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FX Forward Market in Hungary: General Characteristics and Impact of the COVID Crisis*

Anna Boldizsár – Zalán Kocsis – Zsuzsa Nagy-Kékesi – Gábor Sztanó

Our study investigates the basic characteristics, structure and time trends of the Hungarian FX forward market. We demonstrate that, in addition to non-financial firms active in international trade, mutual funds have become key actors in this market. Hedging and speculative motives – based on expectations of EURHUF stability – can be identified in the trading of both sectors. Non-financials are however more sensitive to exchange rate changes than financial actors. Crises, such as the global financial turbulence experienced in March 2020 due to the spread of the coronavirus, are characterised by a decline in speculative trading. During the depreciation of the forint together with regional currencies at the end of March, non-financial firms did not increase their net long HUF forward positions, while mutual funds increased their short HUF positions due to precautionary considerations, the depreciation of international assets and liquidity shocks (*redemption of mutual fund shares, increasing margin call funding requirements*).

Journal of Economic Literature (JEL) codes: C32, D84, F31, G32

Keywords: FX forward market, exchange rate exposure, mutual funds, time-varying parameter model, COVID crisis

1. Introduction

The subject matter of this study is the Hungarian FX forward market. The paper discusses the structure and trends of this market, and the behavioural patterns and motivations of its participants.

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

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In a number of respects, the FX forward market is an important area for Hungarian economic and financial actors, as well as the central bank. It plays a role in domestic international trade because many exporters and importers use FX forwards to mitigate their currency risk. Reducing risk may foster international trade and thus economic activity. Domestic mutual funds use the forward market primarily for hedging purposes, mainly to mitigate the currency risk of the FX asset portfolio. In addition, as discussed in the existing literature, the carry trade (long positions taken in currencies with higher interest rates) and more generally currency speculation, i.e. trading involving positions to exploit exchange rate expectations, also motivate the transactions of domestic actors. The latter, speculative trading motive, is mainly characteristic in the case of retail customers and exporters. Hungarian domestic actors typically bet on the mean reversion (i.e. the stability) of the EURHUF exchange rate.

For the central bank, the FX forward market is important because this market has historically provided support for the forint spot market and strengthened its liquidity. Global shocks to the domestic currency, which typically spill over to the domestic market as a result of purchases and sales by foreign actors, are dampened by the reverse-direction FX forward trading of domestic actors, leading to a smaller change in the exchange rate compared to what would be the case without such activity by domestic actors.

One novel aspect of our analysis is to provide insight into an aspect of the financial market turbulence related to the coronavirus epidemic at the end of March 2020, during which the forward market showed a different pattern than before: it acted to increase the volatility of the forint exchange rate instead of dampening it. We explore the background of this development based on bank interviews and the data available to the Central Bank of Hungary (Magyar Nemzeti Bank).

1.1. Related literature

Much of our analysis is descriptive in nature with an aim to explain the basic characteristics and structure of the market for FX forwards in Hungary. The study thereby continues the tradition represented by several comprehensive studies of the MNB, which describe Hungarian financial markets – and more specifically the FX derivatives market (*Csávás – Gereben 2005; Csávás et al. 2006; Gereben et al. 2006; Csávás – Szabó 2010; Páles et al. 2010; Banai et al. 2013; Kocsis et al. 2013*). Our study is most closely related to *Csávás et al.* (*2006*), who investigated the FX forward market in more detail. Their study revealed key features of the Hungarian forward market back in 2006, including the reasons behind the trading activity of the non-financial sector. The current study builds strongly on these insights and examines the direction in which these features have changed over the past nearly 15 years.

Descriptive analyses of similar vein are mainly published by the Bank for International Settlements (BIS) about international, global financial markets. To relate the Hungarian market to the global market, we use the data of the BIS Triennial Survey (*BIS 2019a*) and rely on descriptive BIS studies that investigate these data and the background of global FX market processes (*Borio et al. 2017; BIS 2019b*). *Borio et al.* (*2017*) argue that the global economy is fundamentally influenced by off-balance-sheet financing obtained through derivative items: they calculate that in this way USD 10.7 trillion of debt is hidden in balance sheets. Traditionally, forward transactions have played a key role in managing the "natural" FX exposure of non-financial firms active in international trade, as exporters hedge their FX revenues, while importers hedge their FX expenditures partly using these financial instruments. However, according to BIS studies (*Borio et al. 2017; Patel – Xia 2019*), inter-dealer transactions between financial corporations and banks currently account for a significantly larger volume compared to the derivative trading of non-financials, and recently transactions related to financial investments contributed most to the growth of the FX derivatives market.

Our study is related to the extensive literature that discusses the FX market activity of the non-financial corporate sector, mainly their foreign currency borrowing and taking FX forward positions. One segment of this literature quantifies natural FX exposures due to international trade, assesses how and to what extent non-financial companies hedge these exposures and investigates what firm characteristics explain differences regarding hedging activity. A large-scale meta-analysis of the literature by *Geyer-Klingeberg et al*. (*2019*) shows that the results are highly dependent on the chosen method and the (international and time) sample (175 studies are used in the meta-analysis which attests the breadth of this literature).

There are some general conclusions nonetheless: larger and internationally more integrated corporations with higher natural FX exposures (i.e. multinational firms) appear to be more active and more involved in using FX hedging tools (*e.g. Guay – Kothari 2003; Kim – Sung 2005; Geyer-Klingeberg et al. 2019*). *Bodnár* (*2009*) arrives at a similar result for the Hungarian non-financial corporate sector. International comparisons confirm that there are significant differences between countries both due to differences in the overall development of financial markets (*Pramborg 2005*) and due to the fact that firms in dollarized countries, which are more vulnerable to crises, have a larger need for hedging (*Gatopoulos – Loubergé 2013*).

One central question related to non-financial firms' participation in the FX forward market (and FX funding markets) is what reasons, in addition to the hedging motive, could explain transactions. In addition to hedging the natural currency mismatch in cash flows, the early risk management literature discusses aspects of managerial

risks and income (*e.g. Smith – Stulz 1985*), and transactions with speculative purposes are also elaborated (*Géczy et al. 2007*). In the literature, the speculative motivation for trading is usually related to the empirical failure of uncovered interest rate parity, the forward premium anomaly (*Fama 1984; Yu 2013; Barroso – Santa-Clara 2015; Jurek 2015*), which promises profits for carry trade strategies, i.e. holding long FX positions of high-interest-rate currencies funded in low-interest-rate currencies. There may also be additional supply-side motivations (resulting from banks hedging their own FX exposure) behind the FX market purchases of non-financial firms.

With regard to the Hungarian data, several studies confirm the existence of a hedging motive for non-financial firms' forward market participation using various methods (*Csávás et al. 2006; Bodnár 2006, 2009; Harasztosi – Kátay 2020*), though the granular corporate level data of *Harasztosi – Kátay* (*2020*) links only a small part of the transactions to the hedging motive. *Harasztosi – Kátay* (*2020*) also finds a small role for exploiting the interest rate differential, which contradicts the results of *Bodnár* (*2006, 2009*) based on questionnaire-based surveys. Interestingly, *Kim – Chance* (*2018*) finds that firms tend to report a larger role of hedging motives in questionnaire-based surveys compared to their true FX market activity, which is better characterised by speculative motives. *Csávás et al.* (*2006*) reveals that the trading pattern of non-financial firms is consistent with expectations of the stability of the forint exchange rate. *Vonnák* (*2018*) and *Harasztosi – Kátay* (*2020*) highlight the significant impact of banks' supply-side factors in FX positions of corporates.

At the microeconomic level, hedging FX exposures versus speculative activity that is less related to the balance sheet position contributes to firm value (*Allayannis et al. 2012*) and to credit risk, while at the macroeconomic level it relates to issues of financial stability. Systematically unhedged FX debt of corporates can lead to financial stability problems and can have noticeable negative effects on real economic activity as well during a crisis (*Endrész et al. 2012; Endrész – Harasztosi 2014; Endrész 2020*).

Finally, the literature on the risk management of financial market actors is also relevant to our study. This literature examines empirical correlations between different asset classes / exchange rates to evaluate risk management strategies, and thus the use of FX derivatives, in the case of investors with international portfolios (e.g. *Massa et al. 2016; Mun 2016*).

1.2. Sources of data

We rely on two data sets for the Hungarian FX forward market, both based on the reporting of domestic banks prescribed by the central bank. In the D01 report, available since 1999, the MNB requests domestic credit institutions to report daily FX market transactions. This data set allows for the tracking of the FX spot, forward and futures, options and swap transactions of domestic banks. For each transaction, banks report the purchase and sale currency and volume of the transaction (based on this implied pricing can be calculated), the date of the contract, the maturity date (where applicable), counterparty characteristics (domestic / foreign residence, bank / non-bank, for financial actors usually also a unique identifier), as well as other transaction details (whether the transaction is related to stock exchange / OTC trading, whether it includes margining, whether the spot transaction is delivery of a derivative transaction) and pricing parameters (option premium for options, interest rates in cross-currency interest rate swaps). One important advantage of the D01 report is the historical depth of the time series, its daily frequency, and the rapid reporting of transactions that allows daily monitoring of the market (transactions are reported the day after the contract).

Our other source of data originates from the monthly M05 report, available since 2017, which is also provided by credit institutions to the central bank and includes reporting on the stock of FX and interest rate derivatives outstanding at the end of the month. In the case of FX forwards, banks report the nominal value and market value of the portfolio and the volume of trading (number of transactions) for the given period for each currency pair (both short and long directions) in large maturity buckets (within-year, 1–2 years and longer than 2 years). One of the main advantages of the M05 data source for our study is that banks report their FX forward market portfolios by sectors of counterparties, and from this information we can cautiously deduce the forward stocks and net exposures of domestic financial and non-financial actors (within that households and corporations separately). The counterparty codes and residence code in the D01 report also help in identifying counterparties, but there are many missing or technical identifiers here, and therefore the M05 report captures the sectoral composition much more accurately.

In addition to these two sources of data, we collected anecdotal information about the forward market. We interviewed Treasury / ALM colleagues of eight major domestic banks in early April. These eight banks cover 85 per cent of the outstanding FX forward portfolio of the Hungarian banking system.

Other data sources used for this study are the international FX market statistics collected by the BIS and the F07 data reports of the MNB. The latter has been

available since 2009 and includes monthly information on key balance sheet items of mutual funds (broken down to HUF, EUR and other foreign currency categories).

1.3. Structure of the study

The *next section* includes a general description of the FX forward market. First, it identifies the sub-market of the global FX market on which the study focuses, FX forwards with one leg in HUF, where one of the counterparties is a Hungarian bank. The section then deals with several descriptive characteristics of this segment (currency denomination, maturity, transaction volume). The *third section* presents the structure of the domestic market, discussing the main participation motives of the three key actors (domestic banks, non-financial firms involved in international trade, mutual funds). The *fourth section* presents time-varying estimates of the exchange rate sensitivity of forward positions. The *fifth section* analyses the developments related to the coronavirus crisis this spring. The *sixth section* summarises the main findings.

2. General characteristics of the FX forward market

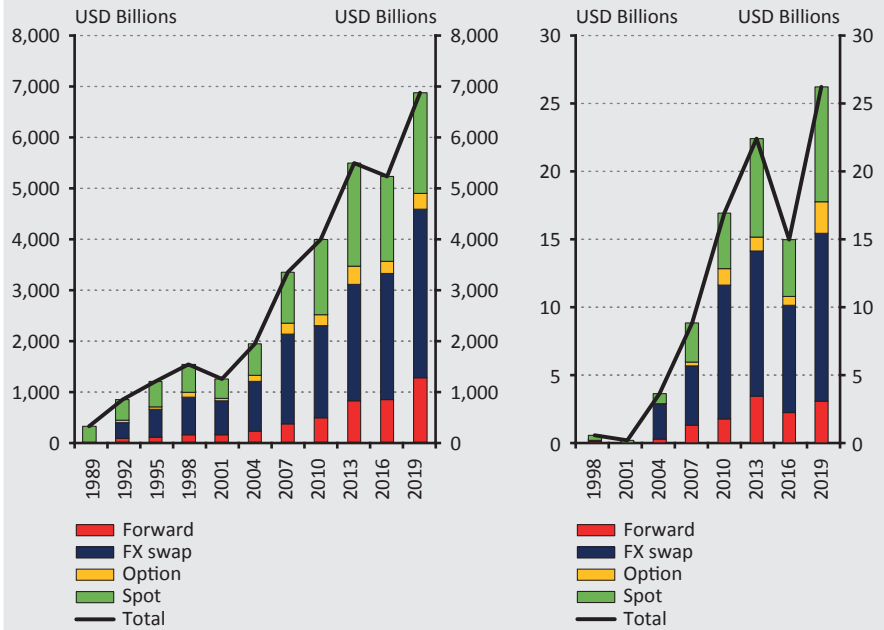
2.1. Global FX market

According to the BIS Triennial survey,[1] global FX market turnover showed a rising trend over the past twenty years, with few smaller setbacks (*BIS 2019a*). *Schrimpf – Sushko* (*2019*) links the temporary decrease in 2016 to the abolition of the Swiss franc cap in January 2015, which shook the global FX market, and to adjustment to new regulatory standards. Interestingly, in terms of dynamics (and total turnover), currency swaps and not spot transactions represent the most important transaction type. However, in addition to currency swaps, all FX sub-markets – thus the spot, forward and options markets – also expanded significantly. The BIS data show that the financial market customer base of banks still plays a major role among market participants, accounting for almost half of the turnover by 2019, while the activity of non-financial corporations was below 10 per cent.

Forward transactions, as the focus of our analysis, account for roughly 18 per cent of global FX market turnover. The share of forward transactions increased significantly compared to the 11–12 per cent typical in the 2000s. However, currency swaps (including both FX swaps with maturity within one year and currency interest rate swaps with maturity over one year) were slightly pushed to the background in the first half of 2010, before their share rose again in the 2019 survey to around 50 per cent within the total FX market turnover (*Figure 1*).

[1] The BIS Triennial Survey, the BIS's comprehensive survey is the most obvious source on global FX market trends. The BIS conducts the survey under the coordination of central banks, with some 1,300 financial institutions in 53 countries contributing to the latest release (*BIS 2019a*). The Triennial Survey provides data on portfolios and turnover (on the average daily turnover in April in the year of publication).

Figure 1
FX market turnover by transaction type (total FX vs. HUF, average daily turnover in April of a given year)



Note: The left panel shows the average daily volumes of all globally traded currencies in April, whereas the right panel shows the average daily volumes of globally traded transactions vis-à-vis the HUF in April.

Source: Edited based on BIS (2019a)

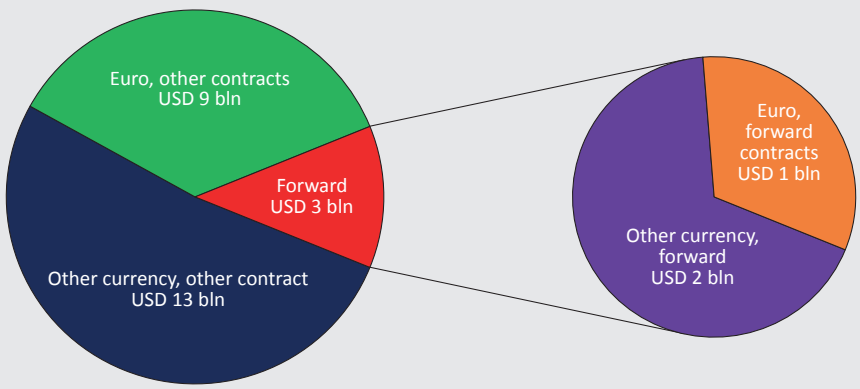
The HUF market accounts for a small share of the global FX market. Barely half of one per cent of global FX transactions have the HUF as the purchase or sale denomination. The same is true for the global vs. HUF relation in the case of forward transactions.

Prior to full convertibility of forint in 2001, international HUF turnover was insignificant compared to current volumes, and since the beginning of the 2000s, there has been a sharp increase in particular in currency swaps. Similar to the data aggregated by all currencies, HUF trading also came to a temporary halt in 2016. Among the types of transactions, FX swaps continue to account for the largest share of the volume, i.e. stable at half of the total market turnover. On the other hand, the share of forwards within HUF transactions decreased: compared to 15 per cent in 2013 and 2016, it was recently at 11 per cent.[2]

[2] In practice, forward positions can be significantly larger than those observed in forward transactions, given that combining FX swaps and spot transactions result in a (synthetic) forward position.

In both the MNB and BIS data sets, most HUF transactions were concluded against the euro. However, on the basis of BIS data, the share of the euro is nearly one-third, while according to MNB data, HUF transactions were trades against the euro in nearly two-thirds of transactions. This is probably due to HUF transactions between non-residents taking place at a higher proportion versus the USD than in the case of transactions reported by domestic banks, which are typically executed with or on behalf of counterparties with EUR involvement. According to BIS, of the approximately USD 3 billion daily HUF forward turnover, approx. 1 billion is transacted against the euro and 2 billion against other currencies. However, non-consolidated data suggest that – in addition to non-euro transactions – forint transactions against the US dollar are significant (*Figure 2*).

Figure 2
Distribution of HUF transactions by type of transactions and currencies transacted against the forint

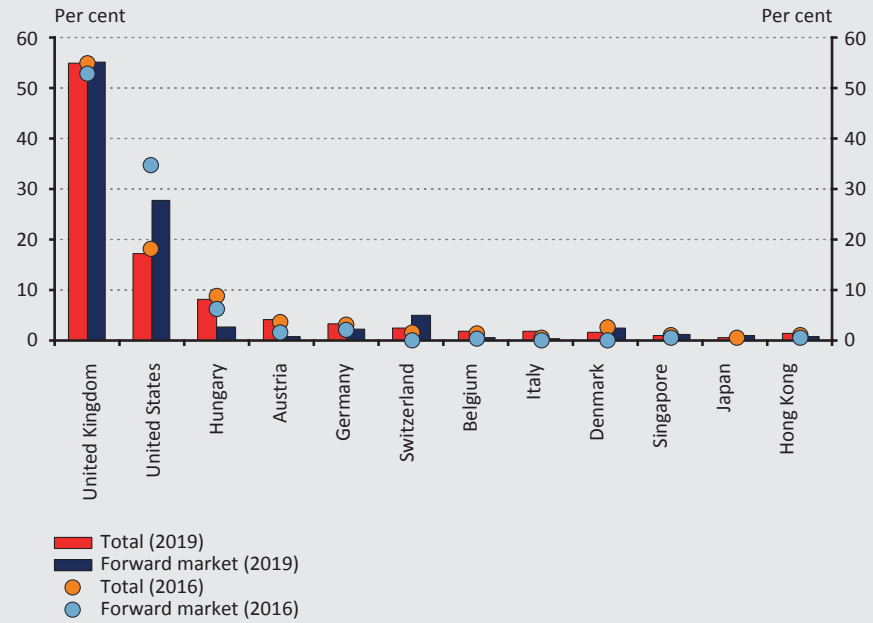


Note: The chart on the left shows the distribution of the turnover of global HUF transactions by forwards and other transactions (spot, swap, option). The chart on the right further breaks down global HUF forward transactions by currencies.

Source: Edited based on BIS (2019a)

According to BIS data, HUF transactions are mostly concluded in the United Kingdom and the United States (*BIS 2019a*). Based on the residence of market participants reporting HUF transactions, there has been no major change in recent years: most HUF transactions continue to be concluded outside Hungary. Interestingly, the share of transactions concluded in the United States decreased significantly in the case of forward transactions in particular between 2016 and 2019, and some Asian financial centres also reported HUF transactions in 2019 (Hong Kong, Singapore, China). At the same time, outside the United States and the United Kingdom, HUF transactions are mostly concluded in Europe, typically in countries that have direct exposure in the Hungarian financial markets. According to the survey, the share of transactions concluded in Hungary is nearly 8 per cent, taking into account all FX transactions (*Figure 3*).

