Compared to the large number of studies discussing the various supply side financial barriers, there are fewer publications addressing various demand side constrains, including technological obstacles from the perspective of the end-user, such as the lack of easy-to-understand-and-use information on suitable technologies and technological synergies, along with their accessibility and affordability on the local market and along the supply chain. When it comes to technical impediments, there are some publications discussing the problem of technical competence, including retrofit project management skills (*Ohene* et al., 2022; Thollander–Palm, 2013). The limited number of publications on market uptake obstacles suggests that many authors are not seriously concerned about the low customer demand for energy efficiency. Some recent studies have been dealing with cultural, social and behavioral obstacles, exploring the behavioral aspect of the demand side (Della Valle N. et al., 2022; *Bertoldi*, 2020; Bertoldi et al., 2013). Resistance to change and lack of clear information on technologies, and their real or perceived impact, are the most researched in this category. Education, training, raising awareness are among the most well-known strategies in the literature to cope with the challenges.

Regarding what drives energy efficiency investments in the housing sector, the personal commitment of the owner/resident to environmental and efficiency principles, a supportive regulatory framework, economic measures and incentivizing policies such as taxes, subsidies, energy audit programs etc., are the best documented factors in the literature (Cristino et al., 2021; *Cooremans–Schönenberger*, 2019; *Chai–Yeo*, 2012). The mainstream theoretical assumption underpinning them is that households make optimal energy efficiency investment decisions, however, individuals, therefore households, often fail in practice to make such rational economic decisions (*Shubert–Stadelmann*, 2015). Such rational choice related individual and collective limitations calling for new policy approaches have been recently explored in studies (*Blomqvist* et al., 2022; *Foulds–Robinson*, 2018; Della Valle N. et al., 2022). This particular research approach suggests that beyond general econom-

ics, behavioral economics and social psychology insights should be drawn into energy efficiency policy making practices. A general observation from the relevant studies is that the volume of energy efficiency literature has become significant over the past decades. The theoretical framework of what drives and limits energy efficiency, especially from the supply side, is well understood. However, it has not evolved in the other direction. Research that goes beyond the supply side of the equation and explores why individuals and communities fail to make optimal energy efficiency decisions and how an interdisciplinary approach might help to better understand this economic phenomenon, seems especially relevant given the nature of the dilemma. However, recent studies that explore the intersectionality of individual behavior, the size of organizations and the decision making process can provide new approaches to policy makers (Blomqvist et al., 2022).

Overall, the limitations of the mainstream literature lie in the fact that even if in general terms the various obstacles to energy efficiency investments are well studied across various economic sectors, only a comparatively lower number concentrate on the residential sector and even fewer on the owner occupied residential sector. Furthermore, even if the numbers of studies dealing with the residential sector are slowly increasing, they cover a few countries only with a smaller regional scope. Equally, although the financial and policy barriers are well covered in the literature, they remain focused on the access to capital, high investment costs, long payback period, lack of information and governmental support. They do not address specifically how energy efficiency financing instruments should be better structured to serve the households' needs and how policy could be better designed to develop and implement such financial products.

The objective of this study is to introduce new thinking around how to best combine various policy elements in order to better respond both to the needs of households themselves and of the financial institutions serving them. We propose that considerations on the demand side limitations to energy efficiency investments should be used to inform financiers and/or policy makers on how financing instruments should be developed and deployed.

2.2 Methodology

This study takes the approach of selecting countries from Europe and dividing them into three regional categories: Northern European countries (Denmark, Finland, Norway, and Sweden) Western European countries (Austria, France, Germany, the Netherlands, and the United Kingdom) and Central-Eastern European countries (Bulgaria, Czech Republic, Hungary, Poland and Slovakia). Based on publicly available European statistics, data are collected on the housing stock, the costs of hous-

ing (running and rental costs) and the financial capacity of households in general. Based on the database, several indicators are developed to describe the quality of the housing stock and the financial capacity of the inhabitants (those who cover running costs and rent if applicable). Most recent data are available from 2018, however, some of the data date back to 2015 or in some cases to 2012. However, considering that the housing stock in general does not change much, we assume that relying on the data between 2015 and 2018 is sufficient for the purpose of this study.

Beyond the drivers discussed in the previous section, the authors will explore various physical and economic conditions that are expected to drive households to invest in energy efficiency retrofits and to employ loans to finance the investment. The first is the physical condition of the dwelling, if it is inadequate. We look at the percentage of housing units built before 1945 and between 1945 and 1969, assuming that those homes require renovation and regular maintenance work, which can include energy efficiency upgrades. Secondly, we look at the average number of rooms per person in dwellings and the average size of the homes measured in square meters. We assume that households who live in smaller homes might be motivated to alter or extend their dwellings in time, which provides an opportunity to introduce energy efficient measures. Similarly, considering the percentage of the population living in homes with the presence of leakage, damp or rot can provide motivation to fix such problems, so every time maintenance work is done on a home it also provides a good opportunity for energy efficient upgrades. Beyond the physical condition of homes, the high maintenance costs of dwellings can also motivate households to invest in energy efficiency. Therefore, the authors review the yearly energy consumption per dwelling and the percentage of income spent on fuel. For households that live in rented dwellings, we review the share of rental costs as a percentage of their disposable income.

In order to better understand the financial capacity of households, the authors also look at their borrowing capacity, in case they would need to take out loans to implement energy efficiency investments. In order to establish whether households have free capacity to take out loans for energy efficiency refurbishment, we review the share of the population owning a home, the proportion of those who have already mortgaged their homes and the average income of households. Finally, with the help of the following indicators, the authors try to describe the segments of society that would be motivated to implement refurbishments, but are not able to carry out the renovation on a market basis. In order to do so, we look at the share of households where expenditure on energy as a share of the disposable income is more than twice the national median, the percentage of arrears on utility bills, and the percentage of the population unable to keep their homes adequately warm.

This study intends to perform a system level investigation and points out challenges the participants face during energy efficiency investments. It is neither a

survey nor the exploration of individual cases. The system level approach aims to help stakeholders to save resources by avoiding similar failures.

The authors assume that there are regional differences regarding drivers to and obstacles of energy efficiency investments of households. Defining the differences in demand in the three regions, which are the subject of our observations, might also allow to define what the financial institutions will face in each region when (and if) they finance residential energy efficiency projects. For example, there might be a difference in the strength of motivation for energy efficiency investments, or a difference in appetite and ability to take out a commercial loan by the household to invest in energy efficiency. It would be valuable to understand the conditions under which households would be willing to take out a loan to finance their energy efficient investment. This study will not be able to answer this question fully, however, it intends to provide a useful conceptual approach for policy makers. Taking into account that the main policy measures used to support commercial lending are interest rate subsidies, grants and guarantees, the authors focus on those policy tools within the framework of the study.

3 DEMAND SIDE DRIVERS FOR AND LIMITATIONS TO ENERGY EFFICIENCY INVESTMENTS IN THE HOUSING SECTOR

In general, we assume that demand for energy efficiency investments is stronger where the physical condition of the building is inadequate, namely it is in need of renovation or extension. Equally, high maintenance costs, especially relative to a household's income can also motivate energy efficiency investments. In addition, the ability to mortgage a home to borrow from a bank and the ability to generate adequate income to be able to pay back the loan are also important indicators when we try to identify the potential demand for energy efficiency investments. However, there are always the energy poor, who cannot access market-based energy efficiency financing for obvious reasons. This study focuses on describing where the demand and financial capacity lies in the society to implement energy efficiency investments with the aim of being able to suggest what the important factors for households are when they consider taking a loan from a commercial bank to finance their energy efficiency needs.

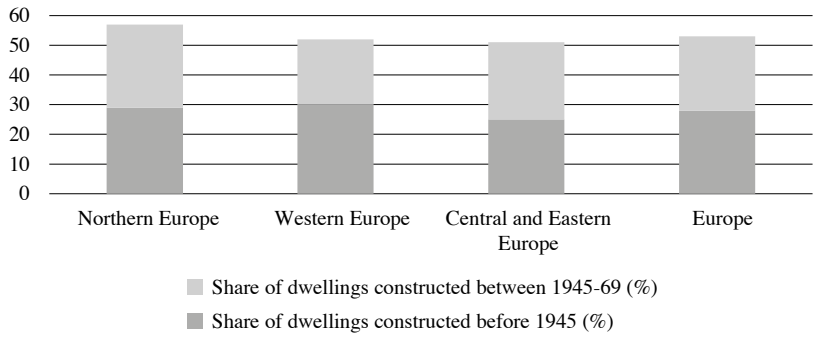
3.1 The physical condition of the dwelling is inadequate

We assume that energy efficiency decisions might be considered by homeowners when they make home renovation or home extension related investment decisions. Therefore, when we look at the demand and motivation for energy efficien-

cy improvements, we do not simply focus on the energy performance of homes. Instead, we use various indicators to characterize the physical conditions of a dwelling on the assumption that aging housing stock may increase the demand for renovations in general. Whenever a renovation project is considered by the household, the opportunity is provided to include energy efficiency improvements in it.

First, analyzing the average age of dwellings in the countries studied shows that some differences are visible between the regions. On average, 28% of the dwellings were built before 1945 and 25% were built between 1945 and 1969 and the two groups together represent just over 50% of the housing stock in Europe. The share of homes built before 1945 is the highest in Western Europe. However, when we add buildings built before 1969, Northern Europe shows the highest share of aging building stock. For the sake of this study, we prefer taking into consideration all homes built before 1969 rather than the ones built before 1945 only, because all those homes are already 50+ years old and can benefit from renovation and energy efficiency improvements. From this point of view, Northern Europe has the highest share of buildings older than 50 years. The result indicates that the demand for home improvements (including energy efficiency) could be higher in Western and Northern Europe than in Central-Eastern Europe.

Chart 1
Share of dwellings constructed before 1969 and between 1945–69 in Europe.

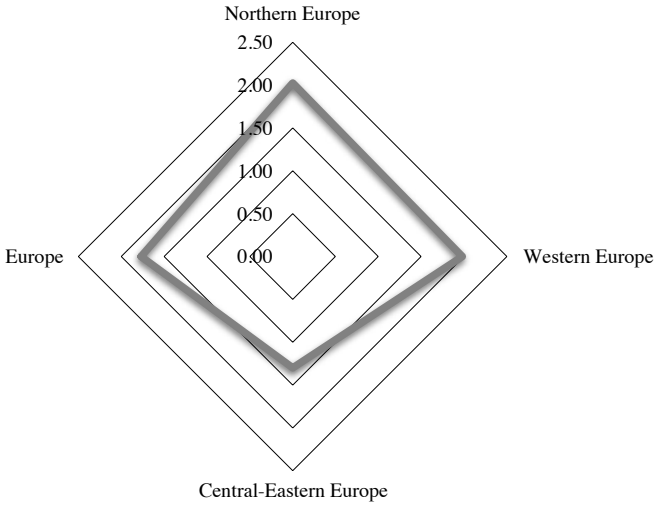


Source: own research based on Eurostat data

Second, looking at the average number of rooms per person in dwellings (2018) shows that households in Central-Eastern Europe live in homes of fewer than two rooms per dwellings on average, while Northern and Western European households enjoy more comfort having more than two rooms per units on average. Therefore, in theory, Central-Eastern European households should have a higher

demand for altering or extending their living space to achieve higher level of comfort. This fact, in turn, creates a window of opportunity to install energy efficient measures in their homes. From this point of view, Northern European households might be the least motivated in carrying out home improvement projects.

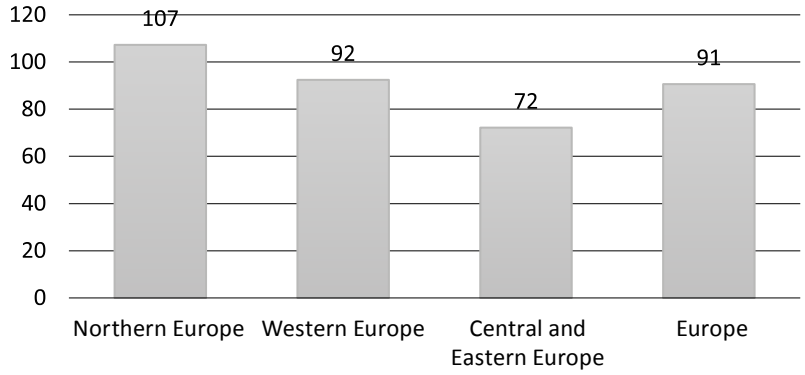
Chart 2
Average number of rooms per person in owned dwellings in Europe (2018)



Source: own research based on Eurostat data

Third, the average size of dwellings measured in square meters (2012) might also indicate the level of comfort and households living in smaller spaces might be motivated to invest in a bigger home, which creates new energy efficiency investment opportunities. In Northern Europe, the average size of dwellings is over 100 square meters. In Western Europe the average size of the homes is close to 100 square meters, except for the United Kingdom where homes are only just above 70 square meters. (This might be caused by the fact that the United Kingdom is a densely populated island nation with limited available and suitable land to build on.) Compared to them, Central-Eastern European residents live in smaller units with an average of 72 square meters in size. However, it is worth specifying that home sizes range between 45 and 75 square meters in this region, in Romania, for example, the average home measures 43.9 square meters only. The data suggest that households in Central-Eastern European countries will be the most motivated to invest in their homes to make them more comfortable.

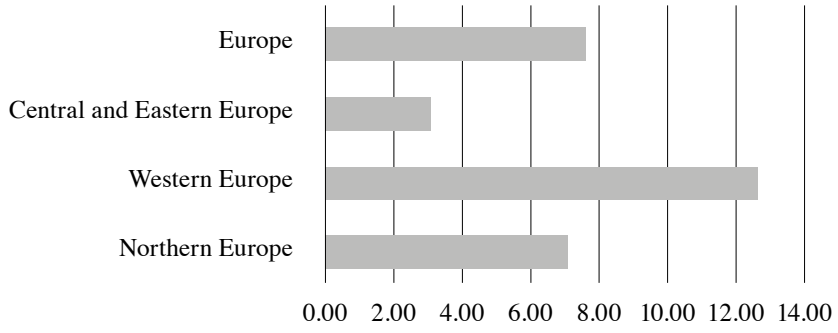
Chart 3
Average size of dwellings in Europe in 2012 (m²)



Source: own research based on Eurostat data

Fourth, analyzing the percentage of population who live in homes with leakage damp and rot (2016), Western European homes show the worst picture, followed by Northern Europe. The lowest percentage of population living under these conditions are in Central-Eastern Europe, which suggests that homes there might be well kept and looked after, and also because the housing stock in this region is the youngest (relatively) among the observed regions.

Chart 4
Presence of leakage, damp, rot in homes



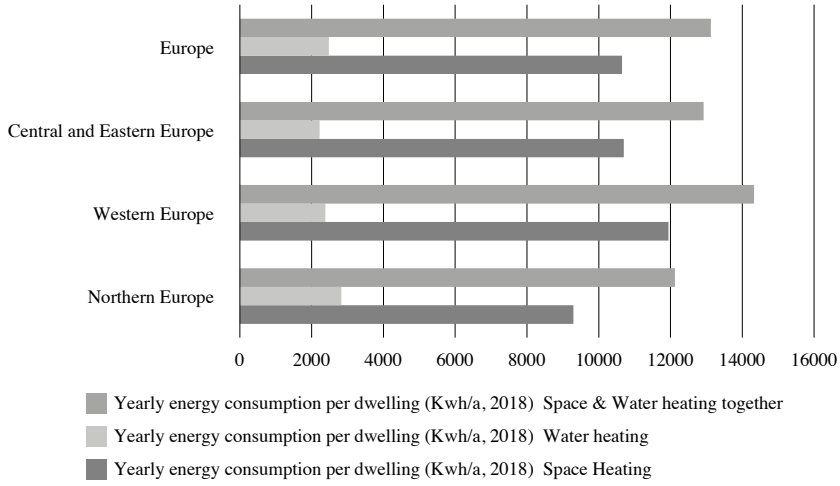
Source: own research based on Eurostat data

3.2 High running cost of dwellings

Besides the physical quality of homes, there are other factors that create demand for energy efficiency. Higher energy bills and generally high maintenance costs of dwellings relative to the income of the household can also create a demand for energy efficiency investments with the aim of reducing energy and maintenance costs. In this part of the study, we use various indicators to describe the potential demand generated by the factor of high energy and maintenance costs.

First, the yearly energy consumption per dwelling (Kwh/a/dwelling, 2018) for space and water heating shows a similar image across Europe. However, Chart 5 shows that Northern European households consume the lowest amount of energy for space and water heating followed by Central-Eastern Europe. When we take into account that, in Northern Europe, the average size of homes is 35 m2 larger than in Central-Eastern Europe, we can assume that the latter is in the most disadvantageous position and might be the most motivated to implement energy efficiency investments.

Chart 5
Annual energy consumption in dwellings in Europe

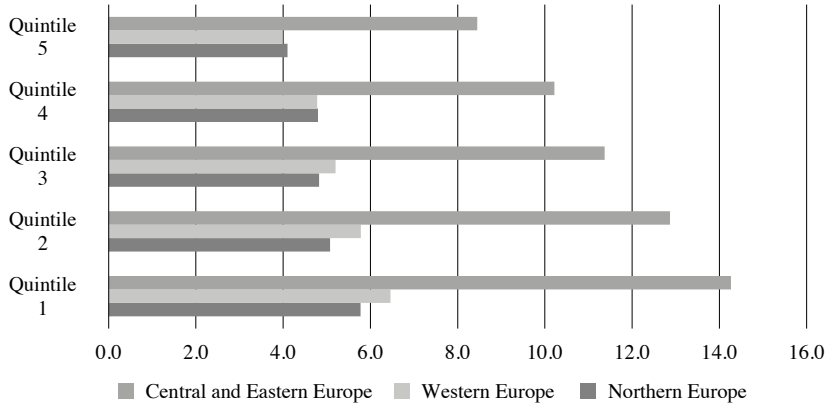


Source: own research based on Eurostat data

Second, looking at the consumption expenditure for electricity, gas and other fuels as a share of income in quintiles, Northern European households spend the lowest percentage of their income on fuel in all the four income levels of the population. However, consumption expenditure slowly increases from quintile 1 to

quintile 5, from the 20% lowest income level population to the highest 20%. Western European households spend a little more of their income on electricity, gas, and other fuels than their Northern European neighbors while Central-Eastern European households spend the most. Furthermore, as we move forward to the middle to low-income segments of the society, fuel expenditures progressively increase. It might indicate a higher demand for energy efficiency upgrades towards the middle to low-income segments of the society. The trend is most striking in Central-Eastern Europe where the poorest 20% of households spend nearly 15% of their income on electricity, gas and other fuels while the richest 20% spends nearly 9%. On the other hand, in Northern and Western European countries the consumption expenditure for fuel in each quantile is around half of that in Central-Eastern European countries'.

Chart 6
Consumption expenditure for electricity, gas and other fuels (%) 2015

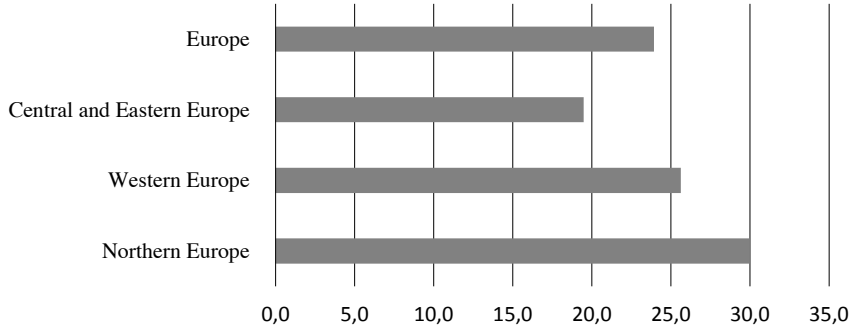


Source: own research based on Eurostat data

Third, we look at the share of rent of occupied dwellings compared to disposable household income, 2018 (as % of income spent on rent) indicator to understand how much households spend on rent as a percentage of income on average. The indicator of the population renting a home (2018, as % of population) shows that on average 27% of the population live in rented homes in the countries of observation in Europe. The rate is the highest in Western Europe where 38.8% of the population rent their homes and they spend on average 23.9% of their disposable income on rent. Compared to that, in Central-Eastern Europe only 14.8% of the population rent their homes and they spend only 19.5% of their disposable income on rent. In Northern Europe 30.6% of the people rent and pay 30% of their

disposable income on it. (Data for Norway were not available here.) Based on the indicators, we might assume that Northern and Western European households living in rented homes might be more interested in energy efficiency investments than Central-Eastern European households where only a small proportion of the population rent their homes and pay relatively low rent for it.