Figure 3
Geographical distribution of HUF transactions



Source: Based on BIS (2019a)

2.2. Characteristics of the Hungarian FX market and forward market

The segment of the Hungarian forint / FX market which is observable through data available from the reporting of domestic banks to the MNB is much smaller than the global HUF market presented above. The total FX market turnover reported by banks amounts to approximately HUF 900 billion per day, of which currency swaps and spot transactions account for the largest part. The average daily turnover of the Hungarian forward market is HUF 65 billion, which is largely consistent with the data collected by BIS: the turnover that can be traced by MNB data may account for 6–8 per cent of the total global forint market.

Based on the transactions reported by Hungarian banks, market participants are most active in the short segment of the forward market: almost three-quarters of the average daily transaction covers transactions of a maximum 3-month maturity, while the share of transactions longer than one year is barely one and a half per cent. This is also in line with BIS data: in the international market, the proportion

of transactions shorter than 3 months was 85 per cent, and only about 5 per cent of transactions were longer than 6 months.

Transaction volumes are also higher for shorter maturities. The 1–3 month segment includes the highest average volumes by transactions. The skewness of the distribution of transaction volumes is positive: the average is increased by a small number of large transactions, and typical transactions are significantly smaller than the average. The median transaction volume was around HUF 30–60 million, compared to the average of HUF 150–300 million (*Table 1*).

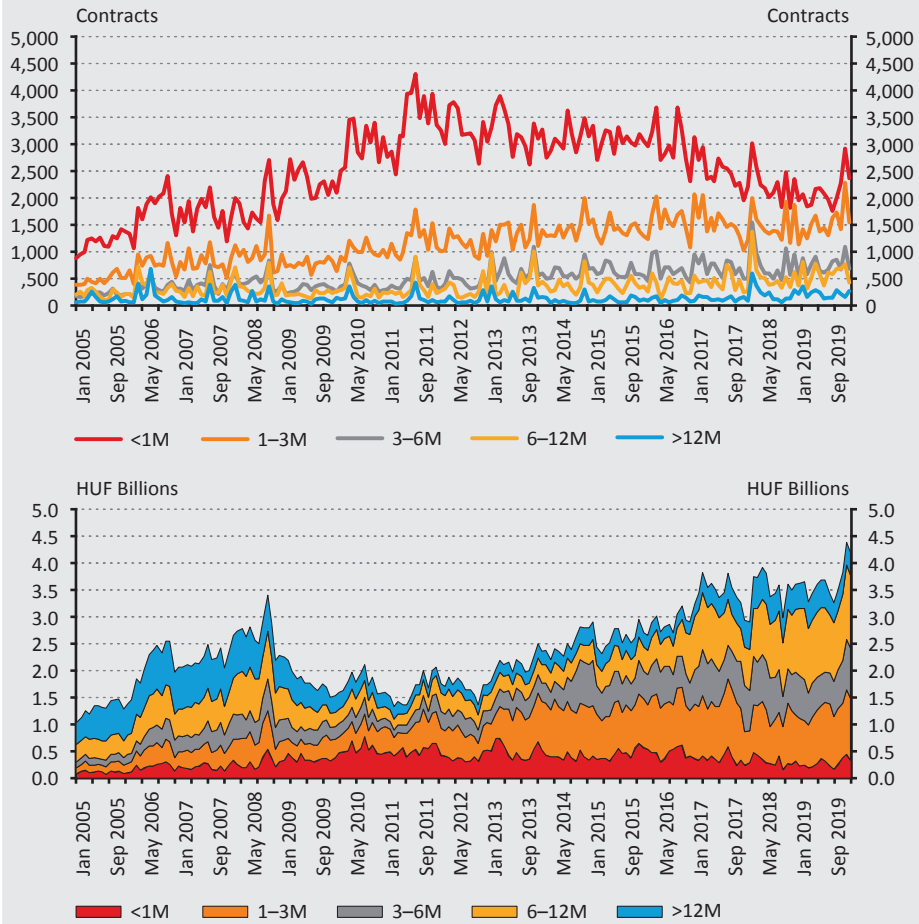
Table 1
Daily average transaction volume and turnover

	Maturity				
	< 1 month	**1–3 months**	**3–6 months**	**6–12 months**	**> 12 months**
Average daily volume traded (HUF billion)	30.0	20.9	8.1	5.6	1.1
Transaction volume (HUF million)					
average	269.1	286.7	235.8	240.0	144.1
perc 10%	6.1	10.0	9.4	7.9	4.2
perc 20%	10.2	18.5	16.2	15.6	8.1
perc 30%	17.9	30.5	25.7	19.5	16.1
perc 40%	29.1	34.1	31.9	31.3	22.4
median	34.4	59.2	45.8	34.9	32.1
perc 60%	61.9	85.8	65.5	60.4	39.0
perc 70%	98.1	136.8	106.7	85.3	60.1
perc 80%	186.0	235.4	166.9	156.0	82.8
perc 90%	428.0	545.0	391.4	336.1	162.4

Note: January 2017 – May 2020 sample
Source: Based on MNB (D01)

Based on the development of the transactions' maturity structure (*Figure 4*), the shortest maturities of less than 1 month were consistently the most frequently concluded transactions, but the number of daily transactions has decreased somewhat in this maturity category since 2011. In the 1–3-month maturity bucket, there was a trend-like increase since the beginning of the time series.

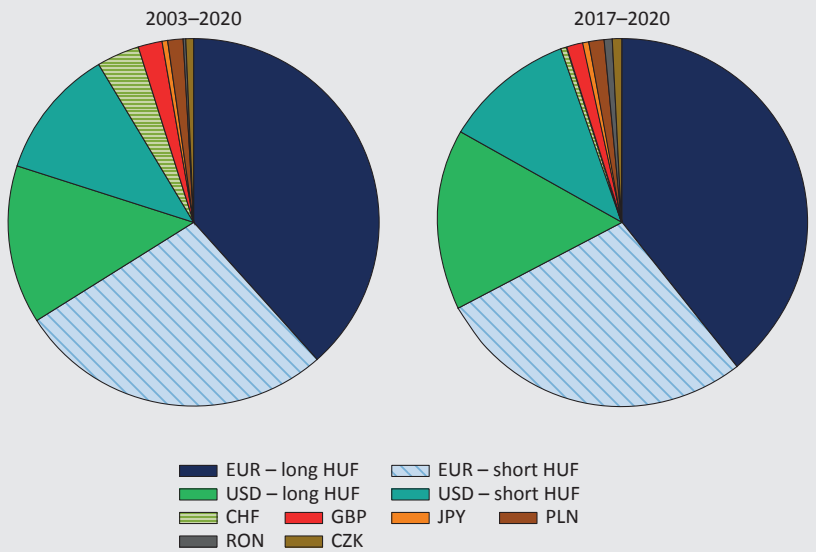
Figure 4
Maturity structure of forward transactions (number of transactions concluded and outstanding portfolio)



Source: Edited based on MNB (D01)

The maturity structure of outstanding transactions shows a different picture compared to transactions. Two-thirds of the outstanding portfolio has a residual maturity of over 3 months, while for transactions this ratio is only around one-quarter. Shorter transactions need to be renewed more frequently by the participants, while the lower volume of forward transactions concluded for longer maturities is offset by the longer maturity of these transactions. The increase in the outstanding stock of forwards in recent years is also largely attributable to longer maturities.

Figure 5
Currency distribution of forward transactions



Note: In the case of EUR and USD, the FX ratio is further broken down into short and long HUF transactions (from the point of view of the banks' counterparties: in the case of short HUF transactions the counterparty buys HUF in a forward transaction from the domestic bank).

Source: Based on MNB data

Regarding the currency breakdown, it seems that there have not been any significant changes in recent years. Shorter forward transactions vis-à-vis the euro continue to dominate, but almost two-thirds of Hungarian transactions concluded were short-maturity EURHUF forwards (*Figure 5*), representing a higher level than shown by the BIS data.

3. Participants in the Hungarian FX forward market

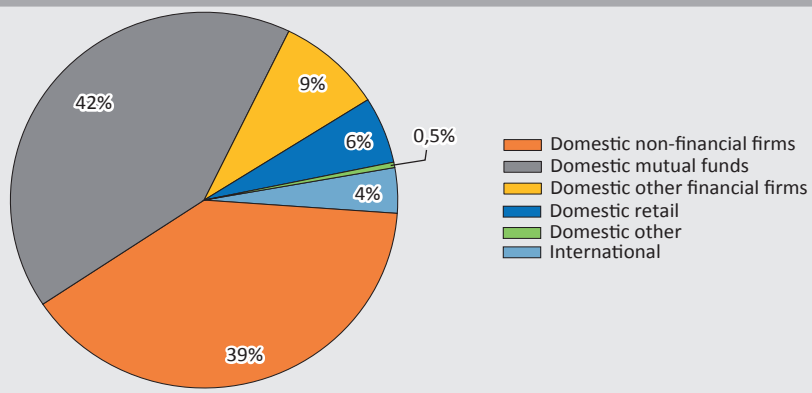
In the monthly M05 report, domestic banks report their outstanding derivatives market portfolios broken down by sector.[3] Based on these, banks' customer base in the FX forward market mainly consisted of domestic clients, and the share of foreigners was low (*Figure 6*).

Domestic financial sector participants accounted for one-half of the portfolio. Within this category, mutual funds were particularly important, whereas transactions of insurance companies, pension funds, other financial corporations and other credit institutions represented a smaller proportion. Another nearly 40 per cent of the

[3] From the daily, transaction-level D01 report we can uniquely identify most of the bank counterparties in the financial sector, but (non-financial) corporate and retail customers can only be traced in the report in an aggregate manner.

forward stocks outstanding was made up of non-financial corporations. There are no unique identifiers available for individual firms within this group; thus, we only know based on bank interviews that it is primarily non-financial firms engaged in international trade, and in particular exporters which typically use the FX forward market. Transactions with retail and municipal customers account for a smaller share of the portfolio. Interestingly, foreign players are barely present in the domestic segment of the market. The reason for this is that among non-residents, those who deal in the FX market with domestic banks (global banks, parent banks) usually generate (synthetic) forward positions through a combination of FX swaps and spot transactions (*Páles et al. 2010*; *Csávás – Szabó 2010* explains in detail the feature and use of FX swaps).

Figure 6
Structure of the Hungarian FX forward market



Note: Customer base of Hungarian data reporting banks on the FX forward market (March 2020).
Source: MNB (M05 report)

In conclusion, the domestic forward market entails three main groups of participants: domestic mutual funds, internationally trading non-financial companies and intermediary domestic credit institutions. This structure was characteristic of the market between 2017 and 2020 with the exact shares of these sectors only slightly changing.

This section presents the FX forward market activities of these three participants.

3.1. Data reporting banks

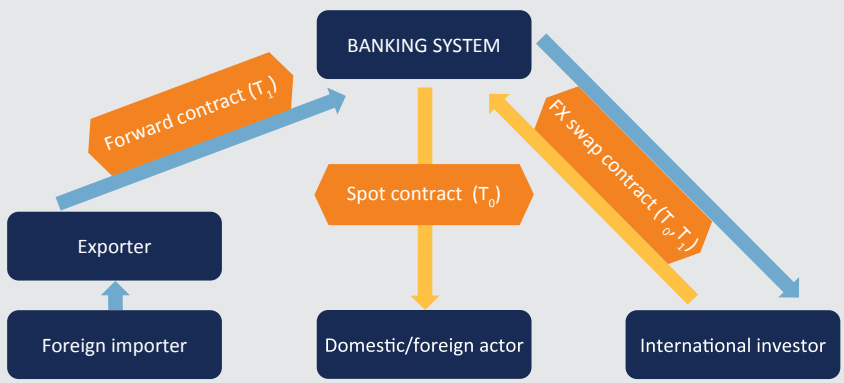
Domestic banks participate as intermediaries in the FX forward market as well as in other segments of the FX market. On the one hand, FX forward positions can be produced as a combination of an FX swap and a spot transaction, and thus mispricing compared to this represents an arbitrage opportunity. On the other hand, due to macroprudential regulations,[4] banks do not hold significant open FX positions

[4] The foreign exchange funding adequacy ratio (FFAR) requires holding sufficient amount of stable foreign currency funding in proportion to foreign currency assets. The foreign exchange balance ratio (FXBR) puts a ceiling on the degree of currency mismatch between assets and liabilities relative to the total balance sheet.

(the total open FX positions relative to the total balance sheet is around half a per cent); thus, they find counterparties to close positions opening due to demand in FX forwards of non-financial corporates and mutual funds in the other two FX market segments (and vice versa: the forward market is also used for offsetting transactions concluded on the other two markets).

To take an example, exporter demand for forint buying in the forward market (long HUF forward) opens the bank's FX position in the direction of increasing its net FX assets, which the bank can cover (other than selling a short HUF forward) by spot selling of foreign currency obtained from the FX swap market (*Figure 7*). In this case, on the forward leg (T_1) of the FX swap, the bank has to repay foreign currency, for which it can use the foreign currency it obtains from the forward transaction. Any changes in the exchange rate move the value of the forward transaction and the FX swap's forward leg by the same extent with opposite signs.

Figure 7
Flow of FX liquidity in the case of export revenue hedged with forward transaction and hedged bank FX position



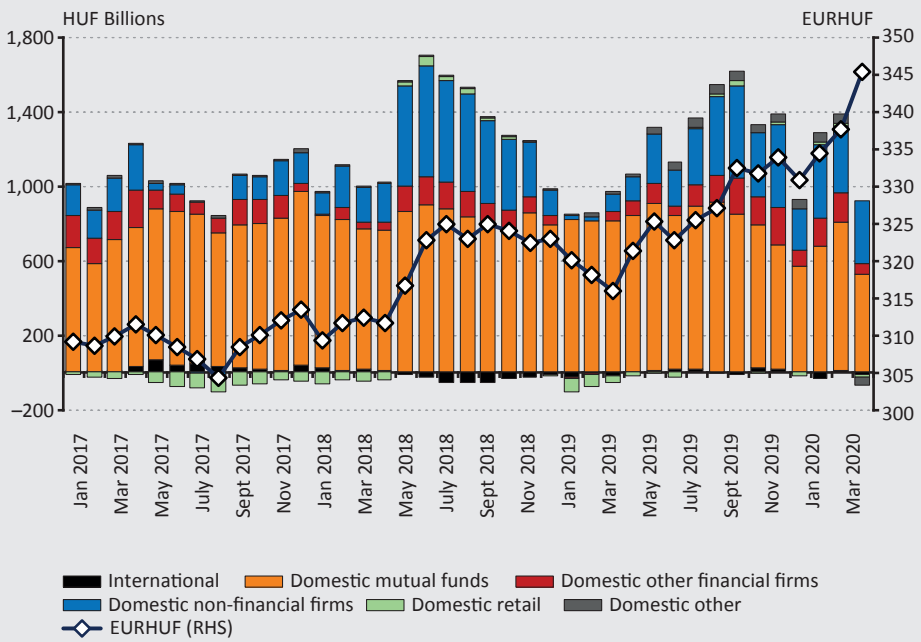
Note: The schematic chart shows the flow of FX liquidity at the spot (yellow arrows) and forward dates (blue arrows) where the exporter hedges the foreign exchange risk of its FX revenue due at a later date with a forward transaction, and the banking system hedges its FX position that opens due to the forward transaction with the exporter using a spot + FX swap (synthetic forward) transaction.

3.1.1. Sectoral portfolios in relation to the forint

Both major client groups of domestic commercial banks, i.e. domestic non-financial corporations and domestic mutual funds, typically maintained a net long HUF position, and thus their stock of long HUF forwards (HUF buying and FX selling in the forward market) exceeded their stock of short HUF forwards. Therefore, the Hungarian banking system took on a net short HUF position in the forward market, but closed this FX position vis-à-vis the foreign sector in the spot market.

The gross short HUF and long HUF stocks of domestic financial and non-financial corporations showed similar dynamics. On the long HUF side, we saw a significant increase in stocks in the spring of 2017, in April 2018, in the second and third quarters of 2019, and in the first two months of this year. These waves of increases, although with different amplitudes, were present in both sectors. These periods coincided with periods of forint depreciation and resulted in increases in not only the gross but also the net long HUF forward positions (*Figure 8*).

Figure 8
Net forward portfolios by sectors and the EURHUF exchange rate



Source: MNB (M05 reporting), Bloomberg

There were a few temporary increases in short HUF stocks in mid-2017 and at the very end of 2018, and at the end of 2019 (mostly in parallel with the increase in the long HUF stock).

3.1.2. Management of counterparty risk: margin accounts and margin calls

As mentioned, domestic banks hold low open net FX market position, but still face significant counterparty risk through their outstanding gross short and long contracts. At the time of initiation, the value of a forward contract is approximately zero as it is priced to the prevailing exchange rate and interest rates. However,

subsequent changes in the exchange rate changes during the life of the contract change the market value of the forward, to the same extent, but in opposite directions for the short and long position holders. Finally, at the maturity of the transaction, the counterparty with the negative position transfers the loss to the profit-making counterparty. This transfer at maturity represents counterparty risk due to the default risk of the loss-making party.

There are several established practices for managing counterparty risk. Commercial banks mark to market the value of forward transactions with financial and retail clients on a daily basis and the bank requests liquid collateral to cover any losses on these positions. If the bank does not receive the collateral, it closes the position with a reverse transaction.

Most of the banks surveyed choose a different procedure for non-financial corporates. In this case, the banks' risk management divisions assess the profile of firms in advance and set limits for forward transactions in a framework agreement. These framework agreements allow taking positions in a direction that is in line with the natural hedge of the firm (for exporters, long HUF position, for importers short HUF position) and is typically somewhat lower than (annual) sales revenues. Such frameworks keep counterparty risk low. For example, if the forint weakens, and this makes long HUF positions loss-making, the HUF value of FX revenues from export sales also increase in parallel for exporters. Thus, it is realistic to assume that the loss from a forward transaction can ultimately be offset by the firm. Therefore, margin calls and the practice of automatically closing out transactions are also rare.

3.1.3. Market concentration

15–25 financial institutions have participated in the Hungarian forward market in the last 10 years, and 8–10 of these banks can be considered more active. Over the years, the number of participating banks decreased, but this was a result of smaller players exiting the market, and accordingly indicators of market concentration did not change much.

The Herfindahl–Hirschmann Index, which sums the squares of market share (and multiplies by 10,000), fluctuated between 1,000 and 1,500 for most of the period, suggesting a low to medium concentration. The market share of the three largest players ranged from 50 to 60 per cent.

3.2. Non-financial firms active in international trade

According to the unanimous responses of the banks contacted, in the non-financial corporate sector, companies active in international trade play a key role in the FX forward market. Within this sector, exporters were more dominant, although the relative role of importers has increased in a trend-like manner over the past

decade. Despite the trend, exporters still represent a greater weight in the market, which was reflected in the consistently positive (long HUF) net forward stock of the domestic corporate sector.

There are several factors behind the larger, but relatively declining, role of exporters. In addition to hedging their natural FX exposure, both speculation on forint strengthening following periods of weakening and carry trade considerations played a role in exporters' forward position taking. Based on several bank interviews, in recent years corporate perception of these factors changed noticeably.

3.2.1. Forward positions as natural hedges

The literature deals in detail with hedging the natural FX position arising from international trade. Exporters receive their revenues in the future and typically at a price fixed in foreign currency, so until the revenue is realised, the change in the exchange rate poses a risk to the balance sheet: HUF strengthening reduces the sales revenue measured in forints. This risk can be mitigated by a transaction with a long HUF forward contract (forint buying and foreign currency selling in the forward market), since HUF strengthening would make a profit on this forward position offsetting the loss in the export revenue. The foreign currency borrowing has a similar effect: HUF strengthening decreases the forint value of FX liabilities (or, in a flow approach, the forint value of interest paid on FX liabilities), which results in a profit.

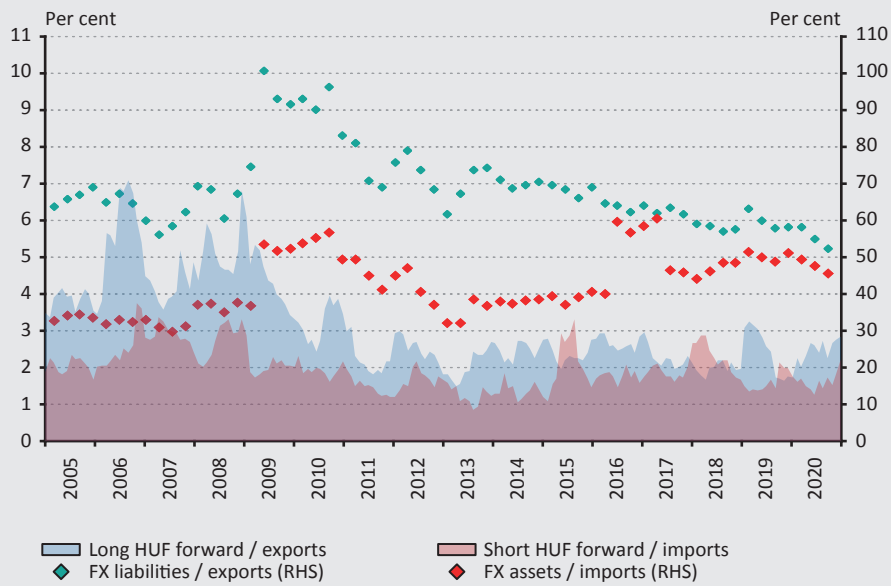
Similarly, in the case of importers, the exchange rate risk of future FX expenditures can be mitigated by a forward short HUF transaction (forward forint sale, foreign currency purchase) or by including FX assets in the balance sheet. As the Hungarian international trade balance has typically been in surplus over the past decade, but net exports have declined since 2016, this, by itself, explains the net long HUF but relatively declining hedging in the forward market.

An (admittedly imperfect) indication of the extent of hedging the FX exposure due to exports and imports of the corporate sector is the ratio of on-balance-sheet FX assets, FX liabilities and FX derivatives to international trade volumes (*Figure 9*).[5]

[5] In a stock-based approach, hedging could theoretically be assessed by comparing on the one hand the value of assets (inventories) held on the balance sheet intended for export / import, but which are subject to be revalued due to exchange rate fluctuations, to the value of on-balance and off-balance-sheet financial items. A first problem is that we only have data at the sectoral and not at the individual firm level, and exports and imports of the same firm already constitute a natural hedge against exchange rate risk (this in itself reduces the needed hedge by financial instruments). On the other hand, instead of the revalued stock, we can observe the export / import turnover. Although the two are related, their volume can vary significantly depending on how many months the products stay in the balance sheet. In the literature, *Borio et al.* (*2017*) also use metrics similar to what we use.

The volume of FX forwards fluctuated between 2 and 7 per cent of (12-month) exports and imports of goods, and after the crisis of 2008–2009, the forward stock of the non-financial corporate sector decreased significantly compared to the total volume of international trade. Interestingly, this was (at least between 2009 and 2012) accompanied by a relative increase in on-balance-sheet FX assets and liabilities.

Figure 9
On-balance-sheet FX items and forward stocks of the corporate sector as a proportion of exports and imports of goods



Note: Non-financial corporate sector FX-denominated on-balance-sheet financial assets and liabilities, stocks of forwards recorded in D01 as resident counterparty each compared to the volume of exports and imports of goods in the last 12 months.

Source: MNB (D01 reporting, Balance of Payments Statistics)

The FX liabilities of the non-financial corporate sector (FX loans, issued securities, other FX liabilities) exceed their FX assets (mainly FX deposits, securities), which is – on the whole – consistent with the "natural hedging" of the net exporter position. On a gross basis, on-balance-sheet financial FX assets and FX liabilities significantly exceed the stock of forward derivatives, and thus a significant part of the FX exposure may be covered by on-balance-sheet items. On-balance-sheet items as well as FX forwards were higher as a proportion of exports than imports.

3.2.2. Speculative and carry trade content of forward positions

In addition to hedging their natural FX positions, it is also easy to identify a speculative motive for forward trading (betting on EURHUF mean reversion) by exporters as already described by *Csávás et al.* (*2006*). In periods of forint depreciation, exporters (with the exception of the spring of 2020) generally increased their long HUF positions (*Figure 8*), because during these periods expectations of forint appreciation become stronger. Therefore, exporters hedged a larger share of their expected revenues in these periods.[6] If exporters did not have mean reverting exchange rate expectations, this pattern would not be observed. On the other hand, several of our bank respondents mentioned the gradual weakening forint exchange rate in recent years as a factor that reduced the interest of exporters in the forward market, because due to this, in the event of further depreciation exporters were less likely to expect the forint to strengthen again. On the other hand, the weakening of the forint, if it affected expectations, could also have strengthened the short HUF position taking by importers.

Finally, the forward rate is typically higher than the spot rate due to the interest rate differential between the forint and the euro (or the dollar). This is justified by the covered interest rate parity.[7] But as forint money market rates have gradually declined over the past decade, much of this differential has melted away relative to euro and dollar money market rates. As a result, while in the past the forward exchange rate was significantly higher than the spot exchange rate, and thus, exporters received a larger HUF amount for their currency in the forward market than in the spot market, due to the smaller interest rate differential this attractiveness has decreased significantly in recent years.[8] Falling forint interest rates also significantly reduced the carry trade-type motivation of long HUF forward exposures based on the interest rate differential. In part, this may also contribute to the difference between older (*Bodnár 2006, 2009*) and newer (*Harasztosi – Kátay 2020*) literature results related to the importance of the interest rate differential.

[6] Our banking interviews also confirm the transactions of exporters motivated by their expectations of exchange rate mean reversion. As a rule of thumb, according to one of the banks, firms active in the forward market hedge between one-third and two-thirds of their export revenues with forward transactions. The ratio typically reaches its upper limit when the exchange rate depreciates. Corporates, however, do not usually fully hedge exports partly because of prudential reasons (they do not risk over-hedging), and in many cases because the bank limits on forward positions are set below that level. Also, the transaction costs of forwards also favours under-hedging.

[7] If the forward exchange rate was not higher by the interest rate differential than the spot rate, an arbitrage-free profit could be made by holding the higher interest currency funded by the low interest currency and the FX risk hedged by a forward.

[8] Based on the theory of uncovered interest parity, a higher interest rate differential carries a higher risk of exchange rate depreciation. However, the empirical validity of UIP is controversial and this constitutes one of the great puzzles of finance, the forward premium puzzle (*Fama 1984*). This puzzle motivates the (FX) carry trade strategy, which constitutes investing in high-interest currency assets financed by low-interest currency funds.

3.3. Mutual funds

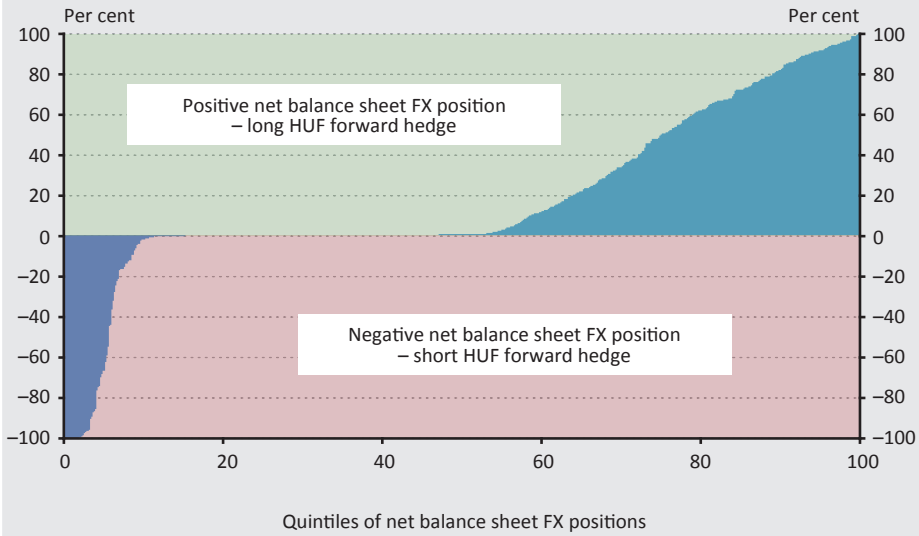
Based on our bank interviews, the primary motivation of mutual funds to participate in the FX forward market is to partially hedge the currency risk of their portfolio. Partial hedging is in line with international experience. Based on the references reviewed by *Melvin – Prins* (*2015*), investors in the financial sector with an international equity portfolio hedge half of the exchange rate risk of their portfolios, and in some cases an even larger share. According to *Borio et al.* (*2017*), the observed hedge ratio was 20–60 per cent for international equity investors and 50–100 per cent for international bond portfolios.

Partial hedging of the exchange rate risk of balance sheet items (as opposed to full hedging) does not necessarily denote speculation, as it can also result from purely risk management purposes. The correlation between exchange rate risk and other risks (e.g. interest rate risk) may yield a lower optimal hedge of the exchange rate exposure. The correlation between yields and exchange rates may also cause existing interest rate derivatives to already partially hedge the FX exposure (*Mun 2016*). In addition, higher exchange rate exposure may have diversification benefits in international equity investments (*Massa et al. 2016*). *Au – Somefun* (*2018*) furthermore points out that due to the correlation between stock prices and FX rates, international equity investments not hedged against FX rates (based on the MSCI World Index) had lower volatility than the hedged index between 2008 and 2015. At the same time, the net forward stocks of mutual funds typically increased during periods of forint depreciation, which suggests similar speculation-motivated trading (betting on exchange rate mean reversion) as in the case of non-financial corporates.

Hungarian mutual funds mostly finance their assets by HUF-denominated mutual fund shares, against which funds with international investment portfolios hold FX assets. The weight of FX assets (equities, FX bonds and deposits, and other mutual fund shares) is significant in mutual funds' investment portfolios. The weight of FX liabilities is typically smaller in the balance sheets, and thus funds are characterised by a positive net FX position (*Figure 10*). The distribution of mutual funds in this respect is characterised by a 50–40–10 per cent proportion of positive – neutral – negative FX positions.

The positive net FX exposure justifies a long HUF forward stock (for funds that want to hedge at least part of this exposure), and indeed mutual funds (similarly to non-financial firms) hold a significant long HUF forward portfolio at the sector level.

Figure 10
On-balance-sheet FX position of domestic mutual funds in proportion to the total balance sheet



Note: The chart shows the distribution of open on-balance-sheet FX positions of domestic mutual funds in March 2020. The open FX position is the difference between FX assets and liabilities in proportion to the total balance sheet. The exchange rate risk of the positive net FX position (the volume of FX assets is higher than that of FX liabilities) can be hedged with forward long HUF transactions.

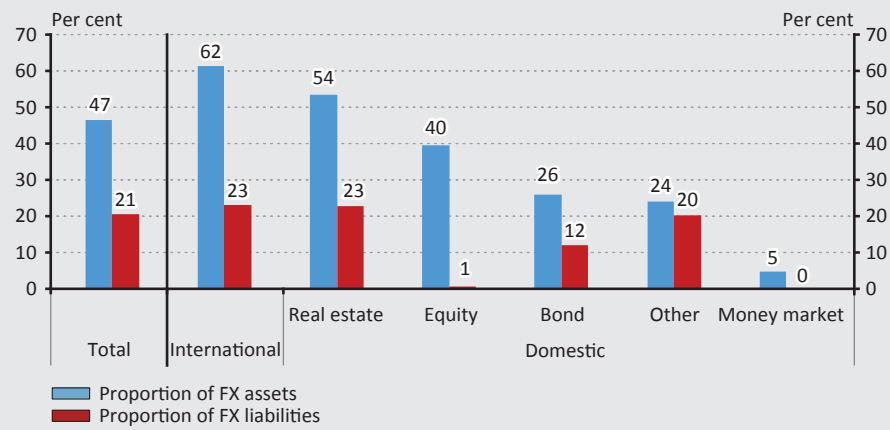
Source: MNB (F07)

Mutual funds are also active on the short HUF side, but to a much lesser extent. This may be justified by funds investing in the domestic securities or real estate market funded by FX liabilities. About one-fifth of the stock of mutual fund shares issued by domestic mutual funds is denominated in foreign currency, mostly in euros. Some of these funds finance HUF assets – and thus the FX liabilities of approximately one-tenth of all mutual funds exceed their stock of FX assets. Due to their negative net on-balance-sheet FX position, these mutual funds appear on the forward market as forint sellers, provided that they want to hedge at least part of the exchange rate exposure due to HUF assets and FX liabilities.

At the sector level, the positive on-balance-sheet open FX position of mutual funds accounts for about 26 per cent of the total balance sheet, however, depending on the investment strategy, there are significant differences between fund types (*Figure 11*). *Equity funds and international* (mainly equity, derivative, guaranteed and mixed) *funds have the largest on-balance-sheet FX positions.* These types of funds have significant stocks of foreign assets. In addition, the on-balance-sheet FX exposure of real estate funds is significant: their FX assets account for twice their FX liabilities. The relatively significant net on-balance-sheet FX position of real estate

funds is justified on the one hand by the fact that in the domestic office market and in the case of commercial real estate settlement in euros[9] is general (the main income sources, rents are typically calculated in euros). In addition, investment in foreign assets – either directly or indirectly in collective real estate investment securities or non-real estate financial assets – may also take place, due to the geographic diversification of real estate funds' asset portfolios. Other (derivative, mixed, venture capital) domestic funds and money market funds have the lowest FX exposure: the portfolio of these mutual funds has a lower weight of foreign investments and the FX composition of financing is in line with the composition of their assets.

Figure 11
On-balance-sheet ratio of FX assets and liabilities of mutual funds in 2020



Source: MNB (F07)

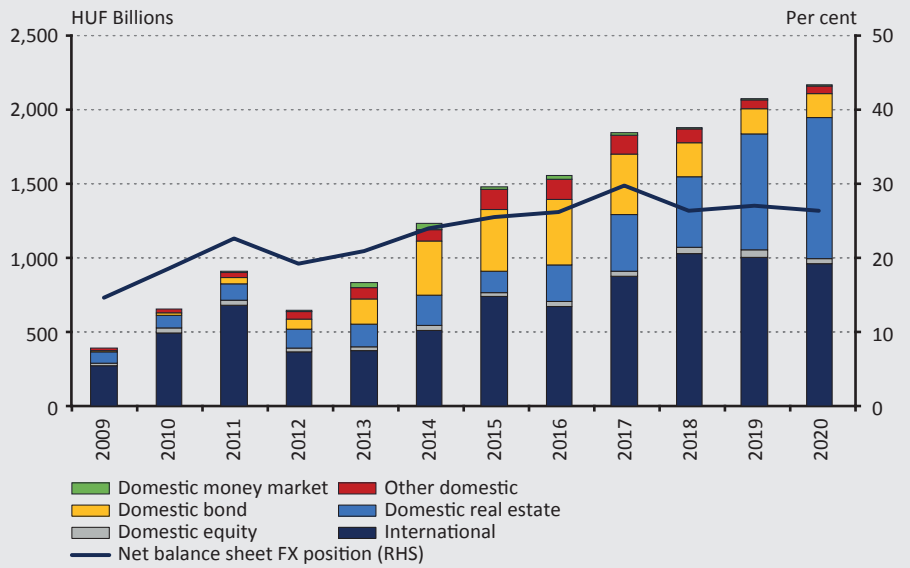
The FX exposure of mutual funds has increased in total by almost HUF 1,800 billion since 2009, which is mainly attributable to international funds and real estate funds, and to a lesser extent to domestic bond funds (*Figure 12*). However, the open positions of mutual funds as a proportion of the total balance sheet has changed less over the years, ranging from 20 to 30 per cent, i.e. the increase in the nominal amount of FX exposure has been roughly proportional to the expansion of mutual fund balance sheets.

First, in line with the favourable post-crisis capital market developments, mutual fund shares increased in increasingly popular international funds, and then in real estate funds in parallel with the expansion of the domestic real estate market

[9] For more details on the domestic commercial real estate market, see the Commercial Real Estate Market Report (*MNB 2020*).

from the second half of 2010s. At the same time, money market funds – that could provide lower yields in the low-yield environment – and from 2017 onwards bond funds lost market share. Owing to these developments, an increase in the market weight of fund types with higher FX exposures led to an increase in the net FX position of the entire mutual fund sector. There is a perceivable correlation of the open position as a proportion of the total balance sheet and the net FX position of international funds.

Figure 12
On-balance-sheet net FX position of mutual funds over time



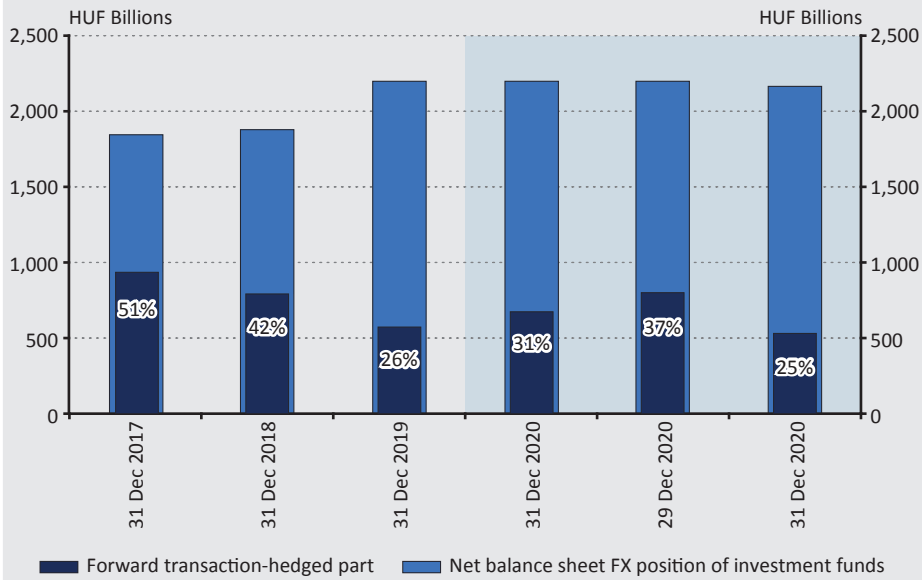
Source: MNB (F07)

Based on D01 data, the total gross forward stock and net long HUF positions of mutual funds have risen in a trend-like manner over the last decade consistently with the balance sheet and total net FX position of mutual funds,[10] although since 2017 – based on M05 data – the net long HUF position has decreased. The M05

[10] Based on the D01 data, there is no direct observation, but only an estimate regarding the forward stock of mutual funds. When explaining the sources of data, we mentioned that based on the M05 report available since 2017, we see the monthly development of forward stocks by sector, and thus for mutual funds as well. In the D01 report, which has been available for a longer time, for many transactions, banks also indicate the unique identifiers of the counterparties, from which the stocks could be aggregated into mutual fund subtypes. However, based on the consistency analysis of D01-M05 between 2017 and 2020, this counterparty identification is not complete: some banks report transactions with funds in the anonymous category, which is why D01-based aggregation accounts for about half of the M05-based stock for mutual fund forwards. We have two types of estimates: (1) an estimate for the forwards that these banks could have traded with mutual funds based on M05 data for 2017–2020, and (2) the exclusion of these banks from the sample. Both estimates support a trend-like increase.

data set shows that in 2017 about half of the open on-balance-sheet FX position of mutual funds was hedged by FX forwards (*Figure 13*). Hedging decreased from this level to the 25–30 per cent range in recent years, and mutual funds thus assumed a larger share of FX risk.