Chart 7
Share of rent related to occupied dwelling in disposable household income, 2018 (as % of income spent on rent)



Source: own research based on Eurostat data

Summarizing the above indicators, we can describe the demand for residential home energy efficient investments throughout Europe and we can identify the critical factors which can trigger positive energy efficiency decisions. The aging housing stock, the inadequately maintained homes and small living space can motivate households to invest in home extensions and renovation which can create a demand for energy efficiency investments as well. Based on the physical condition of the building stock, Western European countries might have higher motivation, potential and demand for energy efficiency investments, because their homes are in a worse condition than homes in Northern and Central-Eastern Europe. Compared to this, in Northern Europe homes are in better condition, larger and they consume the lowest amount of energy compared to the others reviewed in this study. Finally, Central-Eastern European households might be strongly motivated to install energy efficiency measures because they live in smaller homes with relatively high consumption of energy per square meter and even if their housing stock is somewhat younger than in Northern and Western European countries with less of damp, leakage and rot issues, they are also aging.

Comparing the regions based on the indicators describing the physical condition of homes in Table 1., we use mark + to show how pressing the problem is and how

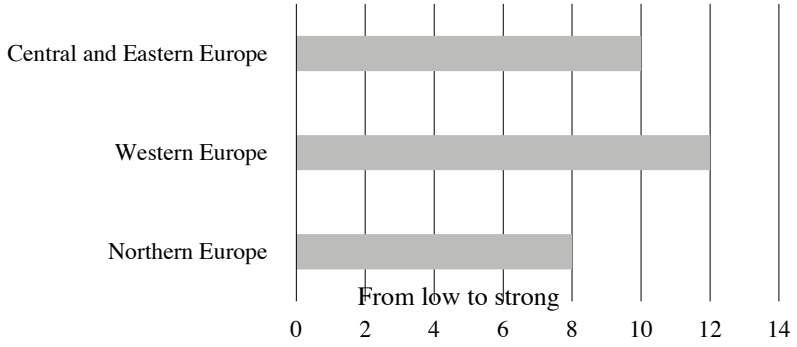
strongly households might be motivated to invest in energy efficiency. For example, the age of housing stock is a pressing issue across Europe and might generate a strong demand for energy efficiency in all regions. However, we can see more significant differences when we compare the share of homes built before 1969. There we can see that the building stock built before 1969 has the largest share in Northern Europe. Also, energy consumption is a less worrying factor in Northern Europe compared to Western and Central-Eastern Europe.

Table 1
Indicators creating demand for energy efficiency investments in regions

Region	Northern Europe	Western Europe	Central-Eastern Europe
Age of dwellings	+++	++	+
Number of rooms per person in dwellings	+	++	+++
Size of dwellings	+	++	+++
Presence of leak, damp and rot	++	+++	+
Energy consumption	+	+++	++
Fuel cost in disposable income	+	++	+++
Rental expenditures in disposable income	+++	++	+

Note: + stands for low motivation, ++ is average motivation and +++ is high motivation
Source: own research based on Eurostat data

Chart 8
Strength of motivation for energy efficiency investment



Source: own research based on Eurostat data

In order to quantify the strength of motivation for energy efficiency investments, we added the marks + from *Table 1* and placed them on a motivation scale, which shows that based on the seven indicators we discussed above, the motivation for energy efficiency investments is the highest in Western Europe and Central-Eastern Europe and the lowest in Northern Europe. In the next step, we analyze what might hinder this motivation and prevent households from implementing energy efficiency measures at an optimal level.

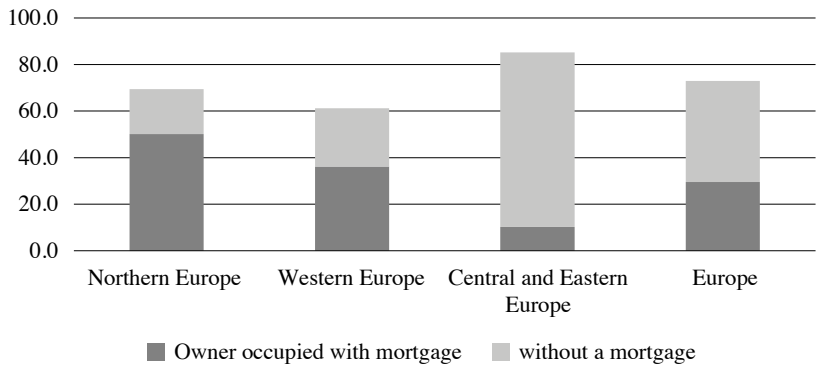
3.2.1 Financial capacity of households

Energy efficiency investments may be financed from the combination of financial savings, governmental subsidies, and commercial loans. This study would like to describe the financial capacity of households by using indicators showing the proportion of households who own their homes (owner-occupied), assuming that they are able to mortgage the unit in question. We also look at the percentage of the population that already has a mortgage or another loan to repay compared to those who are mortgage free. We review differences between regions regarding average mortgage rates, loan-to-value, loan-to-income and loan service-to-income ratios to see if there are regions where mortgage is more affordable in general. We also review the different income levels in the regions of interest as they can indicate the ability of households to enter the loan market. Finally, we check indicators related to fuel poverty. The reason is that, in addition to households that rent their homes, and therefore have no property to mortgage, there are other households that could mortgage their homes in theory but are prevented from doing so by their low income. In order to define this proportion of the so-

ciety, we look at indicators such as arrears on utility bills and an inability to keep their home adequately warm.

First, reviewing the distribution of the population by tenure status (2018, %) we find that 73% of the population own the home they live in (so called owner-occupied homes). Less than half of the population (43.5%) live in a mortgage/housing-loan free owner-occupied home, while 29.5% of the population do not fully own their homes, having a mortgage/housing-loan to repay. When we look at regional differences, we find that in Northern Europe the ratio is 19.3% (without a mortgage) to 50.1% (with a mortgage), while in Western Europe it is 25% to 36.2% and in Central-Eastern Europe it is 75% to 10.2%. In the latter region, 85.2% of the population live in owner-occupied homes and only 10.2% of the population who own their homes have a mortgage or a housing loan to repay. By contrast, in Northern Europe, where 69.4% of the population own their homes, 50.1% of the population are still repaying their loans. Similarly, but to a lesser extent, in Western Europe 61.2% of the people own their homes while 36.2% of them have outstanding repayment commitments. The figures can indicate the level of financial capacity of homeowners to mortgage or remortgage their homes to implement energy efficiency investments. *Chart 9* shows that theoretically Central-Eastern European homeowners might have the largest free capacity to mortgage their homes if they are interested in financing energy efficiency investments from loans.

Chart 9
Owner-occupied homes with a mortgage or a housing loan (2018)



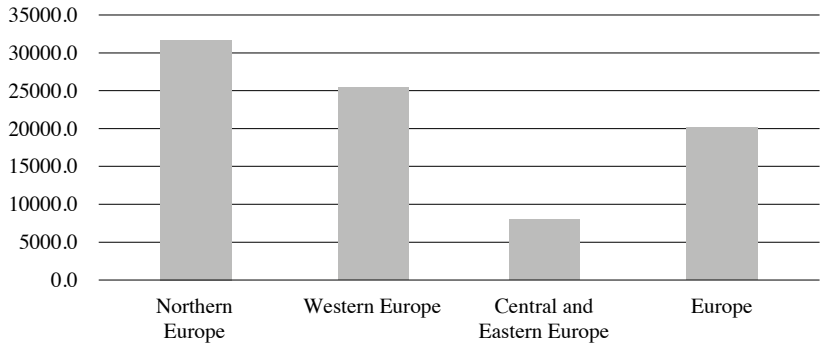
Source: own research based on Eurostat data

Reviewing the annual average mortgage rate (in %, 2018), we find that Northern Europe has the lowest mortgage interest rate at an average of 1.1%, followed by Western Europe with 1.9%. In Central-Eastern Europe in 2018 the annual aver-

age mortgage rate was calculated at 3.8%. Furthermore, in the euro zone (2018), the average loan-to-value ratio was 81% (households borrowed 81% of the purchase price of a home). This represented 4.4 times their annual disposable income (loan-to-income ratio), and those households spent 24.4% of their income on loan repayments (loan service-to-income ratio) (ECB, 2020). At the same time in Central-Eastern Europe, mortgage is not only more expensive but the conditions to take out a loan are also tighter. For example, compared to the average 81% of loan-to-value ratio in the euro zone countries in 2018, the maximum limit of the ratio in Hungary was 80% (NBH, 2023) and typical loan-to-to value ratio of a new mortgage is below 60% (EMF, 2022). Even though there is significant free capacity on the mortgage market in Central-Eastern Europe, the loans there are the most expensive and the mortgage loan conditions are the most unfavorable.

The median disposable income in the European Union (2022) is 19.883 euros. In the Northern European countries reviewed, the median disposable income is over 31 thousand euros while in the Central-Eastern European countries it is four times lower and does not reach 8 thousand euros. The low level of income in Central-Eastern Europe compared to other European countries might exclude households from this vital financing source. We also assume that the significant difference in disposable income levels between Western and Northern European countries and Central-Eastern European countries corresponds to a higher cost sensitivity of households when it comes to the cost of purchasing energy efficient technologies and /or taking a loan from a bank.

Chart 10
Median disposable income in EU27 (2022)



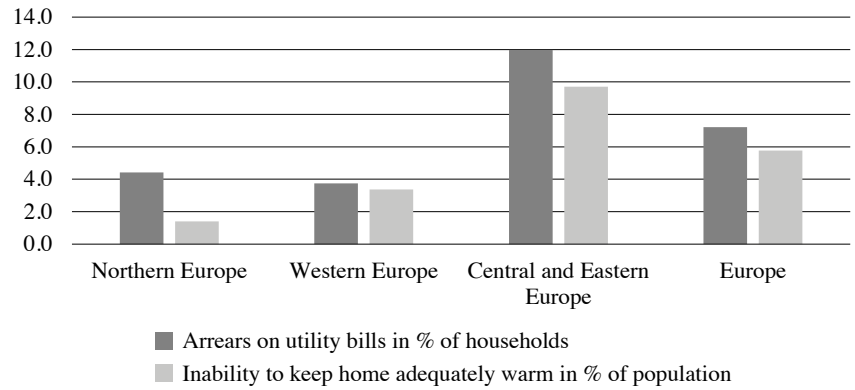
Source: own research based on Eurostat data

Finally, two other segments of the residential market must be briefly reviewed. These segments are not present on the mortgage market either because they do

not own their homes (rental market) or because they live in fuel poverty. Reviewing the rental market in the countries studied we find that 27% of households rent their homes either from the market, at market prices, or, through some social scheme, at below market rates. The main difference between the three regions is that in Central-Eastern Europe only 14.8% of the population live in rented units and the larger portion of them pay a reduced price or access housing for free. In Western and Northern Europe 38.8 and 30.6% of the population live as tenants of rented homes and most of them rent at market prices with a smaller part having access to social housing.

Looking at the indicators of arrears on utility bills and the inability to keep homes adequately warm as a percentage of households (2018), we find the most energy poor households are in Central-Eastern Europe where 12% of the households are in arrears on utility bills while 9.7% of the population are unable to keep their homes adequately warm. In Northern Europe we find only 1.4% of the population struggling with warming their homes and 4.4% of households are in arrears on utility bills. Similarly, in Western Europe 3.7% of households experience difficulties in keeping up with paying their energy bills on time and 3.4% of people struggle to heat their homes properly. These households are certainly excluded from the mortgage market. However, it is important to include them in this study because their challenging condition is also a key driver for energy efficiency investments, both when it comes to reducing their energy bills and increasing their comfort.

Chart 11
Indicators for fuel poverty (2018)



Source: own research based on Eurostat data

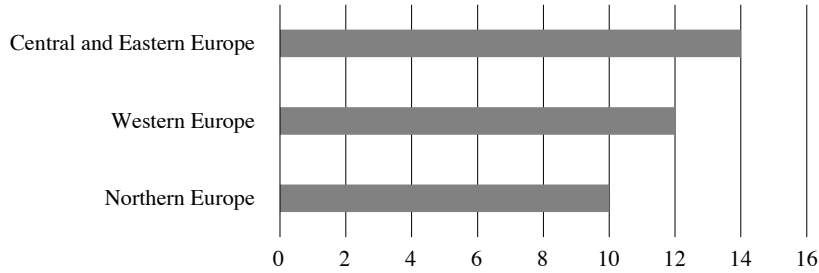
Comparing the regions based on the indicators describing the financial capacity of households in *Table 2*, we use mark + to show how pressing the problem is and how strongly households might be financially limited to invest in energy efficiency. In Central-Eastern Europe the majority of the homes are owner-occupied and free of the loan burden. However, those households might not be able to take advantage of this capacity due to unfavorable borrowing conditions and their comparatively lower income. In addition, fuel poverty is a more threatening and pressing issue. Western and Northern European households might have better financial means; however, a larger portion of the population live in rented homes where they cannot take advantage of the more favorable mortgage loan market for obvious reasons.

Table 2
Indicators for demand side limitations for energy efficiency investments in regions

Region	Northern Europe	Western Europe	Central-Eastern Europe
Ratio of owner-occupied homes	++	+++	+
Mortgage interest rate	+	++	+++
Owner-occupied households with mortgage	+++	++	+
Median disposable income	+	++	+++
Arrears on utility bills	++	+	+++
Inability to keep home adequately warm	+	++	+++

Note: + stands for low motivation, ++ is average motivation and +++ is high motivation
Source: own research based on Eurostat data

Chart 12
Limiting ability to implement energy efficiency investment from low to high



Source: own research based on Eurostat data

In order to show how strong the financial obstacle for energy efficiency investments is, we added the marks + from the Table 2 and placed them on a limitations scale, which shows that, based on the six indicators we discussed above, the constraints on energy efficiency investments are the highest in Central-Eastern Europe and lowest in Northern Europe. Overall, our comparative analysis shows that the stronger the drive, the biggest the limitation to implement energy efficiency investments (Central-Eastern Europe). Similarly, where the motivation is the weakest (in Northern Europe), the financial means are the strongest. Western European countries are somewhere in the middle, with a moderately strong demand for energy efficiency along with the presence of some important limitations, such as the sizable proportion of rented homes and a relatively lower mortgage owner-occupied market.

4 DISCUSSION

Economic measures such as profit maximizing and cost reduction and policies such as taxes, subsidies and energy audit programs drive energy efficiency investments in general. Beyond the economic measures and policies, the regulatory framework in place and the personal commitment of the end-users, such as caring for the environment, also play an important role when it comes to taking the decision to invest into energy efficiency improvements.

Beyond these considerations, general structural, functional, or aesthetic home renovations and extension projects also provide an opportunity for households to integrate energy efficiency measures into their projects. Considering that the housing stock in Europe is aging and the demand for more comfortable living conditions might increase, the demand for larger or remodeled living spaces, the

drive for renovation and home extension does exist, offering an obvious opportunity for energy efficiency investments. The older, the smaller, and in the worse condition an apartment or a house is, the greater the demand for renovation, expansion, and with it for energy efficiency investment. Beyond the physical conditions of housing, energy efficiency investments can be driven by the financial parameters of the home, such as the cost of energy and rent (if applicable) as a percentage of the disposable income of the household. The more expensive it is to run a home, the stronger the demand for energy efficiency investments.

Our research results support the conclusions of previous papers, i.e., there is significant energy efficiency potential in the housing sector across Europe. However, based on the indicators we applied in this study, the highest demand is to be found in the Central-Eastern European region, followed by Western and Northern Europe. This finding has strong implications for pan-European and European Union wide policies meant to facilitate energy efficiency and related climate mitigation and adaptation goals in the residential sector. The greater demand in Central-Eastern Europe should be fostered and built upon.

Compared to these strong driving forces for energy efficiency investments in the housing sector, equally strong or even prohibitive obstacles have been identified. Taking into account the financial obstacles, it can be established that there are noticeable differences across the regions observed. The most striking is the phenomenon that can be observed in Central-Eastern Europe, where the median disposable income of households is just around a quarter of that in Northern and Western Europe. Furthermore, Central-Eastern European households access mortgage loans under less favorable conditions, namely at higher interest rates and lower loan-to-value ratio. Which in turn requires a higher share of savings, own funds they might not possess due to a lower margin of saving potential on their lower income. In addition, the income-proportional energy bills of Central-Eastern European households are more than double those of the Western and Northern European households in all quintiles of the population. Not to mention energy and fuel poverty, which is also the most significant in this region. These findings are important for both national governments in the Central-Eastern European region and for the European Union as a whole when it comes to designing policies and financing instruments that can overcome these challenges and turn them into an opportunity for investment.

However, financial constraints exist in different forms in Northern and Western Europe as well. First of all, fewer households live in owner-occupied properties and therefore they pay market prices on rent, they also, most crucially, do not have control over investment decisions in the property. Another issue is that, especially in Northern countries, a significant portion of owner-occupied households have already mortgaged their homes and might not be able to remortgage

them to finance energy efficiency improvements. Overall, this study finds that the stronger the driving force, the stronger the limitations for energy efficiency investments. This study is not intended to calculate the extent of those barriers and limitations, since that would exceed the scope of this research.

However, it can be established based on the indicators used that in Northern Europe, compared to the other two regions, a relatively lower level of motivation and at the same time weaker financial obstacles can be observed concerning energy efficiency investments. In such an environment, the financier may find that there is no interest in residential energy efficiency loans, even though the bank would be able to finance the interested households, since neither their income nor the prevailing interest rates would be an obstacle. As the study shows, salaries are the highest here and mortgage interest rates are the lowest. The major obstacle may be that the customer can no longer take out another mortgage loan, as the household has already exhausted this option when purchasing the property, and the overall loan burden on the household is already high. What can policy makers do in this case in order to encourage energy efficiency borrowing? If we assume that the major issue is the high mortgage ratio in the owner-occupied housing market, the policy maker may apply risk mitigation tools with the aim of replacing or supplementing mortgage requirements. More innovatively, policy may consider community risk-taking instruments to spread the lending risk across households that have a similar risk profile to implement energy efficiency projects. These instruments could not only be highly innovative but also popular in advanced social cooperative cultures like Northern Europe.

Regarding Western Europe, this study observes stronger drives for residential energy efficiency investments accompanied by stronger financial challenges compared to Northern Europe. The housing stock in Western Europe is also aging rapidly and the largest proportion of dwellings with serious structural and functional problems (leakage, rot, damp, etc.,) are found here. Perhaps that is precisely the reason for the proportionally highest energy consumption. However, the energy costs relative to the disposable income of households are half of the Central-Eastern European figures, therefore, even if the dwellings waste energy, the residents can afford to pay. Compared to Northern Europe, proportionally fewer people live in their own properties here, but the homes are burdened with mortgage loans to a lesser extent, which in principle gives a greater opportunity to take out loans for energy efficiency projects. However, the mortgage interest rate in Western Europe is slightly higher than in Northern Europe, which can be a holding back force for households. Looking for an explanation as to why energy efficiency investments are lagging in the private residential sector in Western Europe, despite the fact that there is sufficient driving force for these investments,

and the financial constraints seem to be surmountable, we argue that it is worth distinguishing between households of different income levels.

It is likely that the more affluent households do not have a strong demand for energy efficiency, perhaps because they see their residential property primarily as an investment and they do not have the tools to monetize investments into energy savings as easily as they can monetize a kitchen and bathroom renovation, or property extension, when they resell their property on the market. The poorer social strata, which most likely live in rented properties, would certainly be very motivated to reduce their energy bills, especially those that have no access to social housing and rent from the private market. On the rental housing market (which is also decisive in Northern Europe) the tenant who pays the energy bill is interested in the energy efficiency investment but cannot take out a mortgage loan in the absence of ownership on the property. Where the costs of the investment are borne by the home owner, but the resident enjoys the reduction in energy costs, the split incentive hinders energy efficiency investments. In order to be able to pay for the energy efficiency investment, the landlords must increase rental fees, a measure which would not probably be very popular in the private sector and especially not in the social housing sector. Overall, financial institutions in Western European countries might be faced with the issue of a lack of interest in standalone energy efficiency loans and they may think that regular housing loans can serve the housing energy efficiency market better from the banks' perspective. Under these circumstances, the policy maker might offer interest rate subsidies to make energy efficiency loans more attractive than mortgage loans and more sustainable than non-refundable grants.