Figure 13
Forward market coverage of the on-balance-sheet open position of mutual funds



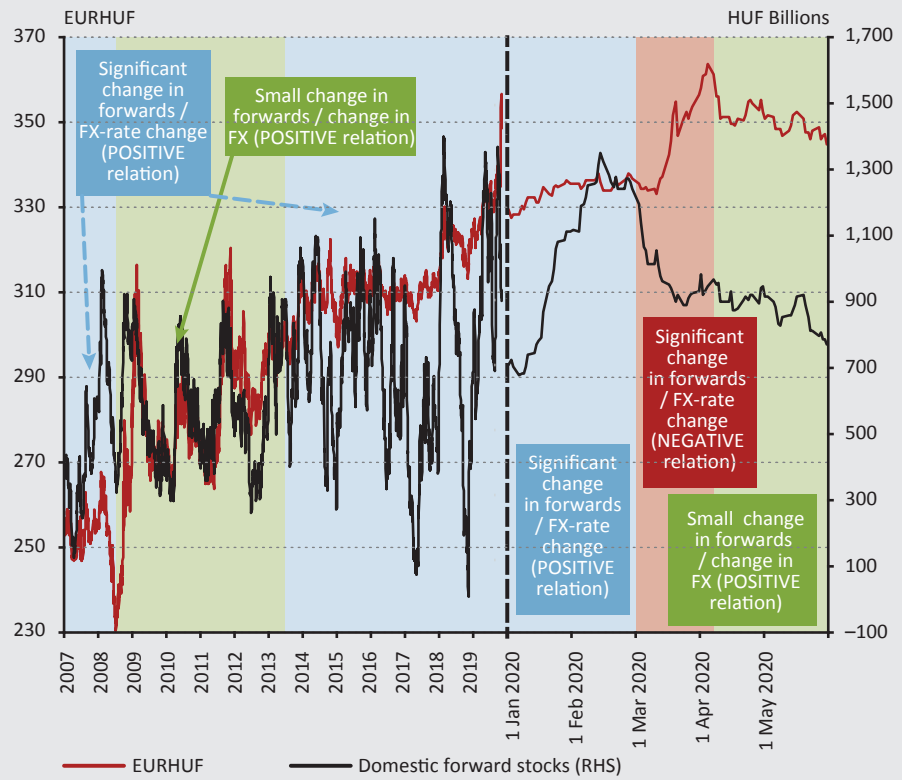
Source: MNB (F07, M05)

The declining net forward stock during this period is therefore not consistent with the increasing aggregate FX exposure, which would have called for an increase in the stock from a risk management perspective. Taking on a larger exchange rate position may have been a result of the relative decline in HUF interest rates, for example, in relation to rising USD yields, which constituted an increase in the cost of carry of long HUF forward transactions. It is conceivable that in the maturing business cycle, funds increasingly expected depreciation of emerging currencies and thus the forint as well. Additionally, a stronger negative correlation between the exchange rate and international equities in the face of rising market tensions could also have supported lower FX risk hedging.

4. Exchange rate sensitivity of FX forwards

In this section, we provide estimates of the time-varying exchange rate sensitivity of FX forwards.

Figure 14
Historical relationship between the EURHUF exchange rate and forwards of domestic actors (time series)



Source: MNB (D01), Bloomberg

Our bank interviews, the existing literature (*Csávás et al. 2006*) and MNB data all suggest that the stock of forwards of domestic bank clients responds significantly to changes in the exchange rate. When the forint weakens (EURHUF increases), residents increase their net long HUF forward position, which is consistent with expectations of forint stability, hence a speculative trading motive. If increasing

forwards also affected the exchange rate, then this negative feedback would act to stabilise the forint.

Nonetheless, the exchange rate sensitivity of the forward stock changed noticeably from time to time, and an exceptional temporarily negative correlation was also observed in March 2020, when the EURHUF exchange rate rose and the net long HUF forward stock of residents decreased (*Figure 14*).

To capture the time-varying sensitivity, we estimate a time-varying parameter model between forwards and the exchange rate. In the model, the EURHUF exchange rate is assumed to be exogenous.[11]

The measurement equation of the model is:

$$\Delta FWD_t = c_{0t} + c_{1t}\Delta FWD_{t-1} + \beta_{0t}\Delta \text{EURHUF}_t + \beta_{1t}\Delta \text{EURHUF}_{t-1} + \varepsilon_t,\ \varepsilon_t \sim N(0,R). \quad (1)$$

where ΔFWD_t is the change in the logarithm of the forward stock,[12] which is assumed to be determined by a factor independent of the exchange rate (c_{0t}), an autoregressive term (with parameter c_{1t}), the effect of the logarithm of contemporaneous and lagged EURHUF exchange rate changes (with parameters [β_{0t}, β_{1t}]), and a normally distributed error term ε_t.

Let B_t denote the vector of latent parameters [c_{0t}, c_{1t}, β_{0t}, β_{1t}] at a given time. We use a random walk assumption for the dynamics of this parameter vector:

$$B_t = B_{t-1} + \nu_t,\ \nu_t \sim N(0,Q) \quad (2)$$

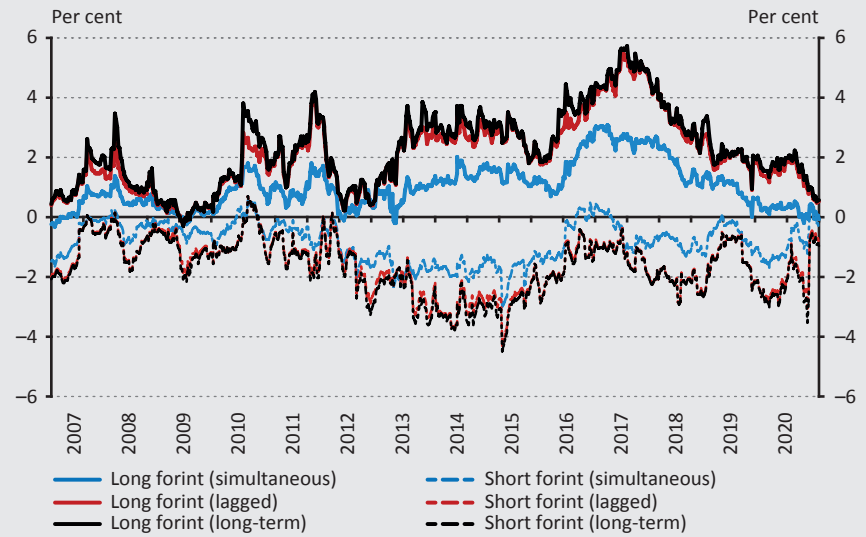
with innovations (ν_t) assumed to be normally distributed with diagonal covariance (Q).

The model is estimated using the EM (Expectation-Maximisation) algorithm (*Dempster et al. 1977*) using the D01 (daily frequency) data set between 2003 and 2020. The technical details of the estimation and the robustness test are reported in the *Appendix*.

[11] Using VAR models (not reported here), we also examined more general models that allow interactions between the exchange rate, the spot transactions of non-residents and forwards (in different sectoral breakdowns). Based on Granger-causality tests, the forward transactions (and spot transactions of non-residents with domestic banks) do not have a significant lagged effect on the exchange rate. The simultaneous (intraday) effect may still be significant, but the extent of this effect cannot be identified using our daily transaction data set. The relatively smaller domestic trading compared to the global forint market however suggests that such an impact is likely to be moderate. The more significant the reverse effect of forward stocks on the exchange rate, the more our model underestimates the sensitivity of forwards to changes in the exchange rate.

[12] In the *Appendix*, we present robustness test estimates with versions of the model where transactions (the volume of new forward contracts) are the dependent variable instead of changes in forward stocks. Similar results are obtained with those models.

Figure 15
Exchange rate sensitivity of domestic forward stocks



Note: Exchange rate sensitivity time series calculated on the basis of filtered model parameters (per cent change of the FX forward stock due to a 1 per cent increase in the EURHUF exchange rate – forint depreciation). Blue lines show the simultaneous effect (β_0), red lines the sum of the simultaneous and lagged effects ($\beta_0 + \beta_1$), black lines the unconditional (long-term) effect ($(\beta_0 + \beta_1)/(1 - |c_1|)$). The solid lines refer to the long HUF stocks (forward forint purchases of the bank client), the dashed lines refer to the sensitivity of the short HUF stocks (forward forint sales of bank clients).

Source: Based on MNB (D01) and Bloomberg data

Figure 15 shows the development of the exchange rate sensitivity of the domestic forward stock (simultaneous, two-period and long-term) based on the estimated (filtered) parameters. In the case of long HUF forwards, the parameters are positive, which confirms that the long HUF forward stock of domestic customers increases as the EURHUF exchange rate rises (forint weakens). By contrast, the volume of short HUF forwards increases when the forint strengthens, as evidenced by the negativity of short HUF forward parameters.

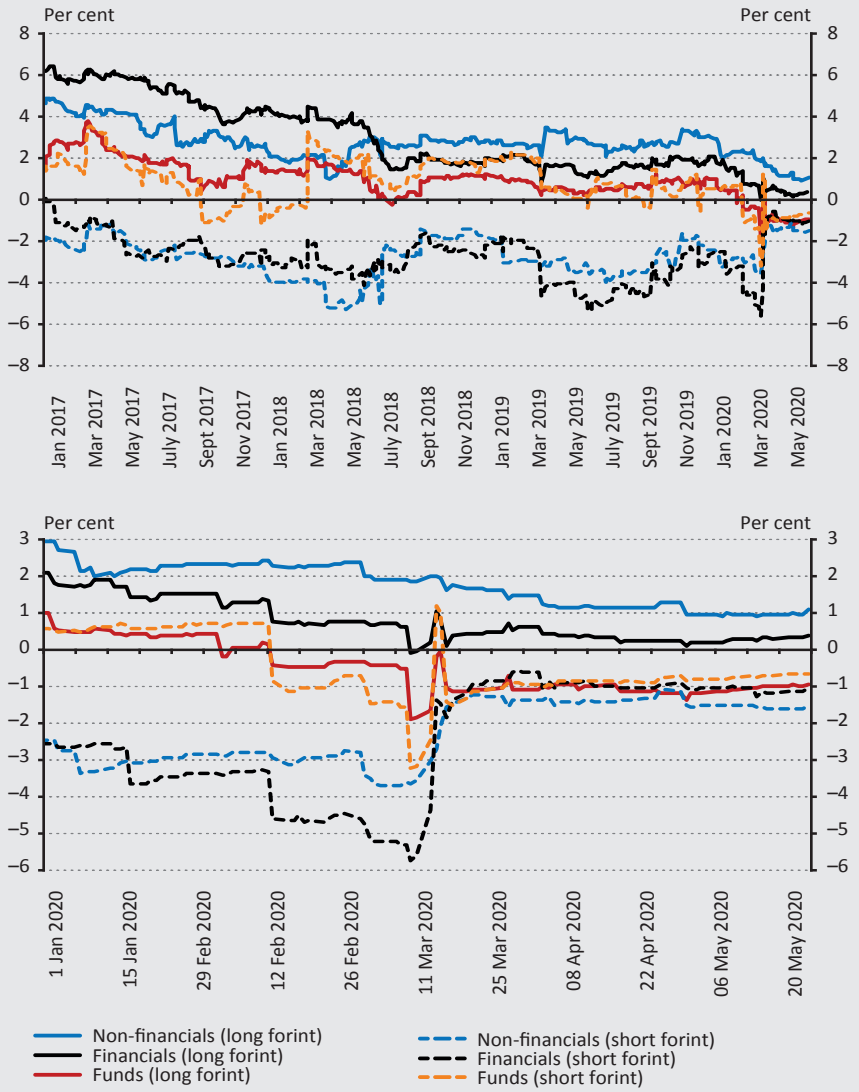
Our estimates show an important common feature of crisis periods. At the end of 2008, in 2011–2012 and this year during the coronavirus epidemic, the exchange rate sensitivity of forwards clearly decreased, meaning that in these periods much larger exchange rate movements were needed to trigger the same forward transactions than in normal periods. Although there is no systematic decrease in forward trading volumes during these periods, the contract volume linked to a unit of exchange rate movement decreases.

Reduced exchange rate sensitivity during these periods can be interpreted in several ways. One possibility is that bank clients become more cautious (for example, due to increased volatility / expected volatility or higher liquidity requirements for potentially loss-making derivative transactions). In this case, although expectations of the mean reversion of the exchange rate persist, clients trade only on larger exchange rate movements. It is also conceivable that in periods of already high volatility and tight liquidity, bank clients – although they are willing to open speculative forward positions – do not have the capacity in terms of liquidity and capital to do so. A further interpretation is that clients' exchange rate expectations shift, or at least the customer base becomes more heterogeneous in this respect, and domestic actors become less certain about exchange rate mean reversion.

Yet another, theoretical, possibility is that the effect of domestic forwards on the exchange rate weakens during these periods. Due to the simultaneity problem of the model, if forward positions directly impact the exchange rate, this increases the estimated parameters (in absolute terms) compared to the true exchange rate effect.[13] Thus, in principle, a reduced exchange rate sensitivity parameter could be a result of a reduced effect of forwards on the exchange rate. However, the low liquidity seen in the market at these times (supported by anecdotal information) does not make this explanation plausible: in illiquid markets, the same forward contract volumes are likely to have a larger, not a smaller price effect.

[13] For example, in the case of long HUF forward transactions, a one-unit exchange rate increase raises forwards, but forwards may act to reduce the exchange rate (strengthen the forint) compared to the original shock. Thus, we observe higher sensitivity of forwards based on observed (smaller) exchange rate changes than the true sensitivity of forwards to the (larger) original shock.

Figure 16
Exchange rate sensitivity by sectors (Jan 2017 – May 2020 and Jan 2020 – May 2020)



Note: Changes in the exchange rate sensitivity of forward stocks (simultaneous+lagged percentage effect on forward stocks of a 1 per cent increase in the EURHUF exchange rate – forint depreciation) according to the sectoral breakdown available from the D01 data, based on filtered model parameters. Blue lines refer to the domestic non-financial sector (corporates / retail customers), black to the domestic financial sector and red/orange to mutual funds. Solid lines depict the exchange rate sensitivity of long HUF forwards, dashed lines that of short HUF forwards.

Source: Based on MNB (D01) and Bloomberg data

The D01 data provides estimates of the sectoral breakdown of forwards of bank domestic clients and we can use this to estimate exchange rate sensitivities of forward stocks for each sector (*Figure 16*).[14] Between 2017 and 2020, long HUF forwards of both financial and non-financial clients were characterised by decreasing exchange rate sensitivity. This may be partly explained by the factors mentioned in the bank interviews, i.e. that the narrowing domestic and foreign interest rate differentials and weakening of the forint during this period moderated mean reversion speculation.

It is notable that the exchange rate sensitivity of the forward portfolio of mutual funds differs substantially from a similar indicator for the total domestic financial sector. In the case of mutual funds, the sensitivity of the long HUF forward stock to the exchange rate is much lower (although also positive), but the really remarkable difference is seen in the case of the short HUF forwards, which – in contrast to other clients – increase when the forint weakens and not when it strengthens. This suggests that speculation on stability of the forint is weaker among mutual funds than among non-financial clients (and other financial actors). At the same time, the net forward stock still correlates positively with the EURHUF exchange rate, because the volume of long HUF forwards is significantly larger than that of short HUF forwards, so a similar percentage change denotes a larger nominal increase in long HUF forwards compared to short HUF forwards.

Based on the bottom panel of the *Figure 16*, the exchange rate sensitivity of long HUF forwards gradually fell in 2020, whereas more substantial movements were observable for the sensitivity of the short HUF forward stock to the exchange rate. Long HUF forward exchange rate sensitivity turned negative in the case of mutual funds as early as February, while for other sectors only the positivity of the coefficient decreased. In mid-March (at the time of the forint depreciation between 13 and 18 March), the exchange rate sensitivity of short HUF forward stocks rose sharply for all domestic clients, but it only switched sign in the case of mutual funds. During this critical period, upon the increase of the EURHUF exchange rate, the short HUF forward stock held by mutual funds increased, while similar holdings of other financial and non-financial participants decreased, albeit only slightly.

[14] The majority of data-reporting banks report transactions with unique IDs for financial clients in the D01 report, from which we can estimate the forward stock of financial sector participants and, within that, the forward stock of mutual funds. Based on the M05 report available between 2017 and 2020, we can refine the D01 estimate (eliminate from the sample data providers for which the D01-M05 sectoral stocks differ).

5. Turbulence in the FX market in March 2020

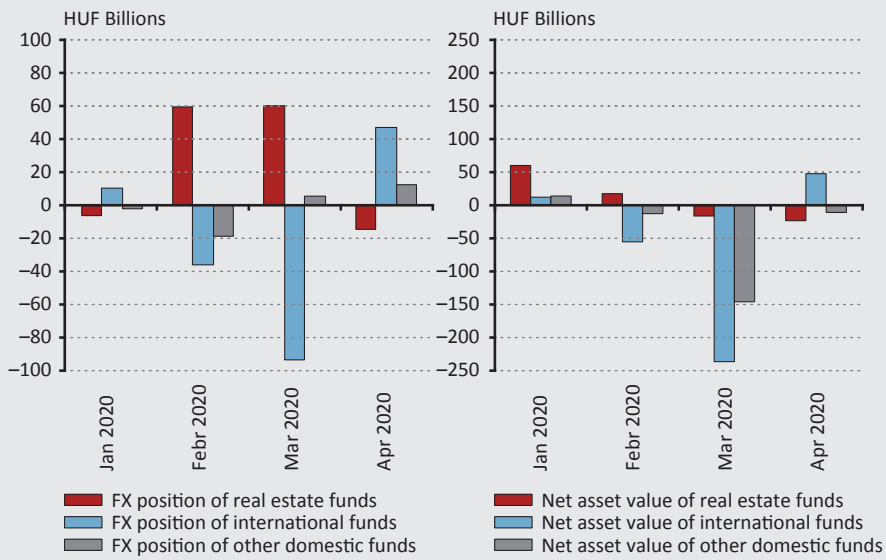
In March 2020, the net long HUF portfolio of the three most important domestic FX forward market clients (non-financial corporates, mutual funds and other financial corporates) declined in conjunction with a significant increase in the exchange rate, thus reversing the traditional correlation (*Figure 8*).

5.1. Mutual funds were behind the decrease in the net long HUF forward position

Mutual funds (and the entire domestic financial sector) increased their net long HUF forward exposure in January–February of this year at the time of a slight weakening of the forint. Then, in March mutual funds recorded the largest decline in net long HUF positions. The reduction of net long HUF forward exposure by other domestic financial actors (insurance companies, pension funds, other intermediaries) also contributed to the drop in total domestic net long HUF forward positions, but to a smaller extent owing to their smaller forward market share. Non-financial corporates, on the other hand, did not significantly change their net forward position.

On the financing side, the reduction of mutual funds' net long HUF position was justified by the significant withdrawal of investments from this sector as a result of the market turbulence related to COVID-19 in March. Thus, mutual funds which faced decreasing financing had to reduce investment portfolios leading to smaller open FX positions (*Figure 17*). International funds suffered the largest decline in shares, and within this group primarily funds with higher capital market exposure – derivative (speculative position-taking), equity and mixed (both with bond and equity exposures) mutual funds – were affected. There was no material decline in the financing of real estate funds, where the value of investments was not directly and immediately affected by the crisis, the wealth held in these mutual funds remained relatively stable. Although shares also decreased in the case of other domestic mutual fund types, this had a smaller impact on the FX forward market due to their low FX exposure.

Figure 17
Monthly changes in the on-balance-sheet FX positions of mutual funds



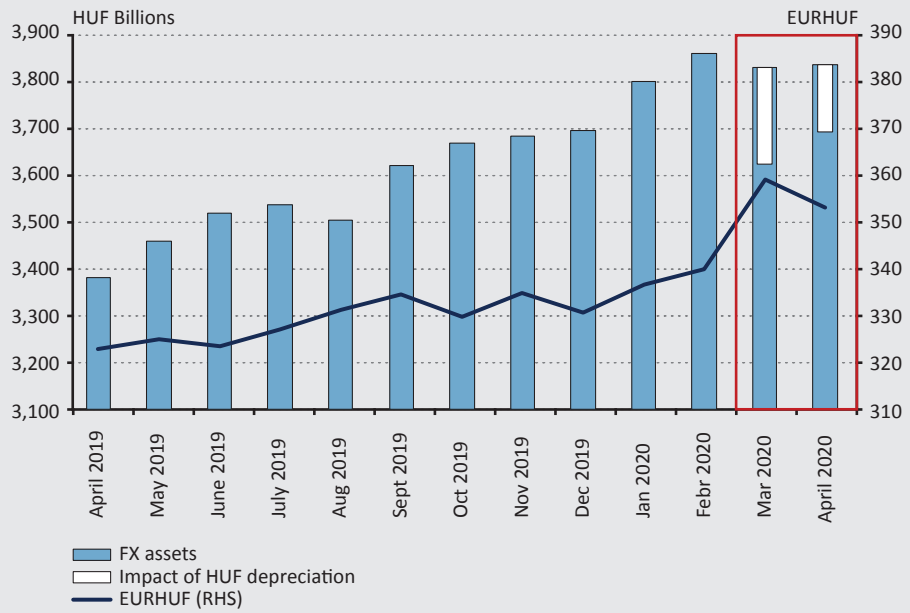
Source: MNB (F07)

On the assets side, the exchange rate risk hedging need of mutual funds (in addition to the assets portfolio liquidated due to the aforementioned withdrawal of funds) was reduced by the fact that the *market value of FX assets held on the balance sheet declined significantly, mainly due to the global drop in stock market prices.* All of this primarily affected international funds (and, within this group, had a stronger influence on derivative and equity mutual funds), which typically held higher-risk assets. On the other hand, the change in the forint value of FX assets was offset by *the significant depreciation of the forint against major currencies in March.* This caused an increase in the forint value of FX assets (and of the smaller FX liabilities).

At the aggregate level, these two effects – the decline in international asset market values and the depreciation of the forint – broadly offset one another in terms of the forint value of mutual funds' FX asset portfolio (*Figure 18*). This may seem strange, given the significantly larger (around 40 per cent) decline in stock market prices compared to the weakening of the forint (below 10 per cent). This can be explained by the fact that only a part of mutual funds (e.g. equity funds, derivative funds) take higher risks, and mutual funds with significant stock market exposure also invest only a certain part of their assets in risky assets. On the other hand, most mutual funds have significant FX assets in their balance sheet. Thus, although

the depreciation of the forint exchange rate was much smaller compared to the fall in stock prices, this latter effect may have impacted mutual funds (and their asset portfolio) more broadly than the change in the market price of risky assets.

Figure 18
Development of mutual funds' FX assets



Source: MNB (F07)

In addition, the FX forward positioning of mutual funds may also have been affected by the fact that existing stocks of *long HUF forwards became loss-making due to the rise in the exchange rate.* For financial actors, current European regulations require a daily marking-to-market and margining of positions and banks therefore *requested additional collateral for loss-making forward contracts (margin calls)*. The situation was further aggravated by the increase in market volatility, which led to a narrowing of margin limits, necessitating the provision of additional collateral to roll over positions. *For participants short of liquidity, margin calls also favoured the closing of forward (long HUF) positions*: by closing the long positions (with new short HUF forward transactions), the resulting liquidity need could be reduced.

5.2. Exporters abstain from the forward market despite significant exchange rate weakening

In the case of non-financial firms, the decline in the net forward position already started in February 2020 and was not significant in March. The small decline seems unexpected compared to the historical positive correlation with the exchange rate and the sharp increase in the EURHUF (based on which long HUF forwards would have been expected to sharply increase). Thus, exporters did not provide support for the forint exchange rate in February and March.

Anecdotal reports from banks highlighted different motivations for exporters than for mutual funds in the course of actions. One of the reasons for the smaller long HUF positions relative to the depreciation of the forint, mentioned almost by consensus, was that the participants, who wanted to hedge the exchange rate risk of their export revenues, had already entered the forward market at exchange rate levels of 330–340. Thus, in order to avoid over-hedging, they could take no more long HUF positions when the forint weakened further.

The other reasons mentioned in some bank interviews were related to the longer-term trends mentioned earlier and less to the developments in March. Such explanations attributed exporters' abstention from the forward market to the general weakening of the domestic currency in recent years and to historically lower interest rate differentials, which may have reduced traditional, speculatively motivated trading that bet on forint stability.

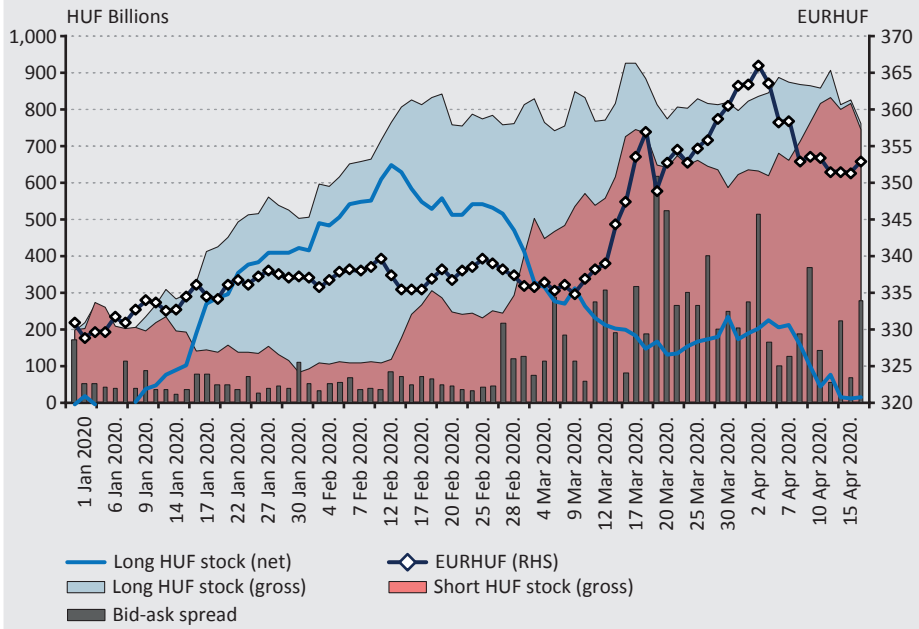
In principle, "stopping out" from forward transactions could also have caused the stagnation of net long HUF positions of non-financial firms, but this was also not confirmed by our bank interviews. As mentioned, for most banks, forced closings of forward positions were rare in the non-financial corporate sector and were not typical in March either.

Also, few bank respondents considered an expected decline in export revenues in the March to be a relevant factor. In this regard, the prudent under-hedging of natural exchange rate exposure was mentioned by several banks, although there were some who expected a reduction in forward exposures due to declining revenues in the coming months.

5.3. Change in the net forward position was mainly related to the rise in the short HUF stock

The gross long HUF forward stock stagnated after a rise in February, which thus supports the information about the absence of exporters. At the same time, it is important to emphasise that the opening of new long HUF forward positions still continued, but only to the extent to offset maturing (previously high) long HUF forwards.

Figure 19
Forward stocks, EURHUF exchange rate and bid-ask spread



Note: Domestic forward long HUF and short HUF positions cumulated from the beginning of the year (for scaling 1 Jan 2020 = HUF 200 billion). The scale of EURHUF bid-ask spreads adjusted to the chart (their real scale range between 0.1 and 7 forints).

Source: MNB (D01), Bloomberg

On the short HUF side, however, the trading volume exceeded maturities as early as mid-February, and thus we could observe active position openings here. This may have partly been due to precautions related to the expected economic impact of the COVID-19 epidemic, i.e. through these transactions, market participants (mutual funds) could reduce their long HUF exposure in advance if they expected the forint to weaken. Based on the model presented in the previous section, this was less directly related to the daily forint exchange rate changes, and short HUF stocks started to build up partly before the forint weakened more intensively. At the end of February, faltering confidence was already palpable in the US stock market as the VIX index jumped, along with a clear decline in liquidity in the forint spot FX market (*Figure 19*). Short HUF forward transactions in early March may have been motivated by the depreciation of the FX asset portfolio suffered by international funds. Later, in mid-March, the liquidity needs due to the redemption of mutual fund shares and margin calls may have caused further increases in short HUF forward transactions.

In early April, market movements moderated and the liquidity in and volatility of the FX market, and within that the FX forward market, began to normalise. Residents' net long HUF forward position decreased further, although at this time the forint strengthened, and thus the traditional positive correlation prevailed. However, based on our model estimates, speculative transactions related to HUF mean reversion remained subdued. The sensitivity of forwards to changes in the EURHUF rate fell to a fraction of the previous values in mid-March and has remained low since then.

6. Summary

Our study reviews the most important characteristics of the Hungarian FX forward market, with special regard to the structure of the market and the motivations of the participating market actors. The forint market represents a small part of the global FX market, but its trends and distribution by transaction types are similar and are also characteristic of the domestic segment of the forint market. Forward transactions account for about 10–20 per cent of the forint FX market.

Many of the conclusions of *Csávás et al.* (*2006*), who previously comprehensively analysed the domestic forward market, remain valid. In contrast to the spot and currency swap markets, foreign players barely play a role. Due also to regulatory requirements, the Hungarian banking system acts as an intermediary and does not take an open FX position. Non-financial firms (active in international trade) trading in the FX forward market typically take long HUF positions, which (at the aggregate level) corresponds to the natural exposure arising from the domestic net exporter position. The motivation arising from the expectations for the stability of the forint is still a distinct characteristic of non-financial corporate forward transactions. According to bank interviews, a carry trade-type motivation based on interest rate differentials is still present in the market, but its importance has lessened in recent years due to the narrowing of interest rate differentials.

At the same time, our analysis highlights that the most important players in the market are no longer non-financial firms active in international trade, but (similarly to the global scene, e.g. *Borio et al. 2017*; *Patel – Xia 2019; Schrimpf – Sushko 2019*) actors in the financial sector. Over the past five to ten years, mutual funds have emerged as the most dominant customer segment within the financial sector in Hungary. The exposures of mutual funds are in many ways similar to those of non-financial corporates: they also maintain long HUF positions, by which they partially hedge (one-quarter or one-half of) their FX exposures arising from HUF-financed

FX assets. Here, too, the motivational element for the stability of the forint can be identified, but to a lesser extent compared to non-financial corporates.

In the case of both sectors – based on our quantitative model – it can be stated that in crisis periods there is a decline in forward trading with a speculative aim to exploit the stability of the forint, and the exchange rate sensitivity of forward stocks diminishes. This also occurred during March of this year during the period of global financial market turbulence caused by the coronavirus. In March 2020, the long HUF FX forward exposures of domestic participants stagnated despite the significant weakening of the forint together with regional currencies: new contracts only covered the maturing stock, and thus, domestic participants did not provide support to the forint exchange rate. At the same time, the stock of short HUF forwards grew rapidly, mostly among mutual funds, initially due to precautionary motives and losses suffered on international FX assets, and later due to liquidity shocks (redemptions of mutual fund shares, margin calls).

Several avenues of further research may help to understand FX market processes more thoroughly. Thanks to the sectoral breakdown of forward stocks, we were able to differentiate the forward market activity of the various players, but the motivations of participants could be much more accurately understood with further disaggregation to individual participants. Our study only focuses on FX forward market exposures. For analysing the FX market as a whole, a joint analysis of other on-balance-sheet and off-balance-sheet FX exposures would be necessary.

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Appendix

In the Appendix, information is provided on the background of estimation of the model presented in *Section 4* and the robustness of these estimates.

Model specification and data

The model is estimated with two types of dependent variables, forward transactions (new forward contracts) and the change in the outstanding forward stock, separately for the gross long HUF and gross short HUF forward legs. In the main text the estimates for the latter, changes in the forward stock, are provided. Theoretically, the modelling of the exchange rate effect on both types of dependent variables can be justified, although both contain simplifying assumptions. The difference in assumptions is in how we view the behaviour of market participants in relation to maturing forwards. In the model with forward transactions as the dependent, implicitly, market participants are assumed not to deal with the maturing portfolio. By contrast, in the case of the dependent of changes in the outstanding forward stock, automatic renewal of the maturing stock is the default assumption. In both cases, the logarithmic form seems justified: in the case of forward transactions, the skewness of the distribution is eliminated by taking logs and brought into line with the symmetry in exchange rate changes (the explained variance is also significantly higher as a result than in the case of a linear form). In the case of forward stocks, the advantage of taking the logarithm is that the variance of percentage changes is more homogeneous over time than the variance of linear changes, because the magnitude of (absolute) changes in the portfolio increases in parallel with the increase in the outstanding stock. In the case of forward transactions, due to days without new transactions, the daily transaction volumes are adjusted by adding HUF 1 billion before taking logs (the use of other adjustment factors has no significant qualitative effect on the results). In the Appendix we provide estimates for both linear forms of the forward transaction and the logarithmic form with the aforementioned adjustment.

Regarding the data, we mentioned that the sectoral breakdown in the D01 report is made uncertain by the fact that some of the data-reporting banks in the sample report part of financial clients among the anonymous client group (which are dedicated to retail and corporate clients in the case of other banks). In estimating the model, we considered the most prudent procedure to omit this data from the sample: if, as can be assumed, the customers of these omitted banks behave similarly to the customers of the banks kept in the sample, then such narrowing of the sample has no effect on time-variation in latent parameters interesting for our analysis (due to the percentage form of stock changes also the magnitude of the estimated parameters would remain the same).

Our model specification assumes the changes in the exchange rate to be exogenous, i.e. not affected by changes in the forward stock. Violation of this condition can lead to a problem of simultaneity. The assumption is partly supported by the fact that the volume of domestic trading is significantly smaller compared to the global

forint market, and therefore any effect is likely to be moderate. However, the possibility of such a reverse effect cannot be ruled out, nor identified at present in the absence of appropriate instruments.[15]

Model estimation

The unknown parameters of the state-space model described in the main text are the variance parameters (R, Q) and the moments of the B_t parameter vector, $E[B_t]$ and $Var[B_t]$. The model is estimated by the EM algorithm (*Dempster et al. 1977*). For the algorithm, starting values were set based on preliminary estimates for the 2003–2005 sample for the total domestic customer base and for non-financial and financial clients, while the 2014–2015 sample was used for mutual funds (transactions before this time were sporadic especially for short HUF forwards in the case of this segment). We used the variance of residuals of fixed-parameter OLS estimates to initialise the variance of the measurement equation (R_0) and changes in OLS parameters estimated based on 200-day rolling windows for the variance of state parameter innovations (Q_0). The initial values ($E[B_0]$) of B_t were also adjusted to these fixed-parameter OLS estimates, but this initial value is of little significance because we set the uncertainty related to the initial value by orders of magnitude greater than the variance Q according to the following formula ($Var[B_0] = R_0X'X^{-1}$). This ensures that initial values have a discernible effect on the filtered parameter time series only for a short time (practically 1–2 months). Therefore, the results reported in the main text from 2007 and in the case of mutual funds from 2017 are not affected by the initial value, B_0. Compared to the initial values R_0, Q_0 we use the EM algorithm to find more suitable parameter values on the estimation sample.

In the iterative estimation method of the EM algorithm, in each iteration step, the M-step obtains new (maximum likelihood) parameter estimates for the *R, Q* variance elements based on the filtered moments of B_t parameters ($E[B_0]$, $Var[B_0]$) of the previous step. In the E-step, new filtered time series of the B_t parameters are generated with the Kalman filter based on the new *R, Q* estimates, and the likelihood is evaluated. The iteration is continued until the increase in the likelihood exceeds 10^{-6}. In our case, 2 to 3 steps are usually enough for convergence.

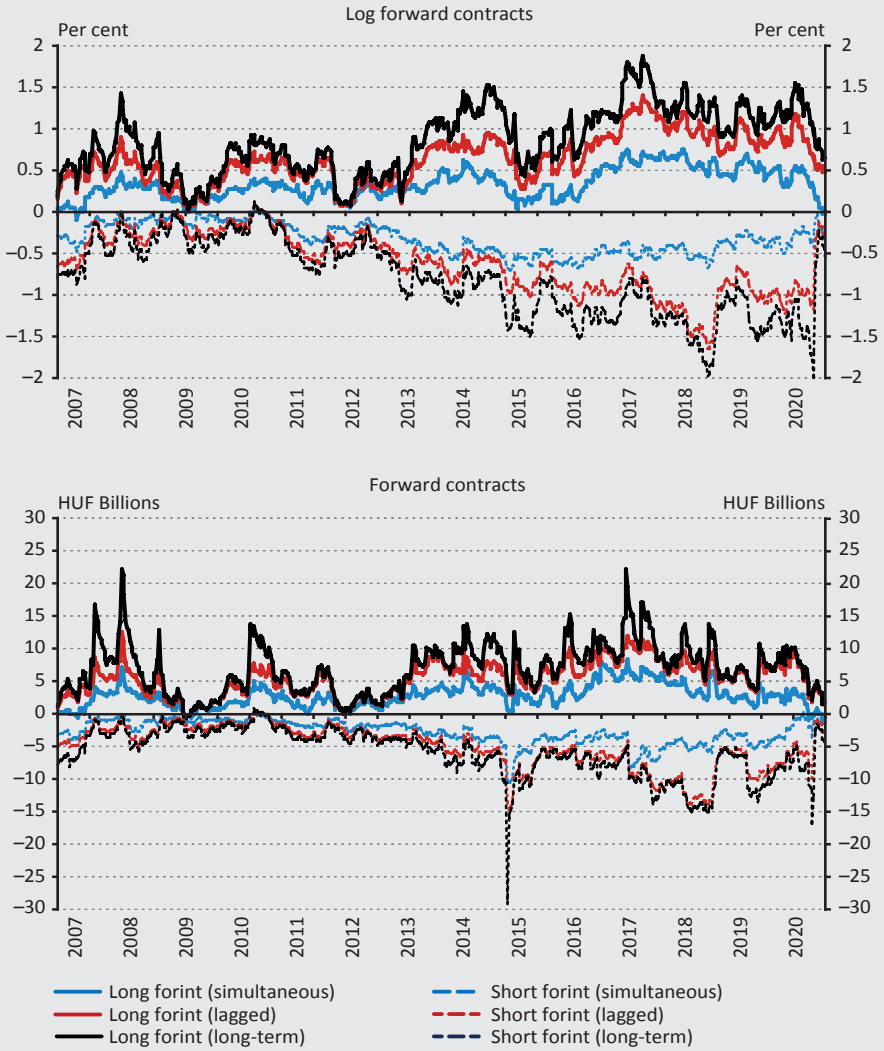
Robustness analysis

We present two robustness analysis estimates, one concerning the data used and the other concerning the estimation method.