This study finds that the motivation for residential energy efficiency is probably the strongest in Central-Eastern Europe where the financial obstacles are also the strongest. Since the driving force for energy efficient investments is strong, we assume that the energy efficiency potential is the highest here, which makes this region particularly interesting from the point of view of research and EU wide policy making. If we understand the demand and its limitations, it might be possible to determine what kind of financing products, energy efficiency loans, can be created for this market and what policy instruments should be behind them. We can conclude from the research that in Central-Eastern Europe the majority of households live in owner-occupied properties, and only a small portion of this ownership pool is burdened by mortgage compared to the other two regions. This provides an advantageous position for homeowners in need of energy efficiency improvements. Due to home ownership rights, they have the decision in their own hands to invest and they probably can mortgage their home to do so, due to its value. However, these investments often do not take place and fall far short of their potential. It is conceivable that, for the reasons described in this study, Cen-

tral-Eastern European households are more cost and price sensitive compared to other regions in Europe. This means that they respond highly sensitively to the price of energy efficiency technologies and the cost of financing such investments. In addition, or precisely because of this, they are especially risk averse. As a result, the financier may find that, in theory, the demand for energy efficiency loans is definitely there, but loans are not requested by those households.

We assume that for the reason of cost and price sensitivity, households would strongly prefer predictable and affordable cost of financing, in order to be able to securely budget the cost and anchor it into their tight monthly household budgets. It suggests that these customers would opt for fixed rates, moderate, and fix monthly loan repayment installments. Moreover, due to their risk aversion, they would opt for other collaterals than mortgaging their homes for energy efficiency reasons, even if in general mortgage rates are more favorably priced than for example personal consumer loans. In addition, they may not have sufficient capital to meet the loan-to-value ratio nor can they finance energy efficiency projects on their own. These multiple contradictions may push households towards an irrational decision, choosing more expensive and riskier financing for their projects or completely preventing them from implementing energy efficiency investments. If our assumptions hold true, policy should aim to reduce the cost of financing to the level that commercial banks could offer loans with fixed and affordable monthly repayment schedules. A combination of public-budget neutral non-refundable grants and interest rate subsidies could be employed to achieve this end without distorting the market with volatile, excessive, and unsustainable grants. On the other hand, policy makers could use financial guarantee tools and community risk sharing instruments to enable banks to replace mortgage with other but equally valuable collaterals.

5 CONCLUSION

Financial barriers continue to be perceived as one of the key obstacles obstructing the implementation of residential energy efficiency investments. However, their extent varies by region. The problems are most striking in Central-Eastern European countries. Households in Central-Eastern Europe continue to be highly cost sensitive and risk averse which is further amplified by the current inflationary environment, interest rate hike cycles and unpredictably fluctuating energy prices. This paper argues that taking into account the cost sensitivity and risk aversion of households might help to better understand what financiers face when they consider financing residential energy efficiency investments. The findings of the study support the argument that where households are more sensitive to the cost

of financing (and technology), and are highly risk averse, a more sophisticated policy approach is required to enable financial institutions to serve the market and respond to the large passive demand present on it. Furthermore, besides relying on traditional policy tools, such as grants, interest rate subsidies and loan guarantees, so called portfolio guarantees could be employed, where households with similar risk profiles can form a loan borrowing community, spreading the risk of financing across the community.

According to our current knowledge, it can be assumed that a properly developed synergic policy tool could move the residential energy efficiency market out of the current suboptimal deadlock, at least in Central-Eastern Europe. In addition to the fact that financial constraints may seem less worrisome in Northern and Western Europe, they are present in a different form and also require a complex and differentiated policy approach. In countries where the rental market is meaningful and the split incentive is a major obstacle to investments in energy efficiency, the regulator and policy maker might have to consider less popular approaches and enforce energy efficiency measures on private and social landlords or accept the inevitable lack of results experienced so far.

The above challenges and opportunities should be studied further. Case studies are already available demonstrating how portfolio guarantees work in the owner-occupied residential market and how split incentives can be addressed in social housing. It would be important to study replication attempts of successful cases to understand how, if at all, it is possible to extend a successful model to other countries within a region or even outside of it.

This study is limited by the fact that demand for energy efficiency investments may be influenced by other variables in addition to the critical factors identified by the authors through their literature review. In addition to their age bracket, the particular conditions of the buildings can be determined, for example, by the time that has passed since they were last refurbished, if such a renovation had an impact on their energy performance, or by the particular construction technology employed, in case it significantly deviates from the general age bracket class reviewed in statistics. In addition, the variables employed in the study could be weighted in a differentiated manner, based on behavioral studies for example, leading to more specific conclusion. Furthermore, short term and midterm variations in inflation and world fuel prices, if not addressed by national and European level policies, could impact household energy prices, thereby modulating this variable.

REFERENCES

Backlund, S. – Thollander, P. – Palm, J. – Ottosson, M. (2012): Extending the energy efficiency gap. *Energy Policy*, 51, 392–396, http://dx.doi.org/10.1016/J.ENPOL.2012.08.042.

Bertoldi, P. (2019): Overview of the European Union Policies to Promote More Sustainable Behaviours in Energy End-Users. In Lopes, M. – Henggeler Antunes, C. – Janda, K. B. (eds.) (2019): *Energy and Behaviour.* Academic Press, Elsevier, 451–477, DOI:10.1016/B978-0-12-818567-4.00030-2.

Blomqvist, S. – Glad, W. – Rohdin, P. (2022): Ten years of energy efficiency – Exploring the progress of barriers and drivers in the Swedish residential and services sector. *Energy Reports*, 8, 14726–14740.

Bertoldi, P. – Rezessy, S. – Oikonomou, V. (2013): Rewarding Energy Savings Rather Than Energy Efficiency: Exploring the Concept of a Feed-In Tariff for Energy Savings. *Energy Policy*, 56, 526–535, DOI:10.1016/j.enpol.2013.01.019.

Blomqvist, S. – Ödlund, L. – Rohdin, P. (2022): Understanding energy efficiency decisions in the building sector – A survey of barriers and drivers in Sweden. Cleaner Engineering and Technology, 9 (2022):100527. https://doi.org/10.1016/j.clet.2022.100527.

Brown, M. A. (2001): Market failures and barriers as a basis for clean energy policies. *Energy Policy*, 29, 1197–1207, DOI:10.1016/S0301-4215(01)00067-2.

Carlander, J. – Thollander, P. (2023): Barriers to implementation of energy-efficient technologies in building construction projects – Results from a Swedish case study. *Resources, Environment and Sustainability*, 11, (2023): 100097. https://doi.org/10.1016/j.resenv.2022.100097.

Chai, K. H. – Yeo, C. (2012): Overcoming energy efficiency barriers through systems approach — A conceptual framework. *Energy Policy*, 46, 460–472. http://dx.doi.org/10.1016/J.ENPOL.2012.04.012.

Clean Energy Wire (2020): Most EU states on track for 2030 climate goals, but higher targets on horizon. https://www.cleanenergywire.org/news/most-eu-states-track-2030-climate-goals-higher-targets-horizon. Accessed: 12.09.2021.

CoE (2021): Fit for 55. https://www.consilium.európa.eu/en/policies/eu-plan-for-a-green-transition/. Accessed: 12.09.2021.

Cooremans, C. – Schönenberger, A. (2019): Energy management: A key driver of energy-efficiency investment? *Journal of Cleaner Production*, 230, 264–275. http://dx.doi.org/10.1016/J.JCLEPRO.2019.04.333.

Cristino, T. M. – Lotufo, F. A. – Delinchant, B. – Wurtz, F. – Faria Neto, A. (2021): A comprehensive review of obstacles and drivers to building energy-saving technologies and their association with research themes, types of buildings, and geographic regions. *Renewable and Sustainable Energy Reviews*, 135, 110191. http://dx.doi.org/10.1016/J.RSER.2020.110191.

Czakó, V. (2012): Evolution of Hungarian residential energy efficiency support programmes: road to and operation under the Green Investment Scheme. *Energy Efficiency*, 5, 163–178, DOI: https://doi.org/10.1007/s12053-011-9135-5.

Della Valle, N. – Bertoldi, P. (2022): Promoting Energy Efficiency: Barriers, Societal Needs and Policies. *Frontiers in Energy Research*, 9, 804091. https://doi.org/10.3389/fenrg.2021.804091.

Dobi-Rózsa, A. (2021): Energy Efficiency Financing Instruments – A comperative Study. *Economy and Finance,* 8(1), 57–84, https://bankszovetseg.hu/Public/gep/2021/057-084_E_Dobi-RozsaA.pdf.

Myers, M. (2021): Fit for 55 will penalise poor Europeans. *Euractiv*, 19.07.21, https://www.euractiv.com/section/climate-environment/opinion/fit-for-55-will-penalise-poor-európeans/. Accessed: 06 September 2021.

EC (2009a): Tackling Fuel Poverty in Europe, Recommendations Guide for Policy Makers. Report produced in the framework of the Intelligent Energy Europe project EPEE- European Fuel Poverty and Energy Efficiency. https://www.finlombarda.it/c/document_library/get_file?p_l_id=1313844&folderId=1327936&name=DLFE-6278.pdf%20.

EC (2009b): 2020 Climate and Energy Package. https://climate-laws.org/document/2020-climate-and-energy-package-contains-directive-2009-29-ec-directive-2009-28-ec-directive-2009-31-ec-and-decision-no-406-2009-ec-of-the-parliament-and-the-council-see-below_c91b. Accessed: 12.09.2021.

EC (2014): 2030 climate & energy framework. https://ec.europa.eu/clima/policies/strategies/2030_enEC (2021a): Proposal for a directive of the European Parliament and the Council on energy efficiency (recast). https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52021PC0558. Accessed: 06.09.2021.

EC (2019a): Public procurement of energy efficient works, supplies and services. https://euneighbourseast.eu/wp-content/uploads/2021/07/easme_public_procurement_projects_study_2020.pdf. Accessed: 06.09.2021.

EC (2019b): European Green Deal. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en. EC (2021b): Social Climate Fund. https://ec.europa.eu/clima/policies/eu-climate-action/delivering/fund_en. Accessed: Accessed: 12.09.2021.

ECB (2020): Trends in residential real estate lending standards and implications for financial stability. Prepared by Lang, J. H. –Pirovano, M. – Rusnák, M. – Schwarz, C. Published as part of *Financial Stability Review*, May 2020. https://www.ecb.europa.eu/pub/financial-stability/fsr/special/html/ecb.fsrart202005_01~762d09d7a2.en.html. Accessed 01.08. 23.

EEA (2019): Overall progress towards the European Union's ‚20-20-20' climate and energy targets. https://www.eea.europa.eu/themes/climate/trends-and-projections-in-europe/trends-and-projections-in-europe-2017/overall-progress-towards-the-european. Accessed: 12.09.2021.

EMF (2022): EU 27 Country reports, Hungary. By Gyula Nagy, Takarék Mortgage Bank. https://hypo.org/app/uploads/sites/3/2022/09/Hungary.pdf. Accessed: 01.08.2023.

EUR-Lex (2018): Directive (EU):2018/844 of the European Parliament and of the Council of 30 May 2018 amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency (Text with EEA relevance): Ref: PE/4/2018/REV/1. https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1529483556082&uri=CELEX:32018L0844. Accessed: 06.09.21.

Estache, A. – Kaufmann, M. (2011). Theory and evidence on the economics of energy efficiency. Lessons for the Belgian building sector. *Reflets et perspectives de la vie économique*, L(3), 133–148, https://www.cairn.info/revue-reflets-et-perspectives-de-la-vie-economique-2011-3-page-133.htm.

Hirst, E. – Brown, M. (1990): Closing the efficiency gap: barriers to the efficient use of energy. *Resources, Conservation and Recycling*, 3(4), 267–281. https://doi.org/10.1016/0921-3449(90)90023-W.

Howarth, R. B. – Andersson, B. (1993): Market barriers to energy efficiency. *Energy Econ*. 15, 262–272. http://dx.doi.org/10.1016/0140-9883(93)90016-K.

Jaffe, A.B. – Stavins, R.N. (1994): The energy-efficiency gap What does it mean? Energy Policy 22, 804–810. http://dx.doi.org/10.1016/0301-4215(94)90138-4.

MNB (2023): Borrower-based measures (LTV, DSTI), https://www.mnb.hu/en/financial-stability/macroprudential-policy/the-macroprudential-toolkit/borrower-based-measures-ltv-dsti. Accessed: 01.08.2023.

Ohene, E. – Chan, A.P.C. – Darko, A. (2022): Prioritizing barriers and developing mitigation strategies toward net-zero carbon building sector. *Building and Environment*, 223, September 2022, 109437. https://doi.org/10.1016/j.buildenv.2022.109437.

O'Malley, E. – Schleich, J. – Scott, S. (2004): The Economics of Energy Efficiency: Barriers to Cost-Effective Investment. *EIB Papers*, 12(2), 82–109, http://hdl.handle.net/10419/44886.

Ostertag, K. (1999): Transaction Costs of Raising Energy Efficiency. Karlsruhe (Germany): Fraunhofer Institute for Systems and Innovation Research, https://www.researchgate.net/publication/258260635_Transaction_costs_of_energy_efficiency_policy_instruments.

Palm, J. – Reindl, K. (2018): Understanding barriers to energy-efficiency renovations of multifamily dwellings. *Energy Efficiency*, 11, 53–65, http://dx.doi.org/10.1007/s12053-017-9549-9.

Thollander, P. – Palm, J. (2013): *Improving Energy Efficiency in Industrial Energy Systems. An Interdisciplinary Perspective on Barriers, Energy Audits, Energy Management, Policies, and Programs*. London: Springer, http://dx.doi.org/10.1007/978-1-4471-4162-4.

Weber, L. (1997): Some reflections on barriers to the efficient use of energy. *Energy Policy*, 25, 833–835, http://dx.doi.org/10.1016/S0301-4215(97)00084-0..

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DIGITAL CITIZENSHIP, DIGITAL BANKING – DIGITALIZATION PROPOSALS BY THE HUNGARIAN BANKING ASSOCIATION

From basic banking services to mortgage loans, or how to apply for a mortgage loan in 15 minutes instead of 15 days

András Becsei – Péter Csányi – Attila Bógyi – Endre Máriás – Márkó Gacsal– Levente Kovács[1]

ABSTRACT

We present through the proposals of the Hungarian Banking Association (the 'Association') how further digitalisation of the individual steps of banking processes and the adoption of international good practices would improve customer experience, as well as the tools by which the banking sector could be made more competitive in international comparison. By following up on these proposals, the turnaround time of a standard mortgage loan application could be reduced from the current 15 days to only 15 minutes. Ideally, it would take such a short time for the binding bank offer and the draft loan agreement to arrive in the client's electronic mailbox. Redesigning processes would simplify the use of other banking products and services, too.[2]

JEL codes: G21, G28, Q56

Keywords: banking system, digitalisation, lending, mortgage loans, competitiveness

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2 Internal documents, proposals and opinions from the Legal Working Committee, the Digitalization Working Group, the Retail Lending Working Group and the Property Valuation Working Group of the Hungarian Banking Association have been used by the authors for this study without reference or the acknowledgment of sources. The authors wish to thank all banking professionals for their contribution to the work of the afore-mentioned working groups.

1 INTRODUCTION: WHY IS DIGITALISATION IMPORTANT IN BANKING? HOW TO MEASURE IT?

'Digitalisation in banking is important for several reasons. First, it allows for more efficient customer service and administration through online platforms, reducing paper-based processes to a minimum. Furthermore, it improves security, increases efficiency and reduces costs through digital transactions. It supports decision-makers in developing business strategies and coping with competition by analysing the available data faster and more accurately. An indicator to measure digital accessibility and progress in banking is the Digital Economy and Society Index (DESI), compiled by the European Commission. The DESI is a highly significant indicator for banks and other economic operators as it helps assessing the digital environment of countries, and thus of banks in a given market, on the basis of digital progress and accessibility. Countries of a high DESI are better equipped to provide advanced digital services, which are essential for competitiveness and customer service.'

The ongoing digital revolution and the pervasive effect of the current directions of technological progress in all areas of our life are illustrated well by the fact that the answer above was provided to our prompt by an AI language model.

Digitalisation and digital customer service have become the norm in the banking sector. The conditions governing banks' participation in the digital transition influence their competitiveness both domestically and internationally. As a result of the joint digitalisation efforts of the banking sector and legislators, since 2019, Hungary has improved its ranking in the use of online banking services and is now among regional frontrunners with a share above the EU average.

The 2023 eGovernment Benchmark published by the European Commission also shows that Hungary has made extraordinary progress in the last five years. It is one of the five countries in the EU which achieved at least 20 percentage points improvement, partly due to the upgrade of the magyarorszag.hu portal in late 2021 and the continuous extension of its functionalities. While Hungary stands out in Central Eastern Europe for its e-government performance, regional examples suggest that its e-government portal (*magyarorszag.hu*) should be used more efficiently in the future in – primarily digital – banking by households and businesses.

To promote the digital transformation and to strengthen the competitiveness of Europe at a global scale, the European Commission and the Member States have formulated ambitious objectives for digitalisation, followed up in the Digital Decade 2030 policy (European Commission: Europe's Digital Decade) and with the DESI. Hungary has drafted its own National Digitalisation Strategy for 2022–2030 (2022) along the lines of the pan-European strategy. The aim of the document is *to make digital infrastructure, digital economy and digital public services*

the drivers of competitiveness and modernisation objectives in Hungary. As banks play a significant role in the operation of the economy, one of the main objectives of this study is to illustrate how the banking sector could contribute even more to improving Hungary's digital competitiveness – and indirectly its DESI rank.

When analysing digitalisation in the banking sector and the role of banks in digitalisation, we should take into account the important lesson learned from process development in recent years, namely that the digitalisation of a process means a real breakthrough for bank clients only if paper-based administration, unnecessary data provision and personal interaction are eliminated from it completely. Any compromise solution in the output due to the organisation of banks' processes or regulatory provisions would prevent genuinely end-to-end online customer service in banking.

Our study presents how further digitalisation of individual process steps and the adoption of international good practices would improve the efficiency of administration in a wide range of banking services, from access to banking services to consumer and mortgage loans. The study started with the brash statement that the turnaround time of a standard mortgage loan application could be reduced from the current 15 days to 15 minutes by implementing the proposals. Ideally, it would take such a short time from the submission of the loan application for the bank's binding offer and the draft loan agreement to arrive in the client's electronic mailbox. Redesigning bank processes would simplify the use of other products and services, too.

In the first section of our study, we present the achievements of digitalisation initiatives from recent years and new directions in EU legislation that fundamentally define the operation of the banking sector. In the second section, we set out proposals for improving the efficiency of the mortgage loan application process. Finally, we provide a summary and an outlook on ongoing innovations that could shape banking in the future.

2 MAIN ACHIEVEMENTS OF RECENT DIGITALISATION INITIATIVES

The Hungarian Banking Association presented its proposals concerning legislation and the management of data assets in two previous studies. The framework for a digital banking which is faster, more user-friendly and fosters economic development even better (Havas et al., 2018) could be establish by acting upon these proposals.

Our *22-point digitalisation proposal package* (Becsei et al., 2019), published with a sense of visionary timing prior to the outbreak of the COVID-19 pandemic,

highlighted focus points for digitalisation paving the way for the widespread use of online banking services. The proposals became even more relevant once previously in-person administration forcibly moved to an online venue due to the pandemic, and banks faced the tasks of ensuring a smooth transition from paper-based to digital administration overnight.

In the Association's 2021 study *Ten Points of Sustainable Banking* (Becsei et al., 2021) the proposals were updated to include sustainability and data management considerations. Increasingly significant ESG[3] proposals – in addition to shaping banking and bank portfolios – have directed attention to the importance of paperless operation and current data access obstacles to green lending. The banking proposals made it clear that green considerations and digitalisation efforts go hand in hand, and are promoting and strengthening each other.