The main text is based on the model where forward stock changes are the dependent variable. *Figures 20* and *21* show that models where forward transactions (new forward contracts) are the dependent lead to qualitatively similar results.

[15] In the future, intraday transaction data will become available, which may clarify (Granger-type) causality and may also provide an identification tool based on hedging adjustments used in the *Melvin – Prins* (*2016*) study. In addition, the strength of the different channels of the exchange rate – forwards relationship can be explored further by a more granular – customer-level – analysis of D01 data.

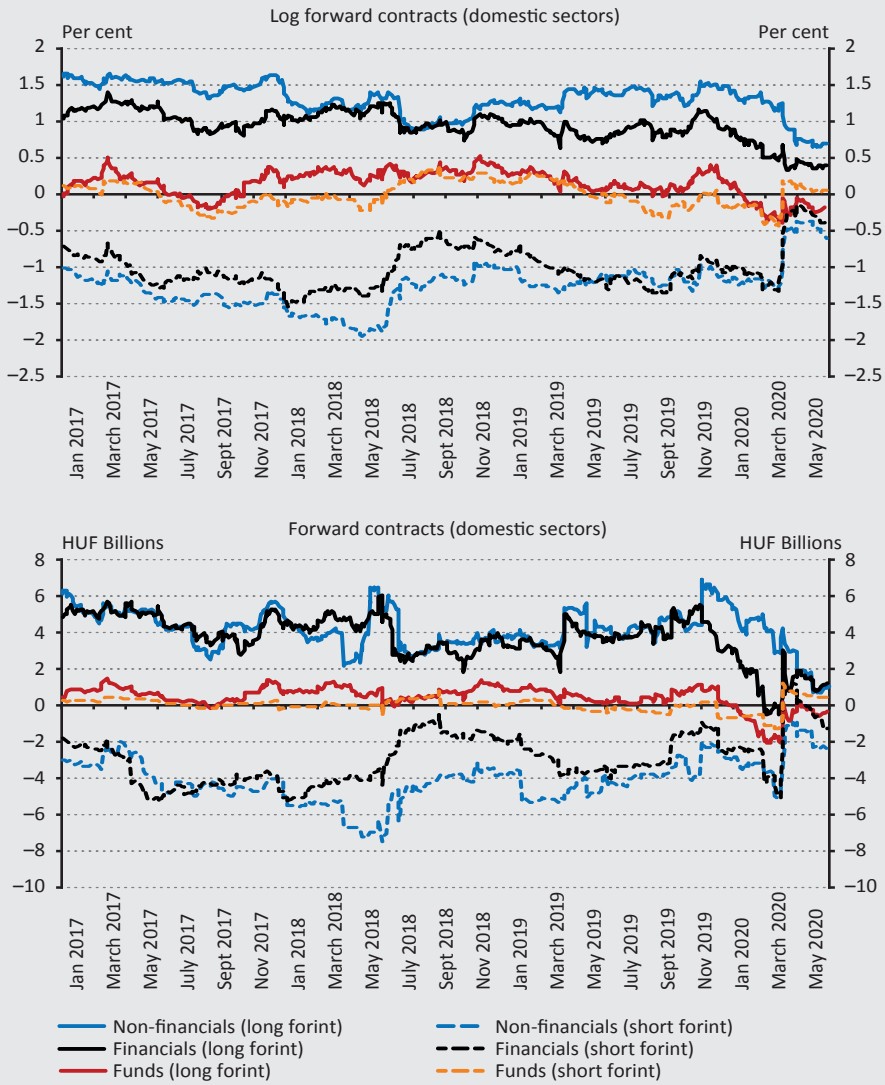
Figure 20
Exchange rate sensitivity of domestic forward stocks (forward contracts)



Note: Exchange rate sensitivity time series calculated on the basis of filtered model parameters (top panel: effect of a 1 per cent change in the EURHUF exchange rate on the logarithm of forward transactions, bottom panel: effect of 1 forint change in the exchange rate on forward transactions in HUF billion).

Source: Calculated using MNB (D01) and Bloomberg data

Figure 21
Exchange rate sensitivity broken down by sectors (forward contracts)



Note: Exchange rate sensitivity time series calculated on the basis of filtered model parameters (top panel: percentage effect of a 1 per cent change in exchange rate on the logarithm of forward transactions, bottom panel: effect of forint exchange rate increase on forward transactions, in HUF billion).

Source: Calculated using MNB (D01) and Bloomberg data

Figure 22
Exchange rate sensitivity of domestic forward stocks (alternative methods)

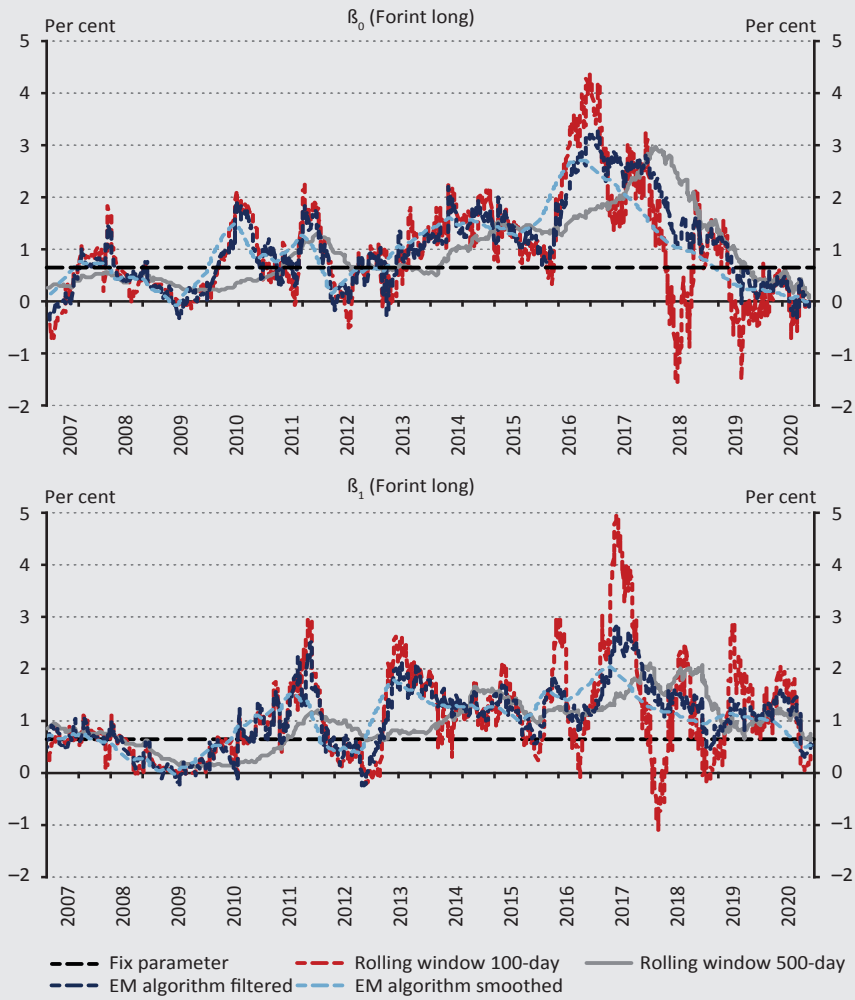
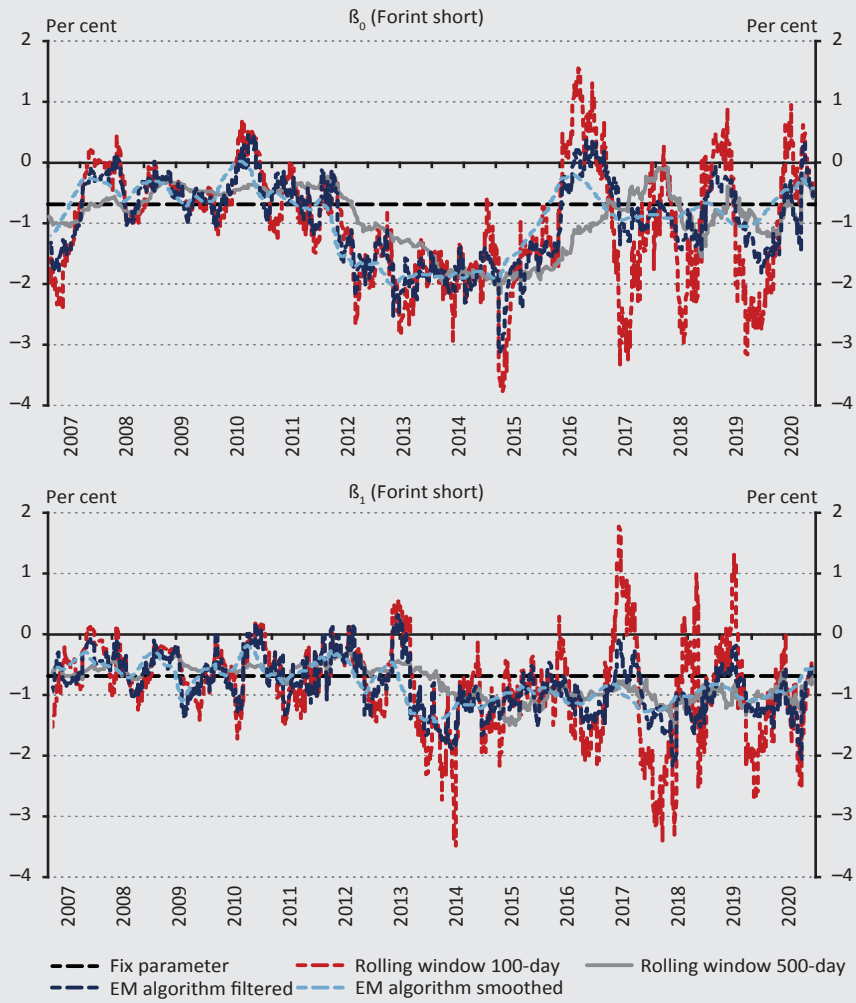


Figure 22
Exchange rate sensitivity of domestic forward stocks (alternative methods)



Note: Fix and rolling window parameters estimated by OLS, filtered and smoothed exchange rate sensitivity parameters obtained by the EM algorithm (simultaneous and lagged effects on the forward stock).

Source: Calculated using MNB (D01) and Bloomberg data

As an alternative to the EM algorithm, we examined how much the B_t parameter time series estimated by OLS regression on 100- and 500-day-long rolling windows differed from the filtered parameters we used. Based on *Figure 22*, the rolling window method also reveals similar trends. The key difference is that the Kalman filter used in the EM algorithm optimally updates the state vector (the expected value of B_t), if the model assumptions are met. However, the advantage of the rolling window method may be that it does not assume a fixed variance and does not contain a constraint for the parameter dynamics. In the current application, the estimates of EM algorithm are more suitable for capturing the current values of the parameters, the rolling window method (due to its stronger retrospective nature) lags the estimates of the EM algorithm.

Modelling Corporate Probability of Default – A Possible Supervisory Benchmark Model*

Márk Szenes – Zsófia Dabi

In recent years, supervisory bodies around the world have lost some of their confidence in the estimations of credit risk parameters at banks applying the internal ratings-based methodology. Supervisory experience shows that differences in risk metrics and ultimately in regulatory capital requirement levels stem primarily from inconsistencies in the modelling techniques applied and the various methodological approaches, rather than from any actual differences between the inherent risks of bank portfolios. To avoid this unwanted effect, in its supervisory review of banks' internal capital adequacy assessment process, the Central Bank of Hungary (Magyar Nemzeti Bank, MNB) aims at specifying the necessary capital requirements by developing and applying harmonised benchmark models. This study shows how it is possible to estimate a probability of default (*PD*) *for corporate portfolios, which is based on large banks' corporate default rate data series and available corporate financial data, uses a harmonised methodology that factors in differences between the credit quality ratings of various customers, and is suitable for the supervisor's calculation of the capital requirement for any given bank. Nonetheless, there may also be other factors in addition to individual financial data* (*e.g. qualitative expert elements, sector information*) *that may affect credit quality; identifying these may be one of the objectives of benchmark model development.*

Journal of Economic Literature (JEL) codes: C51, G21, G32

Key words: credit risk, probability of default, rating systems, supervisory benchmark model, PD

1. Internal models and supervision

In developing the Basel II framework, one of the primary goals pursued by the supervisory authorities was to strengthen the risk sensitivity of the regulations governing banks' capital requirement calculations (*BCBS 2006*); in addition to certain minimum requirements, the framework permitted institutions to develop their own

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

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internal models to more precisely pinpoint their own risks, in the hope that this would improve the standards of risk management as well. Institutions which are permitted by their supervisory authorities to use the internal rating-based (IRB) method may calculate their credit risk capital requirement using their own rating systems.

The Basel II system was already criticised by many during its development, but the competent authorities voiced increasingly strong criticism as experience with the actual use of the framework accumulated. As Basel III laid down the liquidity requirements which had hitherto been absent from the regulation, tightened the requirements pertaining to institutions' own funds and introduced the macro-prudential and capital conservation buffers (*BCBS 2010*), the attention of supervisory authorities turned to internal models and specifically to uncertainties in credit risk parameter estimation.

While banks quite naturally called for the option of using as sophisticated methods as possible and freedom in the choice of methodology, supervisory authorities were making efforts to coordinate and strike a balance between the requirements of risk sensitivity, simplicity and comparability (*BCBS 2013*, *EBA 2013*). In recent years it has become clear that the existing regulatory framework allows banks too much leeway in their choice of methodology, as a result of which differences between risk levels based on internal models stem from the differences between the methodologies and approaches applied and the differences between time series available for different institutions, and not from the differences between the risk profiles of the institutions or their portfolios. It is no exaggeration to say that the competent authorities' confidence in the reliability of banks' internal models has been profoundly shaken.

Efforts to harmonise across methodologies and achieve comparability have been and are being made at all levels of supervision. With the finalisation of the Basel 3 package (*BCBS 2017*) at the international level, the Basel Committee no longer allows modelling of the loss given default (LGD) and the exposure at default (EAD) for the segments with the highest model risk (those with low observed default), such as large corporate and bank exposures; in the case of equity exposures, it has retained only the methodology based on simple weighting and has set a lower limit ("output floor") of 72.5 per cent of the standard methodology's capital requirement level for the capital requirement quantified with the IRB methodology.

Indeed, at the European level, the primary task of the European Banking Authority (EBA) is to achieve harmonisation of the prudential rules across Europe, such as the application of the Basel capital rules as well as banks' and competent authorities' practices. In a report published in 2013 (*EBA 2013*), the EBA identified differences between supervisory requirements pertaining to rating systems used by institutions applying the IRB methodology and formulated supervisory guidelines and technical

standards for regulatory practices to coordinate such requirements [RTS on assessment methodology (*EBA 2016*), PD/LGD guidelines (*EBA 2017a*)]. Moreover, since 2015 the EBA has been collecting annual benchmark data from banking groups using the IRB approach (*EBA 2015*; *EBA 2017b*; *EBA 2017c*; *EBA 2019*; *EBA 2020*), and in its summary report prepared on the basis of the benchmark data it shows differences in IRB approach to capital requirement levels in a breakdown by portfolio segments. In the analysis, the EBA makes an attempt to pinpoint the possible causes of the differences, using a variety of techniques to differentiate the effects stemming from differences between portfolio compositions and risk profiles from effects that may result primarily from differences between the methodologies applied.

Within the framework of a comprehensive project started in 2016[1] (*ECB 2017*; *ECB 2019*), the European Central Bank, which is responsible for the supervision of the euro area's banking groups, prepares an assessment and a revision of the IRB models of the banking groups under its supervision, in order to minimise differences between modelling methodologies.

In the context of the internal capital adequacy assessment process (ICAAP), the amount of economically necessary capital is determined in Pillar 2 supplementing the minimum regulatory capital requirement of Pillar 1, in order to cover risks stemming from institutions' business activities by estimating possible future losses. Institutions quantify their Pillar 2 capital requirement in accordance with their own internal techniques by calculating the capital requirement for all relevant risk types (including those not handled under Pillar 1). Each year, in the context of the SREP,[2] the competent authority reviews the adequacy of the capital requirement levels calculated by the supervised institutions under the ICAAP. The primary aim of the review process is to scrutinise institutions' risk processes in full detail and to identify all material risk exposures, and thus determine the capital level ensuring solvent operation (*MNB 2020*).

The MNB develops and uses a variety of benchmark models to determine the Pillar 2 capital requirement of the banks present in the Hungarian market (*MNB 2020*), in order to make it possible to measure domestic banks' risks in a risk-sensitive way and by rendering them comparable with one another. The purpose of developing supervisory benchmarks is to enable the MNB to measure banks' inherent risks regardless of banks' definitions, modelling approaches and the data quality of the available historical time series, and thereby to adjust capital requirement levels in the Basel Pillar 2 wherever necessary. Finally, supervisory benchmarks provide the only possibility for determining the risk-sensitive capital requirement

[1] TRIM: Targeted Review of Internal Models
[2] Supervisory Review and Evaluation Process

for institutions operating without advanced and reliable internal models, most of which are spillover institutions.

Lessons drawn from losses resulting from retail loans failing in huge numbers in connection with economic downturns showed how the inhomogeneous modelling techniques had been causing unwanted differences between risk levels, but it was the same large number of observations that enabled the development of the MNB's retail PD and mortgage LGD benchmark models.

2. Review of the relevant literature

From the supervisory perspective, the assessment of corporate portfolio risks is just as important as that of retail portfolio risks. In this study, corporate portfolio risks are approached from the aspect of the probability of default. Hungarian and international literature both feature a wide variety of scientific articles and papers dealing with the modelling of corporate default. The methodology of bankruptcy prediction has developed considerably in recent decades; while earlier on, analysts used to apply various discriminant analysis models (initially univariate, later multivariate), as the years went by logit (logistic regression) and probit regression analyses gained popularity. Logit and probit models are also widely used in the development of rating systems meeting the requirements of the Basel "through-the-cycle" approach. Mention should also be made of the most recent methodologies used in bankruptcy prediction, such as decision trees, neural network, machine learning, artificial intelligence and hybrid models which combine the advantages of various models, thereby improving model performance (*Kristóf – Virág 2019*).

Our overview of the relevant literature focuses on the Hungarian models and studies which are most pertinent in relation to this paper, without aiming to present an exhaustive review. In Hungary, the first corporate model which used time series input variables and met the requirements of the through-the-cycle (TTC) approach was published by *Imre* (*2008*), who modelled the occurrence of 90-day-past-due defaults using actual Hungarian corporate data observed between 2002 and 2006, with the help of the decision tree, logistic regression and neural network methodologies. The logit model developed by Imre uses 11 variables including – similarly to the model discussed herein – indicators relating to capital structure, debt servicing, liquidity, profitability, as well as working capital and asset turnover.

Madar (*2014*) also applied logistic regression in developing his corporate rating model, which – in line with the Basel requirements – is also suitable for estimating the long-term probability of default (PD) and for capital requirement calculation. Data from domestic SMEs that prepared balance sheets during the period between 2007 and 2012 were used in the modelling process (not including false businesses formed out of necessity or other technical types of businesses). After a review of

the strength of more than 40 financial indicators and ratios, the Weight of Evidence (WoE) transformed versions of 6 indicators came to be finally used as variables. Indicators describing capital structure were the strongest variables in the observed sample. Liquidity and profitability indicators also showed significant discriminatory power and were thus also incorporated in the model. In the study, the author describes how the rating system developed for the given population provides a stable PD value that is crisis resistant in terms of its discriminatory power and stable over the long-term and also presents proof of the fact that the more accurate discriminatory power a given rating system has, the more closely it will follow the varying default rate values, as a consequence of which the PD increases during a crisis and thus has a pro-cyclical, crisis-aggravating effect.