In recent years, many components of the Association's proposals have been adopted, which, in combination with corresponding government and central bank measures, has promoted more widespread use of digital banking services. As a result of the forced educational process set off by the pandemic, even those who had not used digital banking before have started using these solutions (Demirgüc-Kunt et al., 2022). Back testing results indicate a turning point in digital banking trends, which is supported by bank survey data showing that the number of registered mobile banking accounts have doubled and the pool of digitally active clients[4] has increased by over 41% between 2020 and 2022. Among the long-term benefits of digital progress, digitally advanced countries and businesses operate more cost-efficiently and are also more resilient to external shocks (McKinsey, 2022).

In the following, we provide an overview of the legislative measures, digital developments and initiatives for the digitalisation of the banking sector that we considered the most important in the recent period and also affect the financial sector.

1. **Electronic payment solutions have become an efficient alternative to cash use which entails considerable extra cost for the economy.** In this context, Section 5/F of Act CLXIV of 2005 is an important milestone, which lays down an obligation for retailers operating an online cash register to offer their cus-

3 ESG is an acronym for Environment, Social and Governance. It is an umbrella term for complex social, regulatory and investor expectations for the functioning of economic operators. ESG criteria pertain to the environmental effects of business operation, corporate responses to social issues and requirements for corporate governance.

4 Clients are considered digitally active if they access their online or mobile banking user interface at least quarterly.

tomers at least one electronic payment solution as of 1 January 2021. The effects of that provision were reinforced by the introduction of the instant payments system in March 2020, making electronic payments even more user-friendly just at the right moment.

2. **The electronic alternative to paper-based private documents of full probative force to be signed by two witnesses has accelerated lending considerably.** Pieces of emergency legislation (Bógyi et al., 2023) were passed that enabled declarations of will made by clients via electronic systems to be considered private documents of full probative force, subject to appropriate safeguards. The rules applicable to electronic documents in a private law context have been established on the basis of the provisions for the financial sector in Section 46 of Act XCIX of 2021 on transitional rules related to emergencies and by amending and supplementing the E-administration Act (Act CCXXII of 2015) and Act V of 2013 on the Civil Code (hereinafter 'the Civil Code'). Regarding the new legislative provisions, the Association advocated first and foremost that it should support sectoral digitalisation efforts by upholding competitiveness and neutral conditions for competition. In addition, it should ensure continued use of the already existing solutions of Hungarian institutions for electronic declarations of will.

   The Association is of the view that government initiatives should also include an assessment of whether the requirement to make client declarations in the form of a private document of full probative force is justified in all cases and formal requirements should be relaxed accordingly.

3. **The digital services framework agreement has opened up new horizons in client relations.** A new point (q) added to Section 7(3) of Act CCXXXVII of 2013 on Credit Institutions and Financial Enterprises as of 26 December 2020 has extended the scope of activities that financial institutions are authorised to pursue on a commercial basis. It allows for the creation of a flexible platform for the provision of digital services between banks and clients which provides a secure space for communication, simplifies client identification and application processes for bank products, and also serves as a digital repository for contracts and agreements.

4. **The digitalisation of land registration procedures is expected to speed up banks' lending processes from 2024.** The banking sector has high expectations for the entry into force of Act C of 2021 on the Land Registry, which may reduce the time and costs of mortgage lending processes once automatic decision-making is generally applied. The new procedure requires extensive

preparations on the side of banks. The procedure can be deemed successful if it offers advantages also to clients over the current paper-based procedure, making mortgage application and lending cheaper, simpler and faster.

5. **Property valuation using statistical models is now available also for new loans.** As a result, more time-consuming on-site valuation is required less often, and clients can be informed precisely about the value of their property and the loan amount they can apply for right at the beginning of the process. For typical residential property meeting pre-defined criteria and being involved a high number of transactions, on-site inspection can be replaced by statistical methods as the basis of appraisal, reducing the number of time-consuming on-site valuation procedures. The two-year period that has passed since the extension of the scope of application of statistical property valuation methods to new loans provided proof that the provisions laid down in the Ministerial Decree and the 2021 MNB recommendation (MNB, 15/2021) ensured the prudent introduction of the new service and form a sound basis for including other types of real property in statistical valuation.

6. **Simplification of the involvement of public notaries under family support schemes.** The amendment to Decree No 22/2018 of the Minister of Justice on notarial fees, published on 31 December 2020, introduced a uniform unilateral declaration of commitment form, to be used under family support schemes. The form simplified the task of public notaries as the unilateral declaration of commitment is to be prepared with the statutory content by banks. By easing the administrative burden on public notaries, the amendment reduced the costs of clients as well. Questions regarding the practical application of the form have been clarified by now, and the practice of notaries as well as banks have become more coherent. Based on that positive experience, the Association supports the government objective to extend the scope of application of the form even further.

7. **Comprehensive cooperation for the security of digital finance under the KiberPajzs (CyperShield) Programme.** Digitalisation offers apparent advantages in numerous areas of life, but it is not without (sometimes substantial) risk. To raise awareness of the new threats accompanying digitalisation, the Association and MNB have launched an educational and communications programme in 2022 in cooperation with the National Media and Infocommunications Authority (NMHH), the National Cyber Security Institute of the Special Service for National Security and the National Police Headquarters (ORFK). It has become a public programme with the Ministry of

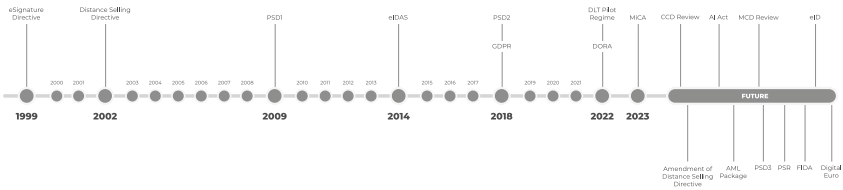
Justice, the Hungarian Financial Arbitration Board, the Supervisory Authority of Regulated Activities (SzTFH), the Ministry for Economic Development and the Hungarian State Treasury (MÁK) joining later. Under the initiative, the participating institutions and market operators have implemented a comprehensive educational and communications programme to promote responsible digital finance among the population. The campaign calls attention to the importance of Internet user awareness, privacy and having basic knowledge of digital security, allowing clients to protect their assets also in the online space.

Additional priorities of the programme are the analysis of trends and developments concerning cybersecurity in the public and private sector, and knowledge transfer with a view to maximising the strength and efficiency of cybersecurity in finance.

HOW DIGITALISATION IN BANKING IS AFFECTED BY EU LEGISLATION

EU legislation on digitalisation is gathering pace. The timeline provided below demonstrates how digitalisation as well as the regulation of digital access to banking services have become a legislative priority in recent years. Legislators put an increasing pressure not only on Member States for speedy implementation, but also on banks which have to cope with the complex and costly task of adjustment to the new requirements.

Figure 1
Timeline of EU legislation affecting digitalisation in banking



Source: authors' elaboration

Although the European Commission will set priorities for the 2024–2029 period only after the European Parliament elections of 2024, it is obvious

that several files having a major impact on banking are foreseen for the period of Hungary's EU Presidency. The most important upcoming legislative proposals are presented below briefly.

I. Payment Services Package (PSD3, PSR)

In accordance with its objectives laid down in the digital finance package, the Commission put forward new legislative proposals in June 2023 for the revision of PSD2 (***PSD3***, Commission proposal 2023/0209/COD) and the adoption of a new directive on payment services (***PSR***, Commission proposal 2023/0210/COD). The proposals aim, among others, at improved protection against fraud (e.g. by stricter rules on customer authentication), broadening consumers' rights further and fine-tuning the operating conditions for open banking. Highlights of the proposals:

- **Reinforcing fraud prevention.** In addition to diverse proposals for awareness raising and Strong Customer Authentication, the proposal that provoked the most vigorous debate was that payment service providers should compensate their clients for losses incurred as a result of the criminal act of masquerading as the client's account servicing payment service provider.
- **Minimising regulatory arbitrage.** Some Member States may apply stricter rules on payment services than others, giving rise to a phenomenon called 'forum shopping', where providers choose as their 'home country' Member States where the regulatory conditions are laxer. To contain the phenomenon, part of the rules will be incorporated in the future in a Regulation instead of a Directive.

II. The Framework for Financial Data Access (FIDA)

At the same time, a new legislative proposal for a framework for financial data access (***FIDA***, Commission proposal 2023/0205/COD) was put forward to promote data sharing. The framework will define the rules of sharing clients' financial data and allows financial institutions and other data users access to a wide range of client data.

- In accordance with the proposal, financial institutions must create an easily accessible online interface (financial data access permission dashboard) informing clients in a clear and transparent manner about the respective data permissions given to external providers. The interface should enable clients to withdraw permissions without limitation or to grant new ones.

- Financial institutions must join a self-regulated financial data sharing scheme, the conditions of which are to be specified by the participants subject to the criteria laid down in the FIDA Regulation.
- Financial institutions are granted the right to transfer data to external operators for a fee. Hungarian banks have proposed to include the services currently provided under the PSD2 among the services offered for a fee.
- One of the legislative objectives pursued by FIDA is to establish a European Financial Data Space which would enable more innovative and personalised financial products and services (e.g. financial services tailored to the sustainable finance needs of clients or automated credit rating that may facilitate access to finance for SMEs).

III. Regulation on artificial intelligence (the 'AI Act')

Due to its expected impact on the banking sector, the regulation on artificial intelligence (hereinafter 'AI') should also be mentioned. The need for an appropriate common regulatory framework has been emphasised in several EU documents (Communication from the Commission, 2018; Ethics Guidelines, 2018; White Paper, 2020). The Commission's 2021 legislative proposal specifies a set of rules based on a risk-based approach, directly applicable in all Member States. Although tripartite discussion is under way at the time of writing this overview, the banking sector will certainly have much to do after the adoption of the proposal if we consider only the strict criteria to be met in respect of high-risk AI-systems (e.g. banks' credit rating systems).

IV. The digital euro

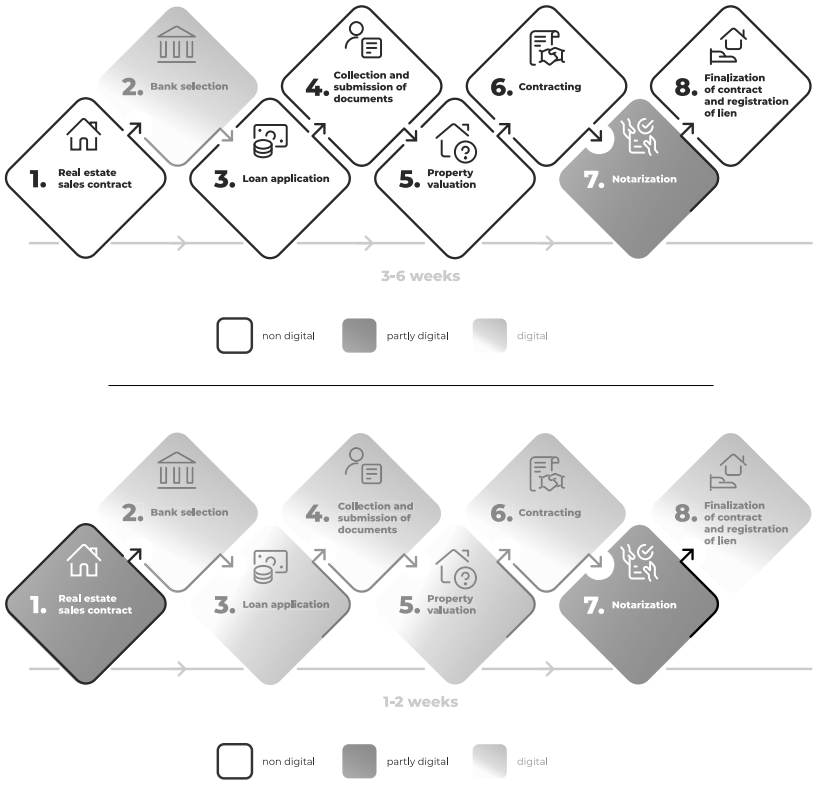
The package of legislative proposals for a central bank digital currency (Commission proposal 2023/0212/COD), put forward in June 2023, aims at establishing the digital euro issued by the European Central Bank and the central banks of Member States whose currency is the euro, and making it available to the general public. In addition to laying down a regulatory framework for the establishment, issuance, distribution and technical features of the digital euro – including privacy considerations and links to anti-money laundering rules – it also includes specific rules for payment service providers established in non-euro area Member States.

In the second section of our study, we discuss proposals for improving the efficiency of the mortgage loan application process.

3 MORTGAGE APPLICATION IN 15 MINUTES? OR THE RECIPE FOR WORD-CLASS MORTGAGE LOAN APPLICATIONS

As a result of the legislative measures presented in the first section, mortgage application and lending processes in Hungary have become much more efficient recently. The average turnaround time of 45 days formerly can now be reduced to 15 days.

Figure 2
Flowcharts of the former and the current mortgage process



Source: authors' elaboration

The improvement is indeed significant, but in the age of instant payments and non-stop online shopping 15 days is still a long time. The question arises: how much shorter the mortgage process could technically be? What is the minimum time required for a client, who is already well-informed about the available mortgage loan products of the bank and familiar with the fair banking regulations to receive the bank's binding offer and the draft loan agreement? We started by claiming that after the property sales contract is signed and countersigned by an attorney-at-law in a standard mortgage loan application process, the bank's binding offer could land almost immediately in the digital mailbox.

Let's take a closer look at the four main components of that claim.

1) Why the disclaimer that a standard mortgage loan application process is concerned?
2) When does the turnaround time of a mortgage loan application matter to clients?
3) From when and until when should the turnaround time run?
4) And most importantly, what would make virtually instant mortgage loan applications possible?

1) Why is it made explicit that a standard mortgage loan application process is concerned?

The reason why we investigate the turnaround time of standard mortgage loan application processes in our study is that, in practice, property loan transactions cannot be expected to become any quicker in some cases because of the extra tasks related to collateralisation or the specific income situation of debtors. In case of issues concerning property title, the application should evidently be rejected. For example, when rights of use to undivided common property are not set out clearly in an agreement on shared use, a loan cannot be granted for only part of the property under a standard procedure. Another case when the offer cannot be sent out immediately is when state support is linked to the mortgage loan and on-site inspection is required. Therefore, we take a simple – or to use industry terminology, a 'plain vanilla' – mortgage loan application as a basis, to be extended to the applicant for the purchase of 100% ownership interest in an existing property, partly from own funds and partly from a loan. We will analyse below the turnaround time of such a standard mortgage loan application, where all of the following conditions are met (and, ideally, banks run an AI-assisted check on the contents of the property sales contract):

- the purpose of the loan is the purchase of used residential property;

- the legislation currently in force permits appraisal of the market and mortgage lending value of the property by statistical methods (typically for apartments of an average value situated in more sought-after neighbourhoods);
- the client applies for only one mortgage loan at market rate;
- not more than two adult debtors of full legal capacity, speaking Hungarian and receiving their income from employment in Hungary only, and no other party will be included in the contract;
- the loan is secured against one real property;
- the applicants will be the exclusive owners of the property to be purchased, it is free from usufruct rights and the only marginal note on the abstract of title concerns the sale, and no other party will be involved in the legal relationship apart from the applicants who are also the mortgagors.

For the optimum operation of the market of mortgage loans, at least half of the transactions should meet the criteria listed above.

Our hypothetical minimum turnaround time of standard mortgage loan applications does not include the personal consultations needed to clarify questions prior to and during the application process. As level of information on bank products and financial literacy varies from client to client, the authors believe that in-person consultation and advice at bank branches will not lose their role as a form of consumer protection and guarantee even in the age of digital processes.

2) When does the turnaround time of a mortgage loan application matter to clients?

Clients may need a quick response from banks to their application in the following three cases:

a) to general queries on whether it would be possible for them to buy a property of average characteristics from the income they earn and bank assistance;

b) to queries on whether they could take out a mortgage loan for a specific real property, and if yes, what would be the loan amount;

c) if they want to know after the conclusion of the sales contract if their application based on prior needs is likely to be accepted or not.

Our study is concerned with the turnaround time in the third case, i.e. when the underlying contract has already been concluded, as it is the most complex. For example, in the case of general queries, property valuation is not part of the process, and turnaround time will accordingly be shorter. It is only logi-

cal that once an instant response is ensured in the most complex situation, it should be available in less complex ones, too.

3) From when and until when should the turnaround time run?

We have indicated in the previous subsection that the starting point is the date of the property sales contract, i.e. when it is signed by the client as buyer and countersigned by an attorney-at-law. However, the end of the lending process does not depend on how long digital processes take, as the last step in which banks play a decisive role is the transmission of the draft contract on the binding offer to the client. That step is followed by several others in the mortgage process, mainly for the protection of consumers.

a) The Mortgage Credit Directive of the EU provides that Member States must specify a 'reflection period' to clients prior to the acceptance of the offer, which entails a delay. Hungary has specified three days for reflection in its national legislation. Nevertheless, this measure, having consumer protection as its main objective, is not regarded as an obstacle to our digitalisation proposals. It is justified for the legislator to provide clients with sufficient time to consider if they really wish to take out the mortgage loan specified in the offer. Our proposals are directed at reducing the administrative burdens of the parties rather than at cutting the time available to clients for reflection.

b) Mortgage credit insurance: Banks may require debtors to take out a mortgage credit insurance policy that covers at least the loan amount and its fees as a precondition to disbursing the loan. The investigation of how much time that takes could be the subject of another study and is not discussed here.

c) Then, the client and the bank conclude the mortgage agreement. At this step, the client's availability for contract conclusion is an important factor. Some are more flexible, while others may be in a situation which prevents them from signing immediately.

d) Clients commit themselves to the agreement before a public notary. Here, availability of the public notary is also a factor to consider.

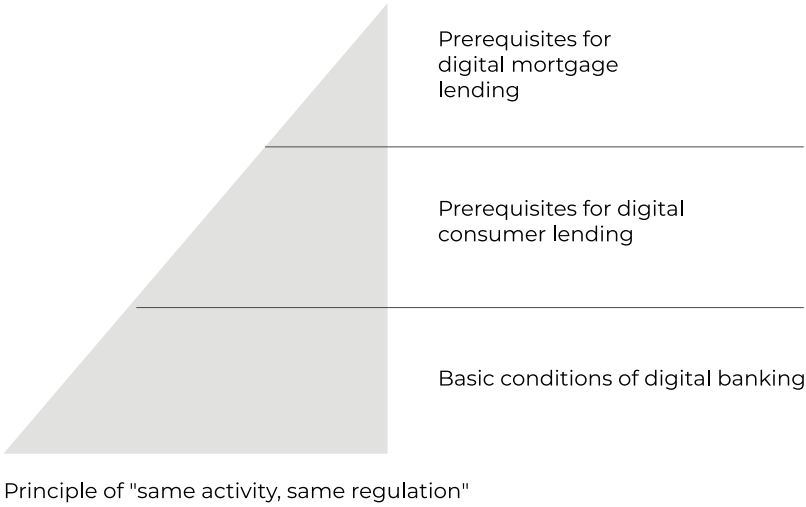
e) Disbursement: if the conditions are met, the time required for this closing step depends again on the bank and the payment terms agreed by the parties in the sales contract. However, for the same reasons described above, we did not take this step into account in determining the turnaround time.

4) What would make virtually instant mortgage loan applications possible?

To arrive at the most efficient process, it is useful to look at the mortgage application process stepwise, and to identify in each step if there are superfluous tasks, if the relevant documents could be consolidated, and if there is a possibility for digitalisation and further streamlining. The overview of the lending process and the transformation of discrete steps should start from the basis. Just as the portfolio building of bank products goes from simple to more complex, also in the case of lending, an end-to-end digital mortgage lending process will only be possible if the basis for digital access to the underlying banking services is laid first.

To explore the feasibility of mortgage loan applications at a record speed, we approach the digitalisation of bank processes along the threefold division below.