Banai et al. (*2016*) connected and used data from the Central Credit Information System (KHR) and businesses' financial reports for 2007–2014 to model the probability of default of micro, small and medium-sized enterprises. The banks' default is the model's dependent variable, i.e. in the analysis the authors examined 30-day-past-due items that had been so for at least 60 days (90+ days past due). In addition to company-specific variables and category variables, the model also includes macro-variables capturing unexplained heterogeneity over time, along with a trend for adjusting default events. In addition to modelling separated by size categories, the authors specified separate models for certain high priority sectors of the national economy with the aim of analysing relationships produced for functioning companies. Their results show that most variables behave in a similar way in these models as well, but the focuses are shifted by the effects of industry or sector characteristics. The estimated PDs show that agricultural companies have the lowest credit risks and construction has the highest credit risks among the sectors reviewed, in line with the results presented in *Section 6* of this study.

Bauer and Endrész (*2016*) estimate probability of bankruptcy for Hungarian companies using a probit model, combining micro and macro variables. Macro information needs to be integrated into the model, in order to capture the aggregated dynamics and the risk level. The estimate was based on the complete 1996–2012 time series of all domestic businesses applying double-entry bookkeeping (approx. 1.5 million observations). The model's target variable is bankruptcy from a legal aspect, identified on the basis of information available in the Opten database. Similarly to the studies discussed so far and the model presented in this article, the model of Bauer and Endrész also includes profitability, liquidity and debt servicing indicators and it takes account of heterogeneity in terms of company size. It is, however, different for instance on account of using foreign ownership and exporting activity as dummies, along with the inclusion of macro variables (GDP growth, credit growth) in the model. The need for the latter is explained by the authors' claim that macro variables can capture shock effects that are not reflected by company level variables, along with spillover effects.

A similar approach was used by *Inzelt et al.* (*2016*), who also estimated bankruptcy from a legal perspective, using the same set of data (Opten and NTCA databases). One major difference is, however, that while Bauer and Endrész aimed to develop a model with strong predictive power, suitable for forecasting future negative events, Inzelt et al. wished to present a simple, stable and easy-to-use corporate monitoring framework for comparing internal models used by credit institutions. This paper aims to improve on the model presented in the study published by Inzelt et al., in a way that it provides a reliable input PD parameter for determining the IRB-based capital requirement of corporate loan portfolios. To this end, in Section 3 we present a detailed discussion of the similarities and the differences between the two models.

3. The corporate PD model framework

Inzelt et al. (*2016*) presented a possible approach for the corporate portfolio, a kind of PD model for monitoring and measuring inherent corporate credit risks. To continue with its development, we changed their models in a number of aspects, as we wish to use our model to estimate banks' long-term probabilities of default regarding their corporate portfolio. For this very reason, we focused on modelling not the entire domestic non-financial corporate sector, but only corporate customers with bank loans/limits, excluding project financing companies and micro-enterprises in the retail segment.[3] In the case of projects, the project asset's[4] cash-flow generating capability and the sponsor's strength need to be explored, while in the case of financial enterprises, modelling would require the identification of the risks associated with the underlying portfolio in particular, but that is not possible from financial data.

One of the most important elements of the PD model is the definition of default. Since bankruptcy, liquidation, etc. procedures do not cover – in terms of timing or definition – the default definition of banks, and since banks also develop their capital models on the basis of the Basel default definition, we also relied on the default databases provided for the MNB in the course of the supervisory review process, in the context of banks' data supply.

Focusing on the stability of the model and the estimated PDs, we paid attention to making sure that the risk segment (micro, small, medium-sized, large enterprise) of a given customer is fixed and that changes in the performance of the company, particularly its decline before default results in no change in the segment to which it is assigned; therefore, we fixed the companies' segments on the basis of the historical maximums of their sales revenue, balance sheet total and headcount data. The quantity of data also made it possible to prepare a model for the large

[3] Projects – e.g. commercial real estate financing exposures – tend to have profoundly different risk profiles than financial enterprises, and these segments are modelled separately by banks as well, therefore our model does not cover these types of exposures.
[4] Typically real estate

corporate segment, which is the smallest segment in terms of the number of entities it contains, but at the same time is the most important one in terms of the magnitude of risks.

The model to be presented links the negative event (default) and the explanatory variables based on the balance sheet and the profit and loss statement via logistic regression; however, the range of the variables taken into account was expanded significantly in comparison to the range of variables used in the model of Inzelt et al. Another change is that while our model uses the same regression coefficients across all segments, the PDs associated with the score were calibrated separately for each segment, making it possible to estimate corporate PDs that adequately reflect the long-term default rate and that can be used for capital requirement calculations. The main differences and similarities between the two models are presented in detail in *Table 1.*

Table 1
Comparison of the two models

	Inzelt et al. (2016)	Adjusted model
Corporate data used	All non-financial enterprises registered in Hungary, using double-entry book-keeping	Only normal companies financed by domestic large banks (excluding project loans, retail micro enterprises, micro enterprises with product-based financing, and financial enterprises)
Negative event	Negative legal events (liquidation proceedings, bankruptcy proceedings, court deregistration proceedings, completed liquidation, compulsory winding-up)	Bank default events
Model development sample period	1999–2013	2006–2017
Segmentation	Based on current sales revenue	Fixed segmentation on the basis of historical maximums of their sales revenue, balance sheet total and headcount data
Modelled segments	Micro, small and medium-sized enterprises	Micro, small and medium-sized enterprises and large corporates
Negative event explanatory variants	In the case of micro enterprises: four indicators; in the case of small and medium-sized enterprises: two indicators, from the following: debt burden, long- and short-term liquidity position, productivity indicator	Six indicators in each segment: long- and short-term liquidity position, profitability indicator, leverage, debt coverage, size
Model	Logistic regression	
Calibration	Separate logistic regression by segment	One logistic regression for each segment, but separate PD calibration for each
Application	Supervisory monitoring: comparing risks, analysing changes	IRB-based capital requirement calculation, Pillar 2

Source: Inzelt et al. (2016) with our own supplements

4. Data used

The corporate PD model was based on corporate default databases collected by major domestic banks and banking groups with advanced risk measurement methodologies (consequently, with long, reliable time series). Not only banks using the IRB approach under Pillar 1, but also most large banks collect credit risk loss and default data (for the calculation of the Pillar 2 capital requirement (ICAAP)) which they use in their rating systems.

For the development of the corporate PD model, we performed a variety of data filtering and cleansing routines:

- In the first step, we only retained normal corporate customers and aimed at separating all segments with radically different risk profiles, particularly projects and financial enterprises, which necessitate a profoundly different modelling approach and for which even banks themselves develop separate rating systems. Micro portfolios with product-based financing under retail management were not integrated into the model, because we found that on the one hand they have significantly higher default rates than other similar-sized micro enterprises under corporate management, and on the other hand their risks may also be affected by product attributes which we do not wish to take into account in a general corporate model.

- An annual customer-level database was prepared, in which each company appears in the modelling database only once a year (provided it had a period of performing status during the given calendar year), regardless of whether it was financed by more than one bank.

- A company was regarded as having defaulted if it was in default with at least half of its financing banks. Default events – as the target variable of our corporate PD model – were registered in the year in which they occurred. In the case of customers with multiple banks, we checked whether this choice causes any significant distortion because in the case of customers financed by multiple banks each of the banks concerned tended to register default events; in general, differences appeared in the timing of the default. In the case of multiple default events when customers kept shifting between performing and non-performing status over the years, the default events were combined into a single default event and assigned to the date of the first default event.

- In the case of large corporates, manual data cleansing was performed for the defaulting entities, by also checking the appropriateness of assignment to the default category based on publicly accessible data.

Figure 1
Default rate time series calculated from the large bank default databases used

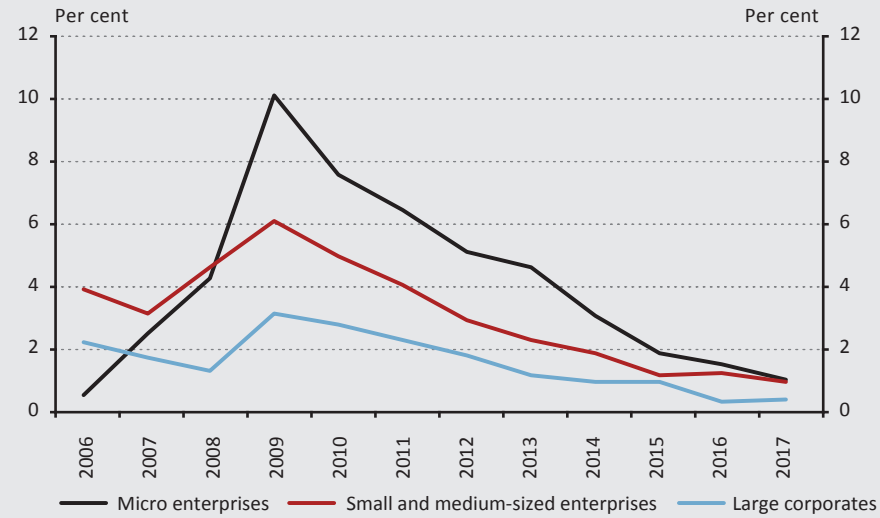


Figure 1 shows the calculated default rate time series for the different company size ranges as a result of the filtering and data cleansing processes.

As the default database is not complete for the year 2006, with full data not available for the micro segment, only the data from after 2007 were used for model building (*Table 2*). The final database includes 286,000 observations per year and per customer, including some 10,000 default events. The annual averages of the default rates were 4.33, 3.00 and 1.49 per cent for the micro, small/medium-sized and large corporate segments, indicating that model calibration was necessary for each segment.

Table 2
Composition of the default database used in modelling

Segment	Number of customers per year	Number of defaults	Average default rate
Micro enterprises	98,727	4,385	4.33%
Small and medium-sized enterprises	174,318	5,386	3.00%
Large corporates	13,400	211	1.49%
Total	286,445	9,982	3.38%

Source: Calculated on the basis of banks' default databases

The explanatory variables required for predicting the probability of negative events – default – over the long-term were generated from the balance sheet and profit and loss statement data of the company information database and the

required segmentation was also devised on the basis of headcount, sales revenue and balance sheet total figures taken from the same source. *Act XXXIV of 2004 on Small and Medium-sized Enterprises, and the Promotion of Their Development* (SME Act) was taken into account as a basis for the definition of the micro, small and medium-sized enterprises, as well as the large corporate segments, however the 'and' relationship was not required in the conditions regarding headcount. The HUF amounts we calculated as equivalent to the amounts in euros to be found in *SMA Act* are presented in *Table 3*.

Table 3
Definition of size-based segmentation

SME category	Headcount (no. of employees)		Annual net sales revenue (HUF million)		Balance sheet total (HUF million)
Micro enterprises	< 10		≤ 300		≤ 300
Small enterprises	< 50	or	≤ 2,000	or	≤ 2,000
Medium-sized enterprises	< 250		≤ 15,000		≤ 15,000
Large corporates	≥ 250		≥ 15,000		≥ 15,000

Source: 2004. évi XXXIV. törvény a kis- és középvállalkozásokról, fejlődésük támogatásáról (Act XXXIV of 2004 on Small and Medium-sized Enterprises, and the Promotion of Their Development)

Segmentation based on the current headcount, sales revenue and balance sheet total may result in significant migration between segments. Switches from segment to segment may be particularly problematic when it is a consequence of the declining economic performance (falling balance sheet total, profit, headcount) of the company facing problems before defaulting, because in this case the default would be shown in a size category smaller than that of the customer's original segment, resulting in underestimation of the larger segments' default rates. Therefore, in defining the modelling segments we used the maximum of the headcount, sales revenue and balance sheet total figures from 2000 on, so that where the given customer belonged to a larger size category according to any one of the indicators on the basis of which segmentation is determined, such higher category was regarded as the customer's final segment (i.e. the indicators are in an "or" relationship with one another). This method enabled the customers' segment to be fixed for the entire modelling time horizon.

5. Rating system – PD model

The purpose of the benchmark model is to assign to each company the particular PD value which best reflects the long-term average default rate of companies with similar risk profiles, across successive cycles. Moreover, a model is expected to

clearly separate exposures based on risk exposure and risk profile, distinguish good companies from poorly performing ones and enable the monitoring of changes in portfolio quality driven by non-systemic factors (i.e. changes independent of economic cycles). Estimating PD parameters as independently as possible from cycles (TTC-type PD parameters) is important for a variety of reasons. On the one hand, the IRB capital requirement calculation requires an unconditional PD value as an input parameter, and on the other hand both the European Central Bank's guideline for the evaluation of internal models (*ECB 2019*) and the European Banking Authority's guideline on PD and LGD estimation (*EBA 2017a*) require TTC-type calibration of the PD parameters, i.e. the estimate must reflect the long-term average default rate. Moreover, from a supervisory aspect it is necessary to assess risks independently of cycles and thus set up a stable capital requirement that is not sensitive to economic cycles (to avoid underestimation during an upswing or overestimation during a downturn).

Rating systems based on logistic regression have been widely adopted by banks in practice for distinguishing by risk profile; therefore just like Inzelt et al., the authors of this study also opt for this approach. By linking historical default events and the explanatory variables characterising the customer's risk profile by a function in the model, it is through regression that we determine the weight and coefficients of the explanatory variables as detailed below (with x_i as explanatory variables and β_i as weights/coefficients):

$$\text{Default probability} = \frac{1}{1 + e^{-(\beta_0 + \sum_{i=1}^{n} \beta_i \cdot x_i)}} \quad (1)$$

In selecting the explanatory variables, we primarily used the variables found in the study published by *Inzelt et al.* (*2016*), and we made our selection on the basis of objective financial indicators found in large banks' corporate models that can be generated from balance sheets and profit and loss statements. We aimed to select variables with high explanatory power and also ensure that we use simple, economically meaningful variables from each major group of variables. The indicators were selected from the following main indicator groups, taking into account their correlations as well: indebtedness/capital leverage, liquidity position, balance sheet structure, debt coverage, profitability and size.

It should be emphasised that banks' experts and analysts usually have much more information concerning companies' credit quality, as compared to the information that can be extracted solely from companies' financial data. Banks' corporate models usually have an expert module as well (in addition to the financial module), containing the above mentioned expert factors. The management's/owner's expertise and commitment, which may be reflected even through the involvement of private guarantees, the company's market position and the industry's outlooks may all contribute to the model's explanatory power. Selecting such factors is, however, clearly complicated by their heterogeneity across banks

and their subjectivity, but their prospective integration may be the target of future development of the model to be presented.

The initial list of large banks' variables consisted of about 50 different financial variables; this was reduced by correlational analysis to a total of 6 variables, including 1 of each of the above groups of variables. One of the key considerations in the selection of variables was the aim to dampen the model's Point-in-Time (PiT) nature as far as possible, and therefore in the case of profitability type indicators we avoided the use of profit (loss) before taxation, while a negative profit (loss) before taxation figure is one of the strongest indicators of default. For the most part, highly similar indicators were defined in the main indicator groups, e.g. in the case of the capital leverage-type indicators either the shareholders' equity or the balance sheet total was typically adjusted (e.g. for intangible assets). In these cases we chose the simpler options. The financial indicators used in the model were defined as follows:

$$\text{Long-term liquidity} = \frac{\text{If(long-term liabilities=0, –1, long-term liabilities)}}{\text{tangible assets + financial investments + intangible assets}}$$

$$\text{Short-term liquidity} = \frac{\text{cash and liquid assets + securities}}{\text{short-term liabilities}}$$

$$\text{Profitability} = \frac{\text{material + personnel + other expenditures}}{\text{sales revenue}}$$

$$\text{Leverage} = \frac{\text{shareholders' equity}}{\text{balance sheet total}}$$

$$\text{Debt coverage} = \frac{\text{operating profit + depreciation}}{\text{long-term + short-term liabilities}}$$

$$\text{Size} = \text{sales revenue}$$

The long-term liquidity position indicator had to be split because the balance sheets of a significant proportion of obligors included only short-term liabilities.

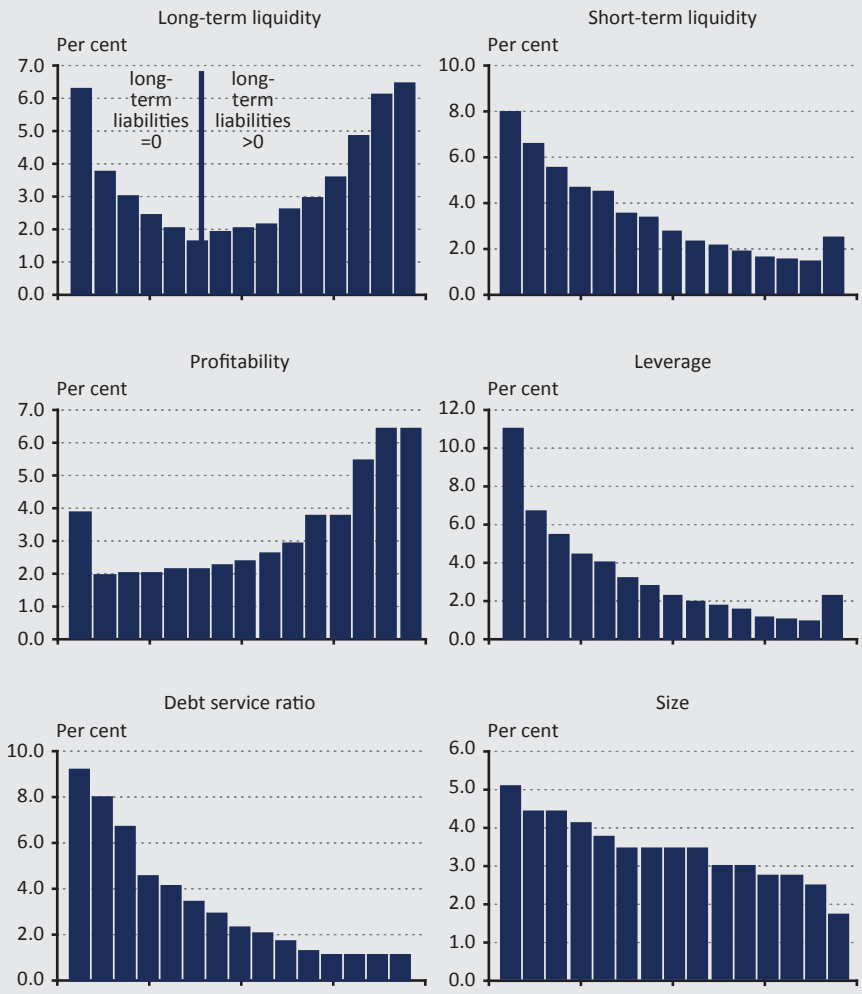
Size, however, was taken into account not only through the segments in the model but also as a variable, by fixing the historical maximum for each company over the period starting from 2000. The use of the maximum value enables avoidance of excessive cyclic patterns by ensuring that the customer's quality does not deteriorate more in the case of a decrease in its sales revenue than the deterioration caused by the current sales revenue decrease already reflected in the profitability ratio itself, so in this case again, the goal of achieving a TTC model was given priority over increasing the explanatory power.

The explanatory power of each indicator was analysed during the selection of variables. Explanatory power means the extent to which it is possible to separate good (non-defaulting) customers from bad (defaulting) customers on the basis of the given indicator. A continuous indicator separates customers effectively when the

observed default rate is monotonous for the indicator and there is a large difference between the default rates of the customers with the best and the customers with the worst financial indicators.