Figure 3
The system of digitalising bank processes

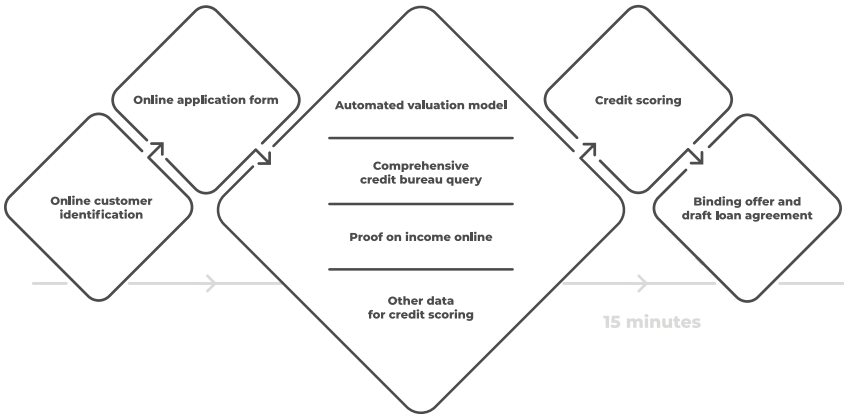


Source: authors' elaboration

'Same regulation for the same activity' is a basic tenet also in this case, as it provides a sound basis for the successive levels of digitalisation. The regulatory and supervisory environment is decisive for successful digitalisation in banking. If regulators are softer on FinTech/BigTech entities than on traditional financial institutions, the process can only be implemented at the cost of unfair conditions of competition and disproportionately high risks to consumers (World Bank, 2021).

Below is a compilation of international good practices and domestic initiatives that could be models for the creation of not simply a regionally competitive but a world-class mortgage process.

Figure 4
Flowchart of an ideal mortgage loan application process



Source: authors' elaboration

- Unsurprisingly, the process starts from the bottom of the pyramid (**Proposal 1**): the client must be identified – of course – online with a quick and presumably mobile banking procedure. The client can realistically choose in 15 minutes which mortgage loan offers the best conditions for them.
- To accelerate selection from the available mortgage loan products, uniform contract terms should be adopted at sector level for standard loans, ensured among others by the common authentic public register mentioned in **Proposal 10**.
- The electronic real property register (**Proposal 8**) would also make it unnecessary for clients to enter information on the property manually, and the scoring system of the bank could easily identify the property by entering a single information, or in the best case retrieve the data directly from the property register.
- **Proposals 5, 6** and **7** are required for swift and automated decision-making. Banks could retrieve the income and other repayment information of an already identified client real-time – the client's consent could be obtained easily through the mobile banking interface – and run an automatic credit scoring.

In this study, instant scoring is reserved for standard loan applications. In practice, there are often more complicated cases where speed is not the most important factor.

- Wider application of statistical property valuation methods and access to energy efficiency data (**Proposals 9** and **11**) would speed up loan security valuation and would promote green lending.
- Concluding contracts electronically **(Proposal 3)** is a possibility that is more likely to become widespread first in the case of contracts for other bank products. However, after the new procedure of real property registration becomes applicable in 2024, the electronic signing of declarations required for mortgage loan applications will become more prevalent.
- During the term of the loan, client experience can be improved by **Proposals 2** and **4**: clients would have it easier if they no longer had to notify changes in their data (Proposal 2), and paper-based correspondence could also be replaced by electronic messages, which are not only greener but also easier to store and retrieve.

Devoting increased attention to fraud prevention, data protection and information security aspects is a general principle and requirement for the process steps outlined above. This is already ensured in the banking sector by advanced fraud-detection systems, internal lines of defence and solutions for Strong Customer Authentication.

In preparation for this study, we have researched country-specific lending practices and innovative solutions already in use in other credit markets that could contribute to the implementation of an optimum mortgage loan application process. Among international good practices, we also discuss further examples from the EU. We wish to express our special thanks to McKinsey & Company for their expert assistance in the preparations and major contribution to the collection and analysis of those examples. The results of our research show that Northern European countries and the Baltic States are the frontrunners in digital banking services, while Western and Central Eastern European countries are sluggish followers rather than trendsetters.

To illustrate the gap between countries' processes, in certain countries, clients are required to provide data, approve declarations and perform clicks more than two dozen times for online personal loan application and disbursement, while in other countries, existing-to-bank clients may arrive at loan disbursement by less than half a dozen clicks after singing in to their online banking interface. The basis for the latter, much simpler process are not less prudent lending terms, but mainly the use of integrated national databases allowing for more efficient client

identification and wide access to other databases assisting credit scoring. That difference in process efficiency illustrates well that significant efficiency gains can be achieved by unlocking the full potential of digitalisation and the parallel fine-tuning of the lending process.

4 PROPOSALS

4.1 Level 1 – conditions of access to banking services, the basics

1) An efficient and free client identification and customer due diligence process should be established

There have been positive developments in customer due diligence and client identification in Hungary recently. Act LIII of 2017 on Preventing and Combating Money Laundering and Terrorist Financing (the new 'Money Laundering Act') and the MNB Decree laying down specific anti-money laundering rules for the financial sector[5] have made the application of several innovative solutions possible which can be used for the remote identification of clients, in addition to ones requiring the presence of clients. Direct identification via an audited electronic communications equipment (the so-called 'videobank') has been supplemented by novel solutions for indirect client identification based on international models, including selfie identity verification (Szegfű, 2020). These new solutions may be assisted also by reading the storage unit integrated into new Hungarian identity cards and passports by NFC-enabled mobile devices.

A regulatory measure regarded especially useful by the banking sector was the entry into force of Section 42/B of Act CCXXII of 2015 on the General Rules on Electronic Administration and Trust Services (the 'e-Administration Act') on 1 January 2022. The provision made available government identification services (the Central Identification Agent (KAÜ) service, the Data Link Register, the Central Government Service Bus (KKSZB)) free of charge to financial institutions performing a public duty in combating money-laundering for the purpose of due diligence under the Anti-Money Laundering Act. The scope of application of that provision could be extended further, and thereby the efficiency of the bank pro-

5 MNB Decree No 26/2020 of 25 August 2020 on the detailed rules concerning the implementation of the Act on the Prevention and Combating of Money Laundering and Terrorist Financing, as applicable to service providers supervised by the MNB, and concerning the minimum requirements for the development and operation of the screening system under the Act on the Implementation of Restrictive Measures Imposed by the European Union and the UN Security Council Relating to Liquid Assets and Other Financial Interests

cedure and client experience could be enhanced, if financial institutions could also use strong client authentication under Act LXXXV of 2009 on the Pursuit of the Business of Payment Services (the 'Payment Services Act') in addition to the Central Identification Agent for the identification of clients under the due diligence process. If that solution would be available, client identification could be performed on the bank's interface, embedded in the administrative process.

Banking could be even more competitive and customer-friendly if comprehensive central client identification, already implemented successfully in several countries, could be applied also in Hungary. The Ukrainian and Scandinavian models presented among international good practices below could provide a good basis.

International good practices

Regarding digital progress in the neighbouring countries, we should mention the significant achievements in Ukraine in recent years, partly implemented out of necessity due to COVID-19 and subsequently by the pitiful Russian invasion. The government of Ukraine launched its next-generation e-government portal, the Diia in 2019 (Motkin, 2023). After further developments to the portal, it now enables Ukrainian citizens to run their administrative errands with the authorities fully digitally. Ukrainian citizens no longer have to carry around their official documents in hard copy. Instead, they can present their fully credible identification data and other official documents from the integrated systems – altogether 12 documents – for verification on their smartphones by scanning a unique QR-code generated by the Diia application. In addition to the comprehensive administrative service provided to the population, including fully digital instant access for parents to the official documents of their newborn child, the portal also offers a fully digital process for setting up businesses.

Of EU Member State's in Hungary's vicinity, the e-government solution implemented by Bulgaria should be highlighted. Although Bulgaria was at the rear end of the Digital Economy and Society Index monitored by the European Commission among Member States of the European Union in 2022 (based on 2021 data), the country has recently reached important digitalisation milestones by the implementation of the Registry Information Exchange System (or RegiX)[6]. The system integrates the database of sixty-two different administrative bodies in Bulgaria, which enables au-

6 https://info-regix.egov.bg/public

tomatic transmission of client data between these bodies, and 'single data entry' has become a reality for clients.

Both Ukraine's Diia and Bulgaria's RegiX facilitate the creation of digital client pathways to financial services considerably, since local financial institutions can access the digitally available – and reasonably required – personal data of clients, subject to their prior consent. After successful identification, clients' data such as biographical information, address, marital status, shareholdings, and in Ukraine also their digital ID, can be retrieved by financial institutions easily and free of charge by automatic data transfer from the above-mentioned authentic public registers.

In Norway, Sweden and Finland, a common solution called 'BankID'[7] supports citizens in their administrative affairs. This solution is QR-based just like the Ukranian system and was designed to comply with the requirements laid down in the eIDAS Regulation. It can be used for client identification as well as for qualified electronic signatures. The solution was established in all three countries as a result of interbank-cooperation and has become by now the most widespread identification and e-signature solution for accessing electronic public services. BankID is very popular with the public – virtually every natural person with a link to a bank uses it, and financial institutions also assist prospective users in setting up their BankID.

The most widespread solution in Denmark is MitID[8] which ensures secure identification through a dedicated application.

Estonia is generally viewed as a pioneer in digital citizenship. The first steps in the so called e-Stonia[9] programme date back to the last decade of the 20th century, when the first digital banking services were introduced in 1996. This gave further impetus to the establishment of e-administration and built up trust for the introduction of digital citizenship. The compulsory eID and electronic signature service rolled out in 2002 is used by 98% of the adult population. According to Estonian estimates, savings on the electronic signature solution alone amount to 2% of the GDP. Lithuania has established a system similar to the Estonian one, allowing for the signature of contracts with the eID issued by the government.

7 https://www.bankid.no/en/privte/; https://www.bankid.com/en

8 https://www.mitid.dk/en-gb/

9 https://e-estonia.com/story/

The two other Baltic states, Latvia and Lithuania are in the frontline of digital citizenship. The regional market of identification services was entered not only by governments but also by private sector providers. The solutions Mobile-ID[10] and Smart-ID[11] are also used by a large share of the population.

In Belgium, citizens can use the solution 'It's Me'[12] for secure identification and electronic signatures.

A common feature of all the solutions described above is that they were designed not only with technological considerations but also with user experience and ease of use in mind.

2) Tracking changes in clients' data should be simplified

Keeping contact with clients is usually impeded by a failure of a significant share of clients to notify changes in their data provided earlier. The introduction of the Data Change Management Service (AVSZ)[13] already in use at telecommunications companies and providers of public utilities – or an equivalent opt-out government service – into the financial sector would help keeping track of changes in clients' data.

International good practices

Banks operating in Finland can update their clients' data by mass data transmissions from the Digital and Population Data Services Agency (DDV)[14]. Client consent is not required for the service, but clients may opt-out any time if they do not wish banks they are in a contractual relationship with to be notified automatically of their current data by making a declaration to that effect.

10 https://www.mobile-id.lt/en/for-businesses/

11 https://www.skidsolutions.eu/services/smart-id/

12 https://www.itsme-id.com/en-BE

13 Chapter 6 of Act XXII of 2022 on Certain Issues Relating to the Operation of Territorial Public Administration and Amending Certain Ain the Context of the 11th Amendment to the Fundamental Law of Hungary

14 https://dvv.fi/en

3) Electronic contracts and electronic signatures are the cornerstones of digital citizenship

Analysing DESI results, it can be established that using the achievements of digital citizenship for managing private and public administrative matters and being a trendsetter are the success factors for countries who want to stay competitive in a changing global economic setting. Hungary has made significant steps forward with its digital public services available through the Client Gate portal. The objectives laid down in the National Digital Citizenship Programme, approved by the Government and coordinated by the Digital Hungary Agency, and the National Strategy for Electronic Public Administration[15] converge with the digital ambitions of the banking sector. One of the aims of the Programme is to implement a digital wallet which can be used for digital identity verification and for signing declarations of will electronically through a mobile application. The objective can be further supported by making digital identity verification and electronic signatures automatically available to all Hungarian citizens as a free public service. In this respect, the Association proposed – in line with domestic and international good practices – that the electronic wallet to be implemented under the digital citizenship agenda should be accessible to all Hungarian citizens automatically, without the need for any administrative steps on their part. It is also proposed that the prospective electronic signature solution should preferably be mobile and cloud-based, and no separate device (e.g. a card reader) should be needed for using it.

In addition to the alternatives provided to clients for electronic signature, the electronic signature solutions of financial institutions should also be reviewed as prerequisites for customisable and non-stop lending. For simple off-the-shelf online loan products available on a 24/7 basis, signing in person by company representatives is not a viable option, but the banking sector considers the electronic seal under the eIDAS Regulation suitable for that purpose.

Furthermore, while the proposed measures are approached primarily from the perspective of retail lending, improving the digital competences of small and medium-sized enterprises (or SMEs) would also deserve special attention as a key to making Hungary's economy more competitive. The fact that Hungarian SMEs are at the bottom range of the Digital Intensity Index (2022), a component indicator in the 2023 DESI, makes that need all the more evident.

15 https://www.dmu.gov.hu/documents/prod/Nemzeti-Elektronikus-Ko--zigazgata--si-Strate--gia-2022-2030.pdf

International good practices

Estonia, Latvia and the Scandinavian countries using BankID that were highlighted in relation to digital identification also implemented forward-looking mobile solution for electronic signatures.

Belgium's above-mentioned 'It's Me' mobile application – the brainchild of banks and telecommunications companies – is suitable for electronic signatures in addition to digital identity verification. Contracts for the use of banking services may be concluded via the internet banking/mobile banking interface up to a certain contract amount, while contracts of a higher amount are signed through 'It's Me'.

4) Paper-based communication should be gradually replaced by digital channels

Current communications between financial institutions and clients in postal letters with advice of delivery should go digital and continue on the authenticated electronic channels of financial institutions. When necessary, this could be supplemented by additional means of communication, such as interactions between Company Gate–Client Gate or Client Gate–Client Gate electronic mailboxes. In principle, that option is already available if the financial institution sets up its own Official Gate, however, it would be important to first lay down rules of delivery (delivery presumptions) for these kinds of communications as well, similar to government–citizen interactions which the law already provides for.

International good practices

A good model for digital client information is provided by Slovenia, where financial institutions can send contracts, regular and *ad hoc* information letters (e.g. amendments to conditions) to clients to the file storage of the client's internet or mobile banking account in the case of most bank products and services. In this solution, automatic system notifications are sent about the delivery and reading of documents. Moreover, a simplified version of the solution is available also to clients who do not have a digital banking contract, making paper-based communication obsolete.

In Scandinavia, most communications are delivered to citizens' digital mailboxes provided by Digipost[16] (Norway), e-Boks (Sweden and Denmark), Kivra[17] (Sweden) or OmaPosti[18] (Finland). To promote digitalization, paper-based correspondence is still available, but priced higher.

4.2 Level 2 – the prerequisites for digital consumer lending

5) Access to real-time income databases should be ensured

In order for banks to provide a loan offer that is best suited to the risk profiles of clients, precise knowledge of the borrower's real income data is indispensable. Obtaining and verifying the employer's salary certificate means a lengthy multi-stage paper-based administrative process for both clients and banks. Therefore, the Income Information System (JIR) established by MNB, the National Tax and Customs Administration (NTCA) and BISZ Zrt. was acclaimed by the banking sector as a significant innovation. The service, which is available since February 2022, allows clients with a Client Gate account to request the compilation and transmission of their income data to the designated financial institutions in a paperless process on the NTCA's website.

Application of the JIR may be further improved by the following proposals:

a) Clients have to use their Client Gate account to submit the income certification request to the NTCA, and it is also here that they receive the data for verification and specify the recipient credit institutions. This multi-stage process may not be competitive in terms of speed with other currently used solutions (e.g. in personal loan, credit card and household loan applications) where clients can print their bank statement at home and attach it to the loan application (also electronically, using an online channel or Open API for retrieval).

   Therefore, a more streamlined process similar to Central Credit Information System (KHR) retrievals should be established also for income data queries, so that credit institutions can obtain income data based on prior consent from, but no further interaction with, the client.

16 www.digipost.no/en

17 https://kivra.se/en/private

18 www.posti.fi/en

b) The launching of the statement of earnings request service was indisputably a significant step towards digitalisation, but currently, credit institutions can request data from the earnings database of the NTCA only for the 12-month period ending 2 months before the date of the request. Because of the 2 months' gap, credit institutions have no information on the income situation of the client at the time of application, which makes scoring problematic. Moreover, the statement does not reveal if the client's employment has been terminated in the meantime. The missing data are collected and verified by banks by direct request to the employers. To the extent possible, the database should contain the most up-to-date data informing of the current situation.

c) Data on the income of entrepreneurs cannot be requested from the system. We recommend including these in the scope of accessible information so that data on the net income of entrepreneurs can be shared with banks.

d) Another highly relevant information for scoring is whether the employment relationship is for a definite or an indefinite term. The request form should be revised to include these data in the statement of earnings.

The Verify[19] application, created by Hungarian developers, could be a solution for the deficiencies highlighted above. Using the application, workers whose employer has registered in the system can share their employer's salary certificate with just a few clicks. Use of the service is currently limited by the requirement of employer registration. Banks would actually benefit from a solution combining the features of the JIR and Verify.

International good practices

In Romania, retail clients need only their IDs to apply for a loan since 2015. They do not even have to present a salary certificate from their employer. This is possible because financial institutions can access – subject to clients' prior consent – the real-time income database of the tax authority (ANAF) and consult data two years back. The database also includes information on the clients' employers for the two year period preceding the query. A similar service is provided to financial institutions in Bulgaria by the National Social Security Institute (NSSI). As a difference, requesting banks can obtain the full employment history of clients, which can facilitate well-founded creditworthiness decisions.

19 https://www.salarify.hu/verify

Open banking is of course another possible means available to banks for establishing the income and creditworthiness of new-to-bank clients by accessing their transaction history. As an example, in 2022, the European open banking platform Tink launched a fee-based service for banks operating, among others, in the United Kingdom for the instant verification of their clients' income, if the client consents.

In Norway, Sweden and Finland, income after taxes data for the previous year are publicly available. However, real-time income data requests are not permitted. Banks in Sweden often obtain client income data from the credit informations company Upplysningscentralen[20]. Clients are not necessarily asked to submit a salary certificate for the assessment of their credit application.

6) Scoring should be supported by more extensive data

As a result of the changing preference for online shopping and stricter regulations for banks, today, FinTech and BigTech companies have more extensive and more detailed data on their customer's payment behaviour than banks have access to, and may therefore set up scoring processes of superior accuracy (Buchak et al., 2018). Access to a wider range of data would not only be beneficial for competition with cross-border service providers, but would also provide banks a more accurate picture of the client's risk profile, based on which they could offer more personalised and generally cheaper loans. Already in earlier studies, the Association called for the extension of the scope of accessible data sources required for the assessment of client's payment discipline, e.g. arrears on utility bills. We continue to consider such an extension expedient. However, the necessary regulatory steps should go hand in hand with a data protection framework ensuring the prudent use of new data sources.

International good practices

We can identify good examples in several neighbouring countries for additional data sources going beyond borrowing from financial institutions, which may contribute to more efficient credit decisions.

20 https://www.uc.se/; https://www.uc.se/om-uc/vara-kallor/

In addition to Czechia where such databases have been used for a long while, Bulgaria's already discussed e-government solution RegiX provides access also to information on debts to public bodies (e.g. unpaid taxes) or legal proceedings against clients. The SISBON system[21] in Slovenia also contains data on legal actions and bankruptcy proceedings, as well as on short term loans provided by telecommunications companies – typically for mobile phone purchases – in addition to data on borrowings from financial institutions. The latter kind of information is available in the credit information system of Serbia, too.

Of the excellent solutions found in Western Europe, special mention should be made of Germany's credit information system SCHUFA[22]. It comprises data not only from financial institutions but also from insurance, energy and telecommunications companies in addition to repayment histories from the e-commerce sector for about 68 million retail and 6 million commercial clients, so that banks and non-bank creditors can rely on a comprehensive view of the applicant for their credit decisions.

7) A mandatory positive central credit information system should be introduced and the scope of accessible data fine-tuned

As currently clients can provide access to their positive data in the KHR on a voluntary basis, creditors may lack transparency about the monthly debt service of their clients. By allowing applicants to choose freely whether financial institutions can have access to data on their debt obligations, the prudent application of debt service-to-income ratio regulations is put to jeopardy. Introducing compulsory and public access to positive credit information would support economic growth and would make Hungary more competitive on the international stage by expediting the administration of loans and through the benefits offered by more precise risk assessment (Béres–Grosz, 2016).

In addition to mandatory positive credit information, a further means by which banks' risks could be mitigated is by granting them continuous access to all the data needed for contacting clients (not only their address, but also their phone number and e-mail address), even in the event of default. Consequently, credit institutions should be allowed to process contact data on a compulsory basis even after the termination of the loan agreement.

21 https://sisbon.si/o-sistemu-sisbon/

22 https://www.schufa.de/schufa-en/about-us/company/how-schufa-works/

International good practices

Slovenia's central credit information system SISBON provides a positive list of retail debtors to financial service providers for the purpose of credit scoring. SISBIZ offers the same functionality for commercial clients. Therefore, it is not possible that interested financial institutions only see negative data in respect of a client if consent to the transmission of their data to other financial institutions has been refused. A mandatory positive debtor list would not only reduce the number of declarations requested by the client during the loan approval process – improving the quality of clients' pathway to the loan – but would also aid financial institutions in assessing the creditworthiness of applicants more efficiently by having full access to their positive credit data.

In Germany, access to positive data is already ensured by the SCHUFA system, in Finland the positive credit data register has been implemented recently, while Estonia plans to launch its own positive credit data service in 2024/25.

Based on the example of Norway, Sweden, Germany and other neighbouring countries, it should also be considered to provide financial institutions broader access to negative data, which is now limited to more than 90 days continuous default on debt exceeding the minimum wage. In this respect, we should mention Serbia as an example, where transactions overdue for 60 days can be accessed irrespective of the outstanding amount, and Romania, where two credit information systems are available – a mandatory public system and a private one set up by the country's financial institutions – from which practically all late payments of any amount can be retrieved by the stakeholders.

The credit information system in place in Slovakia comprises data not only on disbursed loans but also on loan applications. A similar extension to the scope of available data would potentially improve the accuracy of credit scoring systems in Hungary, too.

4.3 Level 3 – the prerequisites for sustainable digital mortgages

8) Optimum use of the new electronic real property registration process, as proposed by the Association

The new Act C of 2021 on the Land Registry is planned to enter into force in 2024. Automated decision-making as part of the new electronic process which is to replace current paper-based administration may achieve a breakthrough in property registration if it actually reduces the time required for mortgage registration – which is now a lengthier process – to only a few seconds. Nevertheless, the regulation in its current form would require additional resources from banks as it provides for the mandatory inclusion of a legal representative in the mortgage registration procedure, while currently signature by a bank employee suffices for the submission of the registration request. That implies new administrative steps and greater costs in the internal processes of banks. Therefore, the procedure should not only be faster but also cheaper to compensate for the extra work it imposes on bank employees, who will practically take over the tasks formerly performed by the staff of land registry offices. It should therefore be considered to keep the arrangements specified in the current Act on the Land Registry in respect of requests for mortgage registration and cancellation, so that the designated employees of credit institutions could continue to submit them in the electronic system, without the inclusion of a legal representative.

If the inclusion of a legal representative, i.e. an in-house counsel registered with the Hungarian Bar Association is required, we propose that public notaries should be allowed to act alternatively as legal representatives in registering a mortgage or a prohibition of alienation and encumbrance on the property.

Granting that option to credit institutions would allow them to decide according to their operating models whether they use a legal counsel from their own resources or involve a public notary for mortgage registration procedures.

International good practices

Electronic land registration is already adopted in Norway, Denmark and Sweden, while Finland is going to launch it in parallel with Hungary.

In Denmark, rights and facts relating to real property are registered, updated and deleted in the digital property registration system Tinglysning[23].

23 https://www.tinglysning.dk/tinglysning/landingpage/landingpage.xhtml

In England, administrative matters related to real property can be handled digitally from 2022 on the Digital Registration Service (DRS) platform[24]. Leases and encumbrances on the property and the data of the owners can be reported and updated through the DRS.

9) Statistical models of property valuation should be applied more widely

One of the most successful legislative steps made recently towards digitalisation was the extension of the scope of application of statistical valuation methods to new loans. The regulation adopted this way in Hungary is one of the most progressive in the European Union. It did not take long for clients to endorse statistical valuation methods which offer greater speed and flexibility over the more time-consuming on-site valuation procedure. It also ensures that applicants obtain precise information about the value of their property and the loan amount they can apply for right at the beginning of the process. Despite these obvious benefits, due to its relatively strict rules of application compared to the risks involved, the solution can be applied only in a small fraction of credit transactions for now.

To extend the scope of application of the method, it is proposed to limit the exposure amount to 60% of the market value of the property at the date of application, instead of the current 60% of mortgage lending value. If the proposal would be adopted, the statutory maximum loan-to-value (LTV) ratio would still remain much higher than in the case of on-site property valuation, where the current limit – in the case of HUF-denominated loans – is set at 80% of the market value, while the scope of real property valuation with statistical methods could still be expected to grow.

In addition to the proposals above, it would be worthwhile to consider the application of statistical methods not only for apartments but also for single-family houses of equivalent properties. Furthermore, we propose to compile the list of settlements eligible for statistical valuation based on a required number of transactions.

24 https://www.gov.uk/guidance/digital-registration-service

International good practices

Statistical valuation methods have a longer history of application in several countries, and proved to be reliable.

In most cases, the scope of application of the method is restricted (e.g. for revaluation), but in Germany, the Netherlands and Denmark the regulatory conditions are similarly progressive as in Hungary and allow for the use of statistical valuation techniques – subject to appropriate safeguards – also for valuation preceding the credit decision (EMF, 2006).

10) Immediate enforceability should be ensured relying on common authentic electronic public registers

In line with the digitalisation efforts of the Government, the possibility of establishing a digital registration system which would ensure a more time- and cost-efficient tracking of liabilities and enforcement should be reviewed. A system similar to the credit collateral register (HBNY) would be the most suitable for that purpose, and could also function as a register for loan and security agreements and letters of commitment. That would represent a completely new system compared to current, predominantly paper-based administration.

11) Free access to the energy efficiency data of real property should be ensured

Based on the DESI, Hungary ranks 24th among the 27 Member States of the EU in respect of open data access. Tapping the full potential in Hungary's abundant data assets would facilitate access to bank loans and would at the same time contribute to the economic competitiveness of Hungary.

Experience from the development of new green mortgage products and the first issue of green mortgage bonds in Hungary also underscored the importance of more efficient data management. The data available on the energy characteristics of the Hungarian stock of residential property are generally linked to individual research projects and may show significant differences according to the methodology used (*Bene* et al., 2023). Providing broader access to energy performance data than the regulations currently allow would be crucial for increasing the volume of ESG bond issuance and for encouraging green lending (*Ritter*, 2021).

To that end

- the most energy efficient 15% of the residential building stock should be determined yearly for compliance with the criteria of the EU taxonomy,

- primary energy consumption data in kWh/m²/year should be made accessible free of charge and mass data retrieval should be enabled (currently only letter grades are published on the webpage of the Lechner Knowledge Center).

Market participants' access to energy performance data is a focal point also in consultations on the ongoing revision of the energy performance of buildings directive (EPBD).

International good practices

In Sweden and Denmark, banks can access the energy performance data of real property free of charge in the state-operated databases Boverket[25] and Boligejer, respectively. The Spanish database went live in 2023 and at the moment contains the energy efficiency data of real property in 11 regions Energy Efficiency Database (2023).

Italy's Sistema Informativo sugli Attestati di Prestazione Energeti[26] provides free access to aggregated national and detailed region-level data on the energy efficiency of residential property. The database now comprises the data of more than 5 million energy performance certificates.

5 WHAT THE FUTURE MAY HOLD? A SUMMARY

As outlined above, the implementation of the digitalisation proposals presented in our study could further improve customer service at banks and make Hungary more competitive internationally. Nevertheless, technological progress and the consequent changes in consumer habits compel continuous adaptation and innovation in banking. Therefore, to conclude our study, we provide a summary below of possible future developments in lending processes.

Growing importance of personalisation and artificial intelligence. As machine learning and AI-based solutions gain ground, loan offers can become even quicker and more personalised, responding to the individual needs and risk profiles of applicants. Based on the data that can be extracted from clients' growing 'digital

25 www.boligejer.dk

26 https://siape.enea.it/

footprint' – mainly linked to online purchases – more accurate and personalised credit scoring methods can be developed (*Agarwal* et al., 2020) that may boost financial inclusion for classes of society whose access to credit is now limited (*Berg* et al., 2019). Artificial intelligence may assume a key role also in cybersecurity. AI-based cybersecurity systems can adapt to and learn from patterns of criminal behaviour, which makes the detection and mitigation of cyberthreats more effective (*Bagó*, 2023).

The rise of innovative solutions for contract conclusion. Although the regulation currently in force permits the conclusion of mortgage loan contracts electronically – primarily for the protection of consumers – it is possible only in the presence of all involved parties at the same time and place, which means that clients must report at the bank branch at least once, as a sign of their serious intentions. If financial literacy grows in the Hungarian population, the option of concluding contracts in the online space using the channels provided by banks (e.g. videobank or internet banking interfaces) should be revisited.

Smart contracts may revolutionise lending. Integrating solutions using the blockchain technology into bank processes may reinforce the security, transparency and efficiency of mortgage loan application and disbursement. Many expect that revolutionary smart contracts will fundamentally change the way in which contracts are prepared, concluded and stored.

Smart glasses and virtual bank branches may end the hegemony of mobile devices. Artificial intelligence will inevitably penetrate financial services, too. Developments in this area are going in the direction of speech- and gesture-based communication, which may bring about a shift away from the now generally used touchscreen devices (such as smartphones, tablets and smartwatches). Many envision the proliferation AR (augmented reality)[27] smart glasses and VR (virtual reality)[28] devices in the next decade, which would fundamentally change the mode of access to banking services. Moreover, with the advent of virtual banking the role of bank branches will also have to be redefined (*The Economist*, 2023).

27 Augmented reality is the virtual (apparent) enhancement of reality which works by mapping virtual objects onto a real environment using e.g. dedicated glasses.

28 The computer-generated image or simulation of a three-dimensional space or an artificial environment that seems to react naturally to the individual actions of users using special electronic devices. Frequently employed interactive devices are helmets equipped with an inner screen and gloves with sensors.

REFERENCES

Agarwal, S. – Alok, S – Ghosh, P. – Gupta, S. (2020): Financial Inclusion and Alternate Credit Scoring: Role of Big Data and Machine Learning in Fintech. Indian School of Business, New York University, https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3507827.

Bagó, P. (2023): Cyber Security and Artificial Intelligence. *Economy and Finance*, 10(2), 182–212, https://bankszovetseg.hu/Public/gep/2023/189-212%20Bago%20E.pdf.

Becsei, A. – Bógyi, A. – Csányi, P. – Kajtor-Wieland, I. – Kovács, L. (2021): Ten points of sustainable banking. *Economy and Finance*, 8(3), 236–263, https://bankszovetseg.hu/Public/gep/2021/236-263%20E%20Becsei_P.pdf.

Becsei, A. – Bógyi, A. – Csányi, P. – Kovács, L. (2019): The bank of the future, the future of banks – Digitalization proposals by the Hungarian Banking Association. *Economy and Finance*, 6(3), 311–322, https://www.bankszovetseg.hu/Public/gep/2019/ENG/311-322%20E%20BecsBodCsaKo.pdf.

Bene, M. – Ertl, A. – Horváth, Á. – Mónus, G. – Székely, J. (2023): Estimating the Energy Demand of the Residential Real Estate Stock in Hungary Based on Energy Performance Certificate Data. *Financial and Economic Review,* 22(3), 123–15, https://hitelintezetiszemle.mnb.hu/letoltes/hsz-22-3.pdf.

Béres, A. – Grosz, G. (2016): Kötelező pozitív adóslista: ettől lehetnek olcsóbbak a hitelek [Mandatory Positive Debtor List: This Can Make Loans Cheaper]. https://www.mnb.hu/letoltes/joberes-grosz-kotelezo-pozitiv-adoslista-ettol-lehetnek-olcsobbak-a-hitelek.pdf.

Berg, T. – Burg, V. – Gombovic, A. – Puri, M. (2019): On the Rise of FinTechs: Credit Scoring Using Digital Footprints. FDIC–CFR, Working Paper Series, https://www.fdic.gov/analysis/cfr/2018/wp2018/cfr-wp2018-04.pdf.

Bógyi, A. – Gacsal, M. – Grenczer, B. – Kovács, L. – Martonovics, B. (2023): A veszélyhelyzeti jogalkotás, a hiteltörlesztési moratórium és a kamatplafon hatása a banki szerződésekre [The Effects of Emergency Legislation, the Loan Repayment Moratorium and the Interest Rate Cap on Bank Contracts]. In: Bodzási, B. – Csehi, Z. (eds.) (2023): *A COVID–19 és a gazdasági jog: A koronavírus-járvány és a rendkívüli jogrend hatása a magyar gazdasági jogi szabályozásra* [COVID-19 and Economic Law – The Effect of the Pandemic and the Special Legal Order on Economic Legislation in Hungary], Magyar Jogász Egylet, 55–95, https://cdn-60b7abf2c1ac185aa47cf636.closte.com/wp-content/uploads/sites/50/2023/05/covid-19-gazdasagi-jog.pdf.

Buchak, G. – Matvos, G. –Piskorski, T. – Seru, A. (2018): Fintech, Regulatory Arbitrage, and the Rise of Shadow Banks. *Journal of Financial Economics*, 130(3), 453–483, https://doi.org/10.1016/j.jfineco.2018.03.011.

Demirgüç-Kunt, A. – Klapper, L. – Singer, D. – Ansar, S. (2022): The Global Findex Database 2021: Financial Inclusion, digital payments, and resilience in the age of COVID-19, World Bank, http://hdl.handle.net/10986/37578.

Digital Intensity Index (2022): https://ec.europa.eu/eurostat/cache/metadata/Annexes/isoc_e_dii_esmsip2_an1.pdf.

Economist, The (2023): Twilight of the screen age – So long iPhone. Generative AI needs a new device. Is this the twilight of the screen age? Oct. 5, https://www.economist.com/business/2023/10/05/so-long-iphone-generative-ai-needs-a-new-device.

EMF (2006): Joint paper on the use of automated valuation models in Europe. https://www.europeanavmalliance.org/files/eaa/Downloads/EMF%20EAA%20Paper%200n%20AVMs.pdf.

Energy Efficiency Database (2023): https://edificioseficientes.gob.es/es.

Ethics Guidelines (2019): Ethics Guidelines for Thrustworthy AI https://www.europarl.europa.eu/meetdocs/2014_2019/plmrep/COMMITTEES/JURI/DV/2019/11-06/Ethics-guidelines-AI_EN.pdf.

European Commission (2020): White Paper on Artificial Intelligence – A European approach to excellence and trust, https://commission.europa.eu/system/files/2020-02/commission-white-paper-artificial-intelligence-feb2020_en.pdf.

European Commission (2023a): eGovernment Benchmark 2023 – Insight Report. https://sitic.org/egovernment-benchmark-2023/.

European Commision (2023b): Europe's Digital Decade: digital targets for 2030. https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/europe-fit-digital-age/europes-digital-decade-digital-targets-2030_en.

European Commission Proposal (2023/0205/COD): Regulation of the European Parliament and of the Council on a framework for Financial Data Access and amending Regulations (EU) No 1093/2010, (EU) No 1094/2010, (EU) No 1095/2010 and (EU) 2022/2554, https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2023/0360/COM_COM(2023)0360_EN.pdf

European Commission Proposal (2023/0209/COD): Directive of the European Parliament and of the Council on payment services and electronic money services in the Internal Market amending Directive 98/26/EC and repealing Directives 2015/2366/EU and 2009/110/EC, https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2023/0366/COM_COM(2023)0366_EN.pdf.

European Commission Proposal (2023/0210/COD): Regulation of the European Parliament and of the Council on payment services in the internal market and amending Regulation (EU) No 1093/2010, https://www.europarl.europa.eu/RegData/docs_autres_institutions/commission_europeenne/com/2023/0367/COM_COM(2023)0367_EN.pdf.

Magyar Nemzeti Bank (2021): 15/2021. (X.29.) számú ajánlása a pénzügyi szervezetek ingatlanokkal összefüggő kockázatainak kezeléséről [Recommendation No 15/2021 of 29 October 2021 of the Hungarian National Bank on the management of risks of financial organisations related to real property]. https://www.mnb.hu/letoltes/15-2021-ingatlan-ajanlas.pdf.

McKinsey (2022): Digital challengers on the next frontier in Central and Eastern Europe. https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/digital-challengers-on-the-next-frontier-in-central-and-eastern-europe.

Motkin, A. (2023): Ukraine's Diia platform sets the global gold standard for e-government. *Atlantic Council*, https://www.atlanticcouncil.org/blogs/ukrainealert/ukraines-diia-platform-sets-the-global-gold-standard-for-e-government/.

National Digitalisation Strategy 2022–2030 (2022): https://kormany.hu/dokumentumtar/nemzeti-digitalizacios-strategia-2022-2030

Novak, J. – Jánoskuti, L. – Havas, A. – Purta, M. – Marciniak, T. – Ignatowicz, K. –Rozenbaum, K. – Yearwood, K. (2018): The Rise of Digital Challengers. How digitization can become the next growth engine for Central and Eastern Europe. Perspective on Hungary. McKinsey, https://www.mckinsey.com/~/media/mckinsey/featured%20insights/europe/the%20rise%20of%20digital%20challengers%20perspective%20on%20hungary/rise-of-digital-challengers-perspective-on-hungary.pdf

Ritter, R. (2021): Van eszköz a magyarországi ingatlanok energetikai állapotának javítására, Úton a minősített zöld jelzáloglevél felé [The Means to Improve the Energy Efficiency of Real Property in Hungary – Towards Certified Green Mortgage Bonds]. https://www.mnb.hu/letoltes/21-03-02-ritter-renato-a-magyarorszagi-ingatlanallomany-energetikai-allapota.pdf.

Szegfű, L. (2020): Otthonról is azonosíthatjuk magunkat és szerződhetünk a bankkal [How to verify our identity and conclude contracts with banks remotely?]. https://www.mnb.hu/letoltes/szegfu-laszlo-elektronikus-ugyfel-azonositas.pdf.

World Bank (2021): Consumer Risks in Fintech: New Manifestations of Consumer Risks and Emerging Regulatory Approaches. Policy Research Paper, https://documents1.worldbank.org/curated/en/515771621921739154/pdf/Consumer-Risks-in-Fintech-New-Manifestations-of-Consumer-Risks-and-Emerging-Regulatory-Approaches-Policy-Research-Paper.pdf.

Acts:

Act CXII of 2013 on Credit Institutions and Financial Enterprises

Act CCXXII of 2015 on the General Rules on Electronic Administration and Trust Services

Act LXXXV of 2009 on the Pursuit of the Business of Payment Services

Act LIII of 2017 on Preventing and Combating Money Laundering and Terrorist Financing

Act XXII of 2022 on certain issues relating to the operation of territorial public administration and amending certain acts in the context of the 11th amendment to the Fundamental Law of Hungary, Chapter 6

Decree:

Decree No 22/2018 of 23 August 2018 of the Minister of Justice on notarial fees

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THE ROLE OF THE CEE REGION'S BANKING SECTOR IN THE TIME OF THE RUSSO–UKRAINIAN WAR: MEASURING VOLATILITY SPILLOVERS

Milán Csaba Badics[1]

ABSTRACT

In this paper, I investigate the volatility spillovers of the European banking network in 21-22. Applying the *Diebold-Yilmaz* framework to the daily stock return, which identified volatilities for 14 European banks, I analyse the impact of the first 100 days of the Russo-Ukrainian War on the banking sector. The empirical results suggest that the volatility-connectedness of the system reaches its maximum at a time of war. Similar to the earlier empirical literature, I find that, in calm periods, large banks play a critical role in volatility risk transmission. However, I conclude that, during the first 100 days of the Russo-Ukrainian War, the key participants in the financial network were institutions from the CEE region. My results suggest that, considering the banking network's macro and group-aggregated level volatility connectedness, an early-warning system to detect troubled financial institutions should be built.

JEL codes: C32, G01, G12, G15, G21

Keywords: volatility spillover, banking sector, Russo-Ukrainian war, CEE region

1 INTRODUCTION

Network analysis of the financial institution (FI) system has become widely recognised as a critical regulatory issue over the past decade. Connections and spillovers between FIs play a crucial role in systemic risk assessment. Furthermore, during crises, the strength of the connections sharply increases. Risk spills over across institutes, as happened during the Global Financial Crisis (GFC) of 2007-2009, the European Sovereign Debt Crisis (ESDC), and more recently during the Covid-19 (C19) turmoil and the Russo-Ukrainian War (RUW) (Diebold and Yilmaz, 2014). These events highlighted the importance of analysing the connections and spillover channels between financial institutions. For this reason, regu-

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lators need to monitor the structural changes in financial networks and identify the systemically important financial institutions (SIFIs), as the key participants in the financial institutions' network.

Recently, several empirical frameworks (quantitative methods) have appeared, aiming to calibrate the linkages among FIs and observe systemic risk. *Bisias* et al. (2012) identified more than 30 quantitative systemic risk measures in economics and finance literature. Their survey classifies them into six groups, one of which is a network-based approach.

On the empirical side of the systemic risk modelling from the network perspective, several measurements have recently been developed to quantify the connections between FIs. The most widespread methods are the Granger causality network (*Billio* et al., 2012), the delta conditional value-at-risk (ΔCoVaR) proposed by *Tobias* and *Brunnermeier* (2016), and the marginal expected shortfall (MES) (*Acharya* et al., 2012). Besides them, *Brownlees* and *Engle* (2017) designed the conditional capital shortfall index (SRISK), and numerous studies appeared based on the Vector autoregressive model-based Diebold-Yilmaz (DY) framework (DY, Diebold–Yilmaz, 2009; 2012; 2014).

We can group these measures in several ways. One differentiates the price-based systemic risk methods from those that incorporate book values. The first includes the ΔCoVaR and the MES, while the second includes SRISK, the leverage ratio, and the CAPM beta times market capitalization (*Benoit* et al., 2017).

Besides that, the existing empirical literature on systemic risk can be divided into two broad approaches. The first measures the financial institutions' overall systemic risk in a univariate framework. These models (ΔCoVaR, MES, and SRISK) cannot consider all connections between the FIs in the network. The second group of studies focused on connections and spillovers between the FIs as a potential source of systemic risk using network-related methods (Granger-causality and DY framework). These methods make it possible to capture the linkages on different levels of the network and consider the global connectivity of all system participants.

Of the relevant systemic risk methods, the Diebold-Yilmaz framework has several favourable properties. First, unlike Granger causality network analysis (Billio et al., 2012), the DY framework estimates weighted connections (Diebold and Yilmaz, 2012). Second, ΔCoVaR (Tobias and Brunnermeier, 2016) and MES (Acharya et al., 2012) are related to the directional connectedness indices of Diebold and Yilmaz so, unlike the DY framework, they cannot track any association between individual firms (Diebold and Yilmaz, 2015).

In recent years, the literature has highlighted the positive implications of these network models. Due to its favoured attributes, the DY framework has often been

used to analyse the spillovers of financial institutions through stock price volatilities ((Diebold és Yilmaz, 2014; *Baruník* és *Krehlík*, 2018), or the linkages between FIs and sovereign bonds (*Alter* and *Beyer*, 2014 and *Demirer* et al., 2018) or sovereign credit default swap (CDS) prices ((*Bratis* et al., 2020; *Greenwood-Nimmo* et al., 2019).

In addition, the DY framework has been applied to networks of different asset classes such as equities (Baruník et al., 2016), bonds (*Claeys* and *Vasícek*, 2014), exchange rates (*Bubák* et al., 2011), commodity prices (*Kang* et al., 2017), crypto currencies (*Moratis*, 2021), or across asset classes (*Kurka*, 2019; *Wang* et al., 2016).

Focusing on the FI network, Diebold and Yilmaz (2014) first applied the framework to systemic risk modelling. They used the daily realised volatility time series to examine the sensitivity of the connections across major U.S. FIs. They focused on the four key events of GFC and illustrated the network on specific days with network snapshots. Diebold and Yilmaz (2015) extended this analysis by examining the spillover channels of the volatility network of major American and European financial institutions that emerged during the GFC and the ESDC. They found the following results related to the two continent's bank systems: prior to the Lehman Brothers' collapse, realized volatility spillovers[2] primarily flowed from U.S. financial institutions to their European counterparts. However, after Lehman Brothers' bankruptcy in September 2008, the financial crisis evolved into a worldwide phenomenon, causing volatility spillovers and linkages across the Atlantic to become two-way, with a notable decrease in net spillover from the U.S. to Europe. Demirer et al. (2018) applied a LASSO (least absolute shrinkage and selection operator) estimated VAR model to extend the number of financial institutions investigated and analyse global bank network connectedness. They examined a network comprising the top 150 banks between 2003 and 2014 and concluded that global bank spillovers have a strong geographic component.

The empirical literature on European systemic risk modelling from a network perspective has become increasingly developed in recent years. One of the first studies by *Paltalidis* et al. (2015) found that the European banking sector is highly connected, which causes a risk of financial contagion. A few years later, *Dreassi* et al. (2018) examined the credit risk spillover based on the CDS spreads between the European banks and insurance companies over the GFC and ESDC. They concluded that, for banks, their funding and income diversification and, for insurance companies, their size and leverage play the key role in risk spillover. *Shahzad* et al. (2019) differentiate large and small banks in the network and highlight that

2 volatility spillover: a shock in a financial institution's volatility affects the other institution's volatility

large institutions are the transmitters of the network, and the small ones play the role of receiver. Besides that, the network connections depend on the market's state. Using an advanced network method[3], *Foglia* and *Angelini* (2020) examined the tail risk connections between FIs in the Eurozone. They show that risk spillover is more substantial during crisis periods. Besides that, they show that the banks are the key participants in the system. *Torri* et al. (2021) strengthened the earlier results, highlighting the strong connections between the institutions of the European banking sector. *Borri* and *Di Giorgio* (2021) examined the role of the largest European banks in the FI network, and show that larger banks contribute more to contagion than smaller ones. Of the European bank network studies, only a few had a Central and Eastern Europe (CEE) regional focus, mainly related to the Hungarian market (*Berlinger* et al., 2011; 2016; *Bodnár*, 2021).

Despite the large number of recent network-based systemic risk modelling studies and the diverse methods used, the deeper structure of the FI networks (analysing at both micro and other aggregated levels) during crisis periods has yet to be investigated. Besides that, more studies that aim to identify the key participants of the system and analyse the dynamics of their connections and spillovers during turbulent periods and different crises need to be carried out. It is essential that regulators monitor any abrupt changes in the financial network, understand the dynamics of the network at different levels and identify the role of the key participants in the system.

To address this situation, in this paper I characterise the static and dynamic volatility connectedness[4] of 14 European financial institutions via the DY framework before and during the Russo-Ukrainian War. My analysis differs from previous studies in its selected time period and the FIs investigated. I examine the connections between the most significant and medium western European banks and four financial institutions from the CEE region.

My research makes a twofold contribution to the systemic risk literature. Firstly, I aim to investigate the spillovers between FIs in different regions of Europe. Despite numerous studies analysing the volatility spillover between financial institutions in Europe, to the best of my knowledge, this is the first research focusing on the role of the CEE region's financial institutions in the network. Secondly, I provide fresh evidence of volatility connectedness during the RUW. Although many papers investigated the spillovers of the bank network during different crisis periods (GFC, ESDC, C19), none of them examined the dynamics of the network and the key participants before and during the war.

3 TENET framework

4 volatility connectedness: the strength of the linkages in the volatility network

This paper proceeds as follows. In *Section 2*, I briefly outline the Diebold-Yilmaz framework. I present the dataset in *Section 3*. In *Section 4*, I provide dynamic and static characterisations of the volatility-connectedness of the European financial institutions during the RUW. Finally, I conclude in *Section 5*.

2 DIEBOLD-YILMAZ FRAMEWORK

I use the framework devised by Diebold and Yilmaz (2014) to estimate the network of the selected financial institutions. Following the seminal paper (Diebold and Yilmaz, 2009; 2014), the network and spillover measures are based on VAR(p) model coefficient and covariance matrix estimation (*Sims*, 1980) and its forecast error variance decompositions (FEVD).

The framework is based on the concept that, for every time series of the network, we can calculate the forecast error variance based on the estimated VAR(p) model coefficient and covariance matrix. This variance is related to its own and other time series shocks. Due to the VAR(p) model identification, the shares of own and other time series' shocks can be calculated. In the last step of the process, the forecast error variance decompositions can be summarized in a spillover table, which we refer to hereafter as the DY spillover table.

The first step of the estimation process is to specify a stationary VAR(p) model with J time series using the following equation:

$$\boldsymbol{y}_{\mathrm{t}} = \sum_{i=1}^{p} \boldsymbol{B}_{\mathrm{i}}\, \boldsymbol{y}_{\mathrm{t-i}} + \boldsymbol{u}_{\mathrm{t}} \tag{1}$$

where $\boldsymbol{Y}_t$ is a $J \times 1$ vector of the time series, $\boldsymbol{\beta}_i$ is an $J \times J$ autoregressive coefficient matrix, and lastly $\boldsymbol{\varepsilon}_t$ is an $J \times 1$ vector of error terms. It has a zero mean with a Σ covariance matrix. The VAR(p) process is assumed to be stable and stationary, while the covariance matrix Σ is needed to be positive definite with bounded largest eigenvalue (*Lütkepohl*, 2013).

To estimate the DY framework's most important element, the DY spillover table, we need to estimate the coefficient matrices $\boldsymbol{\beta}_1, \boldsymbol{\beta}_2, \ldots \boldsymbol{\beta}_p$ and the error covariance matrix Σ efficiently. The $\boldsymbol{\beta}_i$ coefficient matrices reveal the temporal dependence between the time series and Σ reveals the contemporaneous linkages among them (Diebold and Yilmaz, 2014).

The starting point for the DY framework to transform the time series in the VAR(p) in Eq. 1 into its vector moving average (VMA) representation using the *Wold* theorem to derive the following equation:

$$\boldsymbol{y}_{\mathrm{t}} = \sum_{i=0}^{\infty} \boldsymbol{A}_i\, \varepsilon_{\mathrm{t-i}} \tag{2}$$

where A_i is an $J \times J$ moving average coefficient matrix (Diebold and Yilmaz, 2012).

As Diebold and Yilmaz (2014) emphasised, the calculated moving average coefficients and the estimated error covariance matrix (or its nonlinear transformations, such as impulse response functions (IRF) or forecast error variance decompositions (FEVD) are the keys to understanding the dynamics of the time series network.

FEVD allow us to calculate the fraction of the H step-ahead error variance in forecasting $\boldsymbol{Y}_i$ (Y_iH) that is due to shocks to other time series such as $\boldsymbol{Y}_j$, to which we will hereafter refer as a spillover between $\boldsymbol{Y}_i$ and $\boldsymbol{Y}_j$. Generally, in the DY framework the measures of spillovers between the time series are given by the FEVD of the VAR(p) model. Unfortunately the calculation of the FEVD requires orthogonal innovations, but the VAR innovations are generally contemporaneously correlated (Diebold and Yilmaz, 2012; 2014).

There are two widely used approaches in the early DY framework-related papers for deriving the variance decomposition. The first method uses the *Cholesky* factor orthogonalisation of the covariance matrix Σ, which generates orthogonalised innovations. The weakness of this decomposition is that its results in an order-dependent FEVD (Diebold and Yilmaz, 2012).

The other approach uses the generalised VAR framework of *Koop* et al. (1996) and *Pesaran* and *Shin* (1998), which allows correlated shocks. As a result, this second method produces an order-independent FEVD. In the empirical DY network studies, applying the second method is more widespread.

The generalised FEVD can be calculated in the following way:

$$\theta_{ij}^{g}(H) = \frac{\sigma_{jj}^{-1} \sum_{h=0}^{H-1} (e_i' \Phi A_h \Sigma e_j)^2}{\sum_{h=0}^{H-1} (e_i' A_h \Sigma A_h' e_j)^2} \tag{3}$$

where σ_{jj} is the j-th diagonal element of the error term's covariance matrix $\boldsymbol{\Sigma}$, A_h is the moving average coefficient matrix multiplying the h-lagged shock vector in the Wold's moving average representation (*Eq. 2*) and e_i is a selection vector. The numerator in *Eq. 3.* represents the contribution of shocks in variable $\boldsymbol{Y}_j$ to the H-step FEVD of time series $\boldsymbol{Y}_i$. The denominator is the forecast error variance of the time series $\boldsymbol{Y}_i$.

Unfortunately, the sum of the contributions to the variance of the forecast error is not necessarily one because, in the general FEVD, the shock terms are not orthogonalised (Diebold and Yilmaz, 2012). Normalisation is therefore required, which we calculate in the following way:

$$\theta_{ij}^{'g}(H) = \frac{\theta_{ij}^{g}(H)}{\sum_{j=1}^{J} \theta_{ij}^{g}(H)} \tag{4}$$

The generalised FEVD is used to construct the several systemic/network-connectedness measures of the DY framework (Diebold and Yilmaz (2012) and Diebold and Yilmaz (2014). First, the sum of directional spillovers to time series $\boldsymbol{Y}_i$ FROM all other time series (FROM spillover index $S^g_{i\leftarrow *}(H)$) is defined with the following equation:

$$S^g_{i\leftarrow *}(H) = \frac{\sum_{k=1,k\neq i}^{J} \theta^{'g}_{ik}(H)}{\sum_{k=1}^{J} \theta^{'g}_{ik}(H)} * 100 = \frac{\sum_{k=1,k\neq i}^{J} \theta^{'g}_{ik}(H)}{K} * 100 \quad (5)$$

Second, we are interested in the sum of the shocks transmitted by time series $\boldsymbol{Y}_i$ TO other time series (TO spillover index $S^g_{*\leftarrow i}(H)$):

$$S^g_{*\leftarrow i}(H) = \frac{\sum_{k=1,k\neq i}^{J} \theta^{'g}_{ki}(H)}{\sum_{k,k=i}^{J} \theta^{'g}_{ki}(H)} * 100 = \sum_{k=1,k\neq i}^{J} \theta^{'g}_{ki}(H) * 100 \quad (6)$$

The third relevant measure is the NET spillover index (*Eq. 7*), which calculates the difference between the gross transmitted (TO) and received (FROM) shocks from all other time series:

$$S^g_i(H) = S^g_{*\leftarrow i}(H) - S^g_{i\leftarrow *}(H) \quad (7)$$

Finally, at the macro level of the network analysis, the system-wide spillover index (SUM spillover index $S^g_{sum}(H)$) offers information about the average influence one time series has on all other time series, regardless of the direction, in the following way:

$$S^g_{sum}(H) = \frac{\sum_{i,k=1,i\neq k}^{J} \theta^{'g}_{ik}(H)}{J} * 100 \quad (8)$$

In summary, the total spillover index is the sum of all the off-diagonal elements of the generalized FEVD matrix relative to the number of time series considered in the VAR(p) model. It summarises the measurement of how much of the FEV of the time series can be explained by spillovers from other time series. A large (small) total spillover index means that the average propagation of a shock in one time series to all others in the system is high (low) and, thus, the systemic risk of the network is high (low) (Diebold and Yilmaz, 2014).

We can further decompose the directional spillovers between two time series into net pairwise directional spillovers. This decomposition allows the spillover linkages between two specified time series to be determined. NET pairwise spillover index (NETP) between time series $\boldsymbol{Y}_i$ and $\boldsymbol{Y}_j$ is the difference between the gross

shocks transmitted from $\boldsymbol{Y_i}$ to $\boldsymbol{Y_j}$ and those transmitted from $\boldsymbol{Y_j}$ to $\boldsymbol{Y_{i,}}$ calculated in the following way:

$$S_{ij}^{g}(H) = \left(\frac{\Theta_{ji}^{'g}(H)}{\sum_{i,k=1}^{J} \Theta_{ik}^{'g}(H)} - \frac{\Theta_{ij}^{'g}(H)}{\sum_{i,k=1}^{J} \Theta_{ik}^{'g}(H)} \right) * 100 \tag{9}$$

As Diebold and Yilmaz (2014) pointed out, having a positive (negative) value of the net pairwise directional spillovers implies that time series $\boldsymbol{Y_j}$ dominates (is dominated by) time series $\boldsymbol{Y_i}$.

During turbulent periods, an increase in the average pairwise spillovers (NETP) from one time-period to another corresponds to an increase in the total spillover index (SUM) of the system. In the DY empirical literature, abrupt increases in total spillover index or pairwise spillover indices are often interpreted in relation to systemic shocks (Diebold and Yilmaz, 2014; Greenwood-Nimmo and *Tarassow*, 2022). Following Diebold and Yilmaz (2012; 2014), almost all the researchers apply a rolling window approach, because it is a simple and effective way to analyse the dynamics of the linkages between the network of time series.

In order to create a full comparison between the indicators, in my empirical analysis I use both macro (SUM) and aggregated micro (NET) spillover indices, both in a static and a dynamic way to analyse the linkages between the financial institutions. The block-aggregation method of Greenwood-Nimmo et al. (2016) is a flexible tool to extend the spillover measures from variable to any group-level aggregation.

3 DATA

The data cover January 4 2021, to December 30 2022, with 521 daily observations. The institutions are listed in Table 1. We divide the financial institutions into three subgroups: big financial institutions (Big FI), medium banks (Medium FI), and financial institutions from the CEE region (CEE FI). My main objective is to study the spillover channels between the biggest financial institutions in Western Europe and the CEE region.

I investigate the spillovers between 10 Western European financial institutions from the UK (HSBC Holdings, Barclays), France (BNP, Credit Agricole), Switzerland (UBS), Spain (Banco Santander), Netherlands (ING Group), Italy (Intesa San Paolo, UniCredit) and Belgium (KBC Group). Besides that I analyse the role of the CEE region's biggest financial institutions (Komercni banka – CZ, OTP Bank – HUN, Bank Handlowy w Warszawie – POL and BRD Groupe Société Générale – ROM) in the banking network.

Table 1

Financial institutions, tickers and market caps at the end of 2021 in billion €.

Panel A: Big Financial Institutions	Bloomberg Ticker	Market Cap
HSBC Holdings	HSBA	107.44
BNP Paribas	BNP	74.78
UBS	UBSG	54.67
Banco Santander	SAN	50.20
ING Group	INGA	46.23
Panel B: Medium Financial Institutions	**Bloomberg Ticker**	**Market Cap**
Credit Agricole	ACA	38.88
Intesa San Paolo	ISP	44.09
Barclays	BARC	37.23
KBC Group	KBC	31.44
UniCredit	UCG	30.15
Panel C: CEE Region Financial Institutions	**Bloomberg Ticker**	**Market Cap**
Komercni banka	KOMB	
OTP Bank	OTP	
Bank Handlowy w Warszawie	BHW	
BRD Groupe Societe Générale	BRD	

Source: https://www.spglobal.com/marketintelligence/en/news-insights/latest-news-headlines/top-20-european-banks-by-market-cap-q4-21-68258343

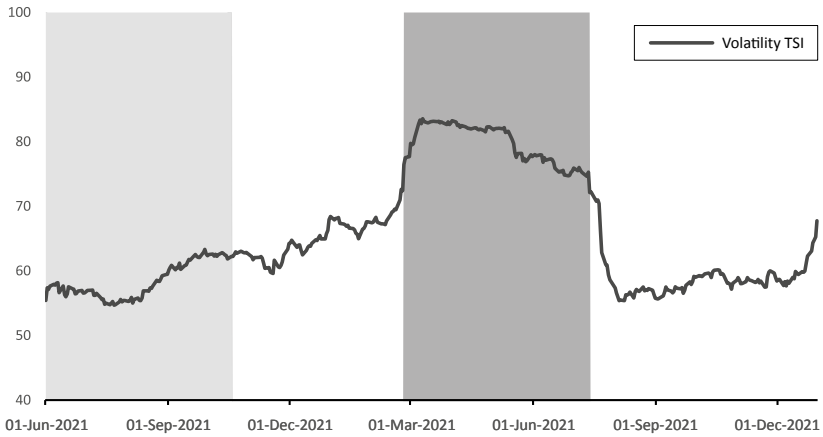
The dataset consists of daily low and high prices, extracted from Bloomberg in order to measure *Parkinson* volatility following the method of Diebold and Yilmaz (2012). I set $H = 10$ (forecast horizon) for the DY framework and $p = 1$ lag in the VAR model estimation. I use 100-day rolling window for the time-varying connectedness. These are the most commonly used parameters in the empirical literature (Diebold and Yilmaz, 2014). To strengthen my results, I also analyse the robustness of these parameters.

In the next subsection, I apply the previously introduced DY framework to perform a crisis analysis of the Russo-Ukrainian War. Using a block-aggregation method, I examine how the CEE region's volatility connections act as contagion channels during this period. Finally, I analyse the robustness of the results for the chosen DY framework parameters (window size, VAR lag).

4 EMPIRICAL RESULTS

Firstly I perform a rolling-window (dynamic) analysis on the volatility network to investigate the dynamics of the total spillover index. *Figure 1* represents the result with a 100-period rolling window, $H = 10$ forecast horizon, and $p = 1$ lags. The light grey shaded area represents a calm period in the second half of 2021, and the dark grey shaded represents the first 100 days of the Russo-Ukrainian War.

Figure 1
Volatility total spillover index for the network from 2021-06-01 to 2022-12-30.



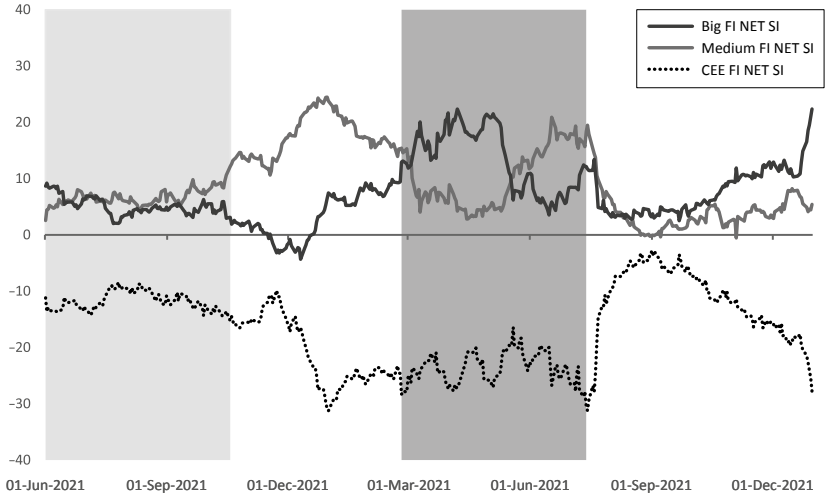
Note: The information in the Diebold-Yilmaz network is calculated from a rolling window analysis with T = 100, VAR(1) estimation. Dates correspond to the end date of the windows. Vertical light gray (dark gray) shaded are highlighted calm(crisis) periods.

Generally, the volatility total spillover index (TSI) ranges from 55 to 65%. However, in the middle of the examined period, the TSI index peaks almost immediately after the Russian invasion of Ukraine (2022-02-24). This peak is sustained in the first 100 days of the war after the total spillover index sharply declines to the original level of the index. Based on *Figure 1*, I can conclude the following: if a shock greater than a certain threshold hits the financial network, it becomes overheated, and strong connections appear in the system temporarily. Figure 1 shows evidence of a structural change in the banking network during the Russo-Ukrainian War. These results align with the earlier network-based empirical literature on the financial markets and strengthens the results of Shahzad et al. (2019).

To better understand the network, I aggregate the spillover table within and between the groups (Big FI, Medium FI, CEE FI), and calculate the aggregated net spillover indices using a rolling-sample analysis. *Figure 2.* represents the result with a 100-period rolling window, $H = 10$ forecast horizon, and $p = 1$ lags. The light grey shaded area represents a calm period in the second half of 2021, and the dark grey shaded area represents the first 100 days of the Russo-Ukrainian War. Solid, dashed, and dotted lines illustrate the group-aggregated net spillover indices of the Big, medium, and CEE region financial institutions.

In general, the net spillover index for the Big and Medium groups is positive, meaning they are the network's risk transmitter[5] participants, and the financial institutions of the CEE group play a shock receiver role (the CEE NET index is always negative). However, the indices vary during the examined period. The net spillover index for the CEE region has the largest volatility, but we can find abrupt changes in the other two net spillover indexes, mostly in turbulent times. These results supports the findings of Borri and Di Giorgio (2021).

Figure 2
Volatility group-aggregated net spillover index for the network from 2021-06-01 to 2022-12-30.



Note: The information in the Diebold-Yilmaz network is calculated from a rolling window analysis with T = 100, VAR(1) estimation. Dates correspond to the end date of the windows. Vertical light gray (dark gray) shaded are highlighted calm(crisis) periods.

5 risk transmitter: NET value is positive

To compare a calm period before the invasion and the first four months of the war, I calculate the aggregated spillover table for two 100-day time periods (between 2021-01-04 and 2021-05-21 for the calm period and between 2022-02-24 and 2022-07-13 for the war). *Table 2* and *Table 3* show the results; information for both tables is calculated from a VAR(1) estimation.

Table 2
Group aggregated spillover table with FROM, TO and NET spillover indices for the network from 2021-01-04 to 2021-05-21

	Big FI	Medium FI	CEE FI	FROM
Big FI	57.86	38.99	3.16	42.14
Medium FI	38.18	57.77	4.05	42.23
CEE FI	10.40	11.66	77.94	22.06
TO	48.58	50.65	7.2	106.43
NET	6.43	8.42	–14.85	0

Note: The information for the Diebold-Yilmaz network is calculated from a T = 100, VAR(1) estimation.

Table 2 and *Table 3* strengthen the results of *Figure 2*. After the Russian invasion on 2022-02-24, the network changed; not only on the macro level but also in the deeper structure. All the net spillover indices increased in absolute terms, and the financial institutions in the CEE region play the key role - as risk receivers[6] - in the network. This information can be important for regulators, who are monitoring the financial system on a daily basis.

Table3
Group aggregated spillover table with FROM, TO and NET spillover indices for the network from 2022-02-24 to 2022-07-13

	Big FI	Medium FI	CEE FI	FROM
Big FI	54.03	37.02	8.95	45.97
Medium FI	39.03	51.11	9.86	48.89
CEE FI	25.25	23.99	50.76	49.24
TO	64.28	61.01	18.81	144.10
NET	18.31	12.11	–30.43	0

Note: The information for the Diebold-Yilmaz network is calculated from a T = 100, VAR(1) estimation.

6 risk receiver: NET value is negative

To check the sensitivity of the results to the window size, I calculate the financial network with 50-day and 200-day windows as well as the selected calm and war periods. *Table 4* shows that volatility connectedness results are not sensitive to window size.

Table 4
Robustness check of the group aggregated net spillover indices with 50-day, 100-day and 200-day windows

Calm period					
First Day	**Last Day**	**Window size**	**Big FI NET**	**Medium FI NET**	**CEE FI NET**
2021-01-04	2021-03-12	50	5.96	10.73	–16.7
2021-01-04	2021-05-21	100	6.43	8.42	–14.85
2021-01-04	2021-10-08	200	10.31	4.43	–14.74
Russo-Ukrainian war					
First Day	**Last Day**	**Window size**	**Big FI NET**	**Medium FI NET**	**CEE FI NET**
2022-02-24	2022-05-04	50	24.68	12.02	–36.7
2022-02-24	2022-07-13	100	18.31	12.11	–30.43
2022-02-24	2022-11-30	200	10.74	13.18	–23.92

Note: The information for the Diebold-Yilmaz network is calculated from a T = 100, VAR(1) estimation.

Besides that, to check the sensitivity of the results to the lag selection of the VAR(p) model, I calculate the financial network with a VAR(2) model as well. *Table 5* shows that volatility-connectedness results are not sensitive to the VAR(p) model lag parameter.

Table 5
Robustness check of the group aggregated net spillover indices with VAR(1) and VAR(2) models

Calm period					
First Day	**Last Day**	**VAR lag**	**Big FI NET**	**Medium FI NET**	**CEE FI NET**
2021-01-04	2021-05-21	1	6.43	8.42	–14.85
2021-01-04	2021-05-21	2	5.57	8.12	–13.69
Russo-Ukrainian war					
First Day	**Last Day**	**VAR lag**	**Big FI NET**	**Medium FI NET**	**CEE FI NET**
2022-02-24	2022-07-13	1	18.31	12.11	–30.43
2022-02-24	2022-07-13	2	16.32	11.17	27.49

Note: The information for the Diebold-Yilmaz networks is calculated from a 100-day window.

At the end of this section, I conclude that the extended Diebold-Yilmaz framework is a robust, powerful tool for undertaking crisis analysis and can identify the key groups of financial institutions and contagion channels. Similar to the earlier empirical literature, large banks play a critical role in volatility risk transmission in calm periods in my analysis. I complete this with a new finding, because financial institutions from the CEE region were the key participants in the network during the first 100 days of the Russo-Ukrainian war.

Despite the several advantages of the original Diebold-Yilmaz framework (Diebold and Yilmaz, 2014), it has a shortcoming, too. The approach only captures the linear relationship between the time series due to the VAR model concept. If researchers assume nonlinear linkages between the financial institutions, they can apply the TVP-VAR version of the framework (*Antonakakis* et al., 2020), which handles nonlinear relations using time-varying parameter estimation.

My results are relevant for regulators as they provide insights into the behaviour of the European banking network during turbulent and tranquil periods. My findings related to the financial institutions from the CEE region during crisis periods can be important for identifying European SIFIs.

5 CONCLUSION

This paper examined dynamic and static volatility spillover between 14 European banks over the last two years, focusing on the Russo-Ukrainian war. For this purpose, I applied a network-based analysis. To analyse the role of the smaller financial institutions in the network, I included four banks from the CEE region. My results provide an essential insight into the structure of the European banking system during calm and turbulent periods. Both the static and dynamic analyses highlight that the network is highly interconnected. I find that the volatility connectedness of the system reaches its maximum at the time of war. In my examined period, big and medium financial institutions from Western Europe play a shock transmitter role, while CEE region banks play a receiver role. These institutions were the key participants in the network during the first 100 days of the Russo-Ukrainian war, as the net spillover index decreased during this period. The study on the impact of the Russo-Ukrainian war on the banking network is still at an early stage. My results suggest considering the banking network's micro and group-aggregated level volatility connectedness in building an early-warning system to detect troubled financial institutions.

REFERENCES

Acharya, V. – Engle, R. – Richardson, M. (2012): Capital shortfall: A new approach to ranking and regulating systemic risks. *American Economic Review*, 102(3), 59–64, https://doi.org/ 10.1257/aer.102.3.59.

Alter, A. – Beyer, A. (2014): The dynamics of spillover effects during the European sovereign debt turmoil. *Journal of Banking & Finance*, 42, 134–153, https://doi.org/10.1016/j.jbankfin.2014.01.030.

Antonakakis, N. – Chatziantoniou, I. – Gabauer, D. (2020): Refined measures of dynamic connectedness based on time-varying parameter vector autoregressions. *Journal of Risk and Financial Management*, 13(4), 84, https://doi.org/10.3390/jrfm13040084.

Baruník, J. – Kocenda, E. – Vácha, L. (2016): Asymmetric connectedness on the US stock market: Bad and good volatility spillovers. *Journal of Financial Markets*, 27, 55–78, https://doi.org/10.1016/j.finmar.2015.09.003.

Baruník, J. – Krehlík, T. (2018): Measuring the frequency dynamics of financial connectedness and systemic risk. *Journal of Financial Econometrics*, 16(2), 271–296, https://doi.org/10.1093/jjfinec/nby001.

Benoit, S. – Colliard, J. E. – Hurlin, C. – Perignon, C. (2017): Where the risks lie: a survey on systemic risk. *Review of Finance*, 21, 109–152, https://doi.org/10.1093/rof/rfw026.

Berlinger, E. – Michaletzky, M. – Szenes, M. (2011): A fedezetlen bankközi forintpiac hálózati dinamikájának vizsgálata a likviditási válság előtt és után [The analysis of the network dynamics of the uncovered interbank forint market before and after the liquidity crisis]. *Közgazdasági Szemle*, 58(3), 229–252, https://unipub.lib.uni-corvinus.hu/403/.

Berlinger, E. – Daróczi, G. – Dömötör, B. – Vadász, T. (2017): Pénzügyi hálózatok mag–periféria szerkezete: A magyar bankközi fedezetlen hitelek piaca, 2003–2012 [Financial Networks Core-

Periphery Structure: The Hungarian Interbank Unsecured Loans Market, 2003–2012]. *Közgazdasági Szemle*, 64(11), 1160-1185, https://doi.org/10.18414/KSZ.2017.11.1160.

Billio, M. – Casarin, R. – Costola M. – Pasqualini, A. (2016): An entropy-based early warning indicator for systemic risk. *Journal of International Financial Markets, Institutions and Money*, 45, 42-59, https://doi.org/10.1016/j.intfin.2016.05.008.

Bisias, D. – Flood, M. – Lo, A. W. – Valavanis, S. (2012): A survey of systemic risk analytics. *Annual Review of Financial Economics*, 4(1), 255-296, https://doi.org/10.1146/annurev-financial-110311-101754.

Bodnár, Á. Zs. (2021): An analysis of the hungarian unsecured interbank market before and after the COVID-19 pandemic. *Economy and Finance*, 8(2), 1093–209, https://bankszovetseg.hu/Public/gep/2021/193-209%20E%20Bodnar%20A.pdf.

Borri, N. – Di Giorgio, G. (2022): Systemic risk and the COVID challenge in the European banking sector. *Journal of Banking & Finance*, 140, 106073. https://doi.org/10.1016/j.jbankfin.2021.106073.

Bratis, T. – Laopodis, N. T. – Kouretas, G,(2020): Systemic risk and financial stability dynamics during the eurozone debt crisis. *Journal of Financial Stability*, 47, 100723. https://doi.org/10.1016/j.jfs.2020.100723.

Brownless, C.T. – Engle, R. (2017): SRISK: a conditional capital shortfall measure of systemic risk. *Review of Financial Studies*, 30(1), 48–79, https://doi.org/10.1093/rfs/hhw060.

Bubák, V. – Kocenda, E. – Zikes, F. (2011): Volatility transmission in emerging European foreign exchange markets. *Journal of Banking & Finance*, 35(11), 2829–2841, https://doi.org/10.1016/j.jbankfin.2011.03.012.

Claeys, P. – Vasícek, B. (2014): Measuring bilateral spillover and testing contagion on sovereign bond markets in Europe. *Journal of Banking & Finance*, 46, 151–165, https://doi.org/10.1016/j.jbankfin.2014.05.011.

Demirer, M. – Diebold, F. X. – Liu, L. – Yilmaz, K. (2018): Estimating global bank network connectedness. *Journal of Applied Econometrics*, 33(1), 1–15, https://doi.org/10.1002/jae.2585.

Dreassi, A. – Miani, S. – Paltrinieri, A. – Sclip, A. (2018): Bank-Insurance Risk Spillovers: Evidence from Europe. *Geneva Papers of Risk and Insurance – Issues and Practice.* 43(1), 72–96, https://doi.org/10.1057/s41288-017-0049-0.

Diebold, F. X. – Yilmaz, K. (2009): Measuring financial asset return and volatility spillovers, with application to global equity markets. *The Economic Journal*, 119(534), 158–171. https://doi.org/10.1111/j.1468-0297.2008.02208.x.

Diebold, F. X. – Yilmaz, K. (2012): Better to give than to receive: Predictive directional measurement of volatility spillovers. *International Journal of Forecasting*, 28(1), 57–66, https://doi.org/10.1016/j.ijforecast.2011.02.006.

Diebold, F. X. – Yilmaz, K. (2014): On the network topology of variance decompositions: Measuring the connectedness of financial firms. *Journal of Econometrics*, 182(1), 119–134, https://doi.org/10.1016/j.jeconom.2014.04.012.

Diebold, F. X. – Yilmaz, K. (2015): Trans-Atlantic equity volatility connectedness: US and European financial institutions, 2004–2014. *Journal of Financial Econometrics*, 14(1), 81–127, https://doi.org/10.1093/jjfinec/nbv021.

Foglia, M. – Angelini, E. (2020): From me to you: Measuring connectedness between eurozone financial institutions. *Research in International Business and Finance*, 54, 101238, https://doi.org/10.1016/j.ribaf.2020.101238.

Greenwood-Nimmo, M. – Nguyen, V. H. – Rafferty, B. (2016): Risk and return spillovers among the G10 currencies. *Journal of Financial Markets*, 31, 43–62, https://doi.org/10.1016/j.finmar.2016.05.001.

Greenwood-Nimmo, M. – Huang, J. – Nguyen, V. H. (2019): Financial sector bailouts, sovereign bailouts, and the transfer of credit risk. *Journal of Financial Markets*, 42, 121–142, https://doi.org/10.1016/j.finmar.2018.11.001.

Greenwood-Nimmo, M. – Tarassow, A. (2022): Bootstrap-based probabilistic analysis of spillover scenarios in economic and financial networks. *Journal of Financial Markets*, 59, 100661, https://doi.org/10.1016/j.finmar.2021.100661.

Kang, S. H. – McIver, R. – Yoon, S.-M. (2017): Dynamic spillover effects among crude oil, precious metal, and agricultural commodity futures markets. *Energy Economics*, 62, 19–32, https://doi.org/10.1016/j.eneco.2016.12.011.

Koop, G. – Pesaran, M. H. – Potter, S. M. (1996): Impulse response analysis in nonlinear multivariate models. *Journal of econometrics*, 74(1), 119–147, https://doi.org/10.1016/0304-4076(95)01753-4.

Kurka, J. (2019): Do cryptocurrencies and traditional asset classes influence each other? *Finance Research Letters*, 31, 38–46, https://doi.org/10.1016/j.frl.2019.04.018.

Lütkepohl, H. (2013): Vector autoregressive models. *Handbook of research methods and applications in empirical macroeconomics*, 30. Cheltenham: Edgar Elgar, https://elearning.unito.it/sme/pluginfile.php/192766/course/section/41571/Kilian_Handbook13.pdf.

Moratis, G. (2021): Quantifying the spillover effect in the cryptocurrency market. *Finance Research Letters*, 38, 101534. https://doi.org/10.1016/j.frl.2020.101534.

Paltalidis, N. – Gounopoulos, D. – Kizys, R. – Koutelidakis, Y. (2015): Transmission channels of systemic risk and contagion in the European financial network. *Journal of Banking & Finance* 61, S36–S52, https://doi.org/10.1016/j.jbankfin.2015.03.021.

Pesaran, H. H. – Shin, Y. (1998): Generalized impulse response analysis in linear multivariate models. *Economics Letters*, 58(1), 17–29, https://doi.org/10.1016/S0165-1765(97)00214-0.

Shahzad, S. J. H. – Van Hoang, T. H. – Arreola-Hernandez, J. (2019): Risk spillovers between large banks and the financial sector: Asymmetric evidence from Europe. *Finance Research Letters*, 28, 153–159, https://doi.org/10.1016/j.frl.2018.04.008.

Sims, C. A. (1980): Macroeconomics and reality. *Econometrica: journal of the Econometric Society*, 48(1) 1–48, https://doi.org/10.2307/1912017.

Tobias, A. – Brunnermeier, M. K. (2016): Covar. *The American Economic Review*, 106(7), 1705–1741, https://doi.org/10.3386/w17454.

Torri, G. – Giacometti, R. – Tichy, T. (2021): Network tail risk estimation in the European banking system. *Journal of Economic Dynamics and Control*, 127, 104125, https://doi.org/10.1016/j.jedc.2021.104125.

Wang, G.-J. – Xie, C. – Jiang, Z.-Q. – Stanley, H. E. (2016): Who are the net senders and recipients of volatility spillovers in China's financial markets? *Finance Research Letters*, 18, 255–262, https://doi.org/10.1016/j.frl.2016.04.025.