The model's discriminatory power was assessed in two different ways: customers were first assigned on the basis of the indicators to 15 categories, with the same number of customers assigned to each category. The default rate within each category was checked and where the relationship was not monotonous – this could be observed only in the case of some neighbouring categories – the categories

Figure 2
Financial indicators of the model divided into 15 categories and the average default rates calculated within each category



concerned were combined. The missing values were assigned to a separate "missing" category. The default rates calculated on the basis of the final categories of variables are presented in *Figure 2*, while the missing values were assigned to the first or last categories.

Even at first glance, *Figure 2* shows that debt coverage and leverage are the most powerful variables, with an 8–10 time difference between the default rates in the lowest and the highest variable categories. Size appears to have the weakest explanatory power where this difference is less than threefold. Size, however, will be of relevance particularly in the large corporate segment. The way this is taken into account is specifically discussed during the model's calibration.

We then also measured the Gini indices of the various variables, the metric most often used by banks for measuring explanatory power. Instead of raw variables, however, the model uses the WoE values, which are widely used for automatically dealing with non-linearities, extreme values and missing values and can be calculated for the categories of variables. The weight-of-evidence was calculated for each category as described below:

$$\mathrm{WoE}_i = \ln\left(\frac{\text{ratio of non-defaulting customers assigned to category i to all non-defaulting customers}}{\text{ratio of defaulting customers assigned to category i to all defaulting customers}}\right)$$

Since in our model we used the WoE values calculated for the above 15 categories, the Gini indices were also calculated on the basis of the same WoE variables. The explanatory power values in each segment, as characterised by the Gini index, calculated for the financial variables used in the model, are presented in *Table 4*.

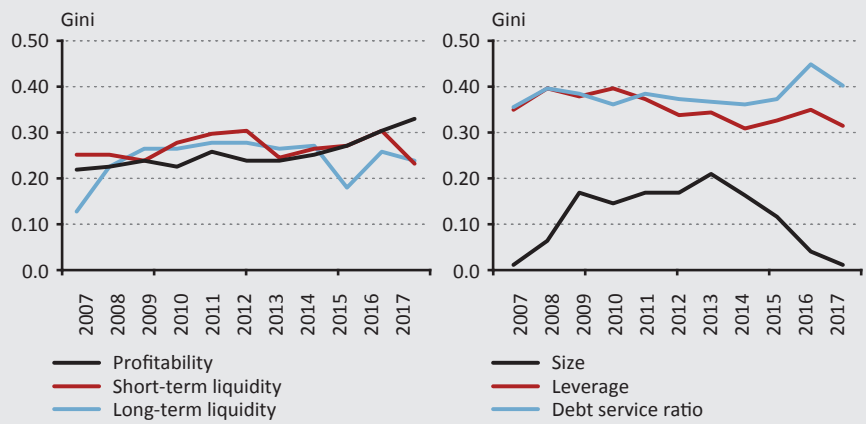
Table 4
Gini indices characterising the explanatory power of each financial indicator used in the model, by segment

Segment	Gini index					
	Long-term liquidity	Short-term liquidity	Profitability	Leverage	Debt coverage	Size
Micro enterprises	0.23	0.24	0.24	0.33	0.33	0.06
Small and medium-sized enterprises	0.24	0.38	0.29	0.45	0.46	0.08
Large corporates	0.17	0.31	0.38	0.31	0.55	0.13
Total corporate portfolio	0.26	0.30	0.26	0.40	0.40	0.14

One important question is how stable over time each variable can be regarded, i.e. whether they have reliable explanatory power in the long-term. This is of particular relevance to periods during which large numbers of defaults occurred. The "crisis resistance" of the model is shown by the Gini value of each variable during years

with high default rates, i.e. 2009–2013 according to the modelling database. Explanatory power is less relevant to years with low default rates, because the small numbers of defaults are caused by factors (we regard as idiosyncratic factors) that have only little negative impact on the model's long-term performance. Based on *Figure 3* therefore we can declare also that size – the variable with the smallest explanatory power – has the highest Gini values during the years between 2009 and 2013. The larger the size category, the smaller the number of companies it holds, and the greater the explanatory power of size is; and since the bulk of bank exposures is associated with medium-sized and large enterprises, the inclusion of this variable is all the more important if we are to build up a rating system that is well aligned to actual observations.

Figure 3
Changes over time in the explanatory power of each financial indicator



The indicators were primarily chosen with a view to minimising overlaps between the balance sheet and profit/loss data used to establish them. We also carried out correlational analyses to establish the extent to which each variable can be expected to add to the discriminatory power. If the ranking order set up on the basis of one variable is very similar to the ranking order established using another variable, the integration of the two variables cannot be expected to add much to the model's explanatory power in comparison to just using only one. This type of relationship is measured by rank correlation, the result of which is presented in *Table 5*. The largest overlap is found between the ranking set up on the basis of debt coverage and the one based on leverage and profitability. The 0.55 correlation between debt coverage and leverage can be regarded as adequate, considering the explanatory power of each. An even stronger (0.59) correlation was found between debt coverage and profitability; profitability has low explanatory power on the whole, and therefore

only a little extra value could be expected for the whole model. It should also be taken into account, however, that this indicator is one of the best variables in the large corporate segment, and therefore we decided to retain it.

Table 5
Spearman's rank correlation coefficient among financial indicators used in the model

	Long-term liquidity	Short-term liquidity	Profitability	Leverage	Debt coverage	Size
Long-term liquidity	1.00	–0.11	–0.01	–0.24	–0.10	0.16
Short-term liquidity	–0.11	1.00	–0.20	0.46	0.39	–0.14
Profitability	–0.01	–0.20	1.00	–0.25	–0.59	0.11
Leverage	–0.24	0.46	–0.25	1.00	0.55	0.00
Debt coverage	–0.10	0.39	–0.59	0.55	1.00	0.00
Size	0.16	–0.14	0.11	0.00	0.00	1.00

After selecting and examining the explanatory power and correlations for the variables, we carried out the model's logistic regression alignment. As we have shown, instead of the financial indicators themselves, their WoE values, allocated to 15 categories, were assigned as explanatory variables to the default indicators. The logistic regression was carried out using the SAS software; the Wald test results show that each variable is highly significant. In terms of the Gini coefficient, the model has an explanatory power of 0.507, a very good result for a model using purely financial indicators and covering the complete range of companies in terms of size. Our supervisory experience shows that Gini indices over 0.6 are produced only by models which also use some behavioural variables or other variables based on more recent financial indicators than those based on annual reports.

Although the incorporation of behavioural variables and current information in the model would have increased the explanatory power, this would also have made the model pro-cyclical which we wished to avoid since our model is to be used for capital calculations. In addition to capital calculation, however, some relevant risk management and risk monitoring considerations require banks to monitor current information. Early intervention is one of the most effective means for mitigating risks and minimising losses; and impairment also has to reflect the current prospects.

The coefficients and significance of the explanatory variables are presented in *Table 6*.

Table 6
Results of the logistic regression in the SAS software and Wald test of the coefficients

	Coefficient's value	Standard error	Estimate's significance (p-value)
Intercept	–3.3181	0.0112	<0.0001
Long-term liquidity	–0.5012	0.0247	<0.0001
Short-term liquidity	–0.6093	0.0208	<0.0001
Profitability	–0.1654	0.0276	<0.0001
Leverage	–0.3739	0.0179	<0.0001
Debt coverage	–0.5125	0.0216	<0.0001
Size	–0.5018	0.0411	<0.0001
Gini value	0.507		

The larger the company, the more important size is as a variable. However, when establishing the 15 size categories with the same number of companies in each rank, all of the companies with HUF 15 billion in sales revenue are added to the largest size category, because of the small number of large enterprises. In response, we supplemented the above model in the case of the large corporates with a continuous size variable, defined as the historical maximum of the sales revenue and the balance sheet total. Thereafter, we produced the natural logarithm for this value. The "score" $\left(\beta_0 + \sum_{i=1}^{n} \beta_i \cdot x_i\right)$ value as per the above model and the size variable as explanatory variable were used in the large corporate logistic regression which resulted in a Gini of 0.603 (see *Table 7*).

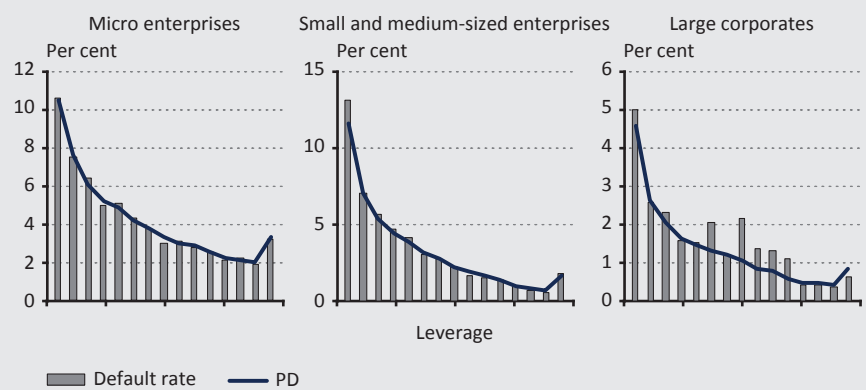
Table 7
Result in the large corporate segment of supplementing the model with size; the value and significance of each coefficient

Large corporate size calibration	Coefficient's value	Standard error	Estimate's significance (p value)
Intercept	5.2099	0.8157	< 0.0001
Score (from the corporate model)	1.1727	0.0886	< 0.0001
ln (max (sales revenue, balance sheet total))	–0.3144	0.0492	< 0.0001
Gini value	0.603		

As we have seen, the different explanatory variables for each corporate size segment explain the default event probability to varying extents, while each financial indicator can be regarded as adequate for each size range. Two different solutions can be used to tackle this: on the one hand, the segments could already have been

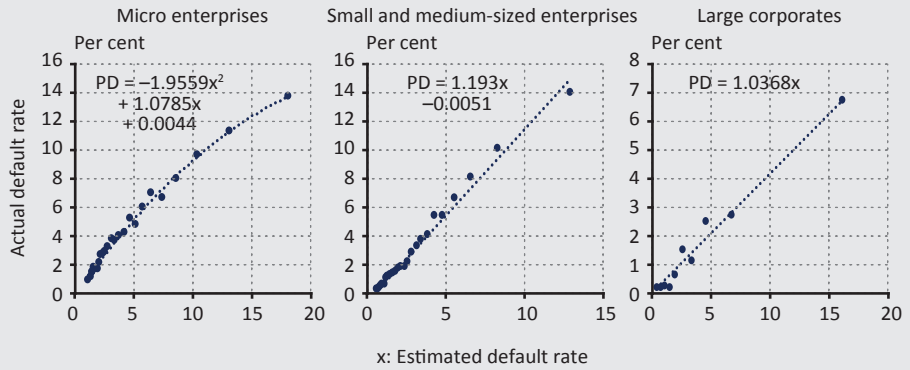
separated along with the logistic regression process, which would have resulted in different sets of coefficients for each segment, or, on the other hand, the single model can be calibrated separately for each segment. Having reviewed both options, we chose PD calibration by segment, because in this case explanatory power and alignment corresponding to those produced by separate logistic regression can be achieved, while the single logistic regression provides a simpler and more robust model. At this point, we only mention the fact that using the same set of variables and coefficients we built up an effectively aligned model during supervisory reviews in the retail micro segment with product-based financing, merely by recalibrating the model. *Figure 4* illustrates – using the leverage indicator as an example – that even by mere PD calibration we can achieve excellent alignment by segment and there is no need for separate logistic regression models. Another possible direction for continued model development is examining whether different financial indicators may be the best explanatory factors in the different size segments, in which case even specific models could be developed for each segment. There are also examples in banks' practices for separate modelling for large enterprises and medium-sized enterprises using different sets of variables.

Figure 4
Alignment of calibrated PD to the default rates by calibration segment, subject to leverage



PD is calibrated by plotting the actual default rate subject to the default rate generated by logistic regression, modelled in accordance with function (1). The PD calibration function was defined with the adequately chosen regression function between the modelled and the actual default rates; its result yielded the final PD parameter values that can be used for IRB capital requirement calculation. The alignment and the PD calibration functions are presented in the charts in *Figure 5*.

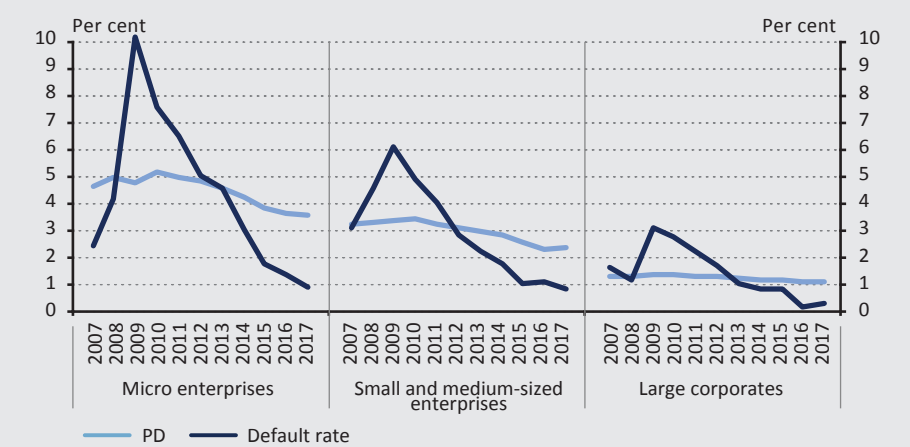
Figure 5
Alignment of PD calibration functions on each corporate segment



6. Results

From the PDs calculated with our corporate benchmark model, we can conclude that the model produces a stable result, closely aligned to historical default rates (*Figure 6*). The time series of the estimated PDs show no such cyclical pattern as does a Point-in-Time model which includes behaviour variables as well, and which cannot capture companies long-term credit quality by following fluctuations in the annual default rates. Significant improvement is evident, however, in the PD time series; this may stem not only from the improved composition of the financed portfolios and from idiosyncratic effects, but also from favourable – cyclical – effects of an economic upswing on financial indicators.

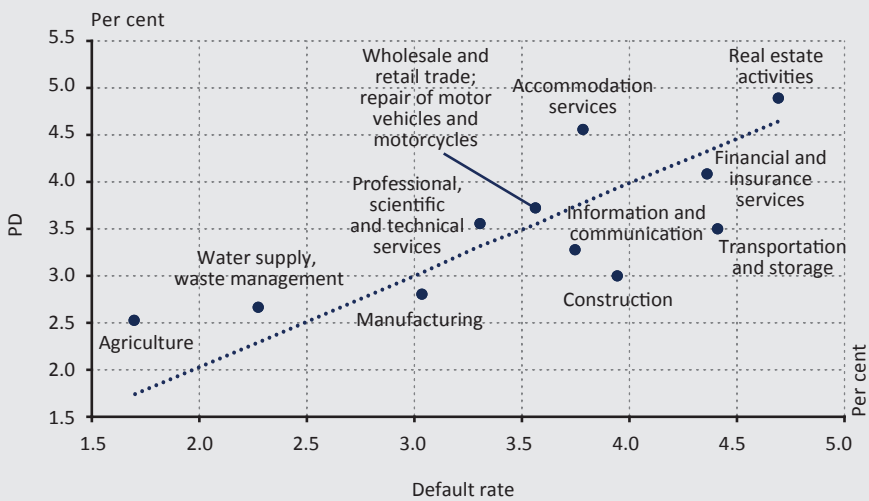
Figure 6
Historical default rates and PDs calculated with the benchmark model, by segment



Another important decision point in the development of the model was whether industry should be included in the set of explanatory variables. Our considerations were: 1) if the average default rates of the various industries are captured sufficiently closely by the model based on purely financial indicators during backtesting, and 2) if the model reflects the risk ranking order by industry, then we do not incorporate it in the PD model, because in this case we can say that industry specifics are already reflected by the selected financial indicators. *Figure 7* shows how effectively the results of the PD model reflect industry specifics. Agriculture carries the lowest risks even in the PD as per the model, while the highest PD is attached to the real estate activities which is the segment with the highest default rate. Although the PDs calculated for construction and for transportation and storage, are below the relevant actual default rates, the size of the difference and the number of such cases did not necessitate the integration of industry as a variable in this model. Based on just one cycle one cannot expect the long-term default rate to be reflected in the case of every single industry, and therefore we wished to avoid 'over-fitting' the model, that is, modelling relationships that may not actually exist.

It is also possible however, that different factors have different influences on credit quality in the various basic sectors – e.g. production, service provision, trade – but this would take additional, even deeper, analyses that would go beyond the limits of this article.

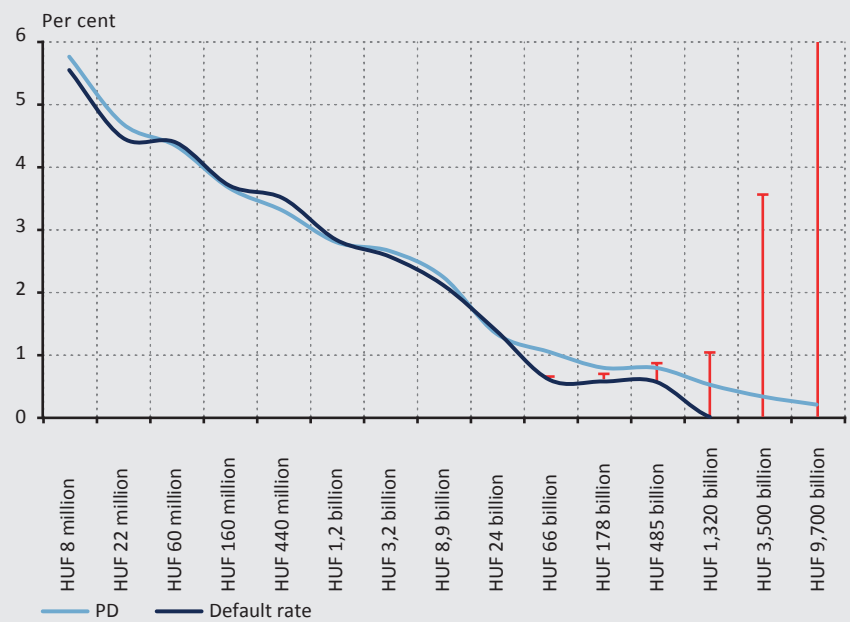
Figure 7
Estimated sectorial average PDs versus observed default rates



In our view, one of the key merits of our benchmark model is that it can be effectively applied to an extremely wide size range. We have managed to develop a robust model with remarkable explanatory power not only for the micro segment which comprises a large number of businesses and which can therefore be efficiently modelled, but also for the large corporate segment. The supervisory authority has a difficult time assessing a PD model with a small number of defaults, one that may even rely on data of foreign banking group members via the parent bank, but by combining domestic banking system data used in our model and with the PD model calibrated on it, it became possible to carry out quantitative assessments of large corporate PDs as well.

Figure 8 shows how accurate the alignment between the actual default rate and the modelled PD is across the entire size category. There are so few companies and defaults in the largest size category (> HUF 50 billion) that even a single default can cause a significant shift in the default ratios. For this very reason, the calculated PD values are considered to be adequately conservative in this category.

Figure 8
Alignment of the corporate benchmark PD to the actual average default rate across the entire size range



Note: Size was logarithmically shown, the band of error was plotted (in red) with a single additional default.

The results, backtested by banks and portfolio segments, show that the historical default rates of the various portfolio segments are in close correlation with the calibrated PDs in the case of individual banks as well, i.e. banks' specific risk management practices and qualitative elements do not systematically and materially deflect the credit quality level from the level that would be implied by financial data alone.

Capital requirement calculation is the single most important use of our corporate PD benchmark model. A supervisory benchmark PD model is an important tool for checking, and, where necessary, revising the PD estimates of institutions already using internal models; or for directly establishing the Pillar 2 capital requirement in the case of institutions that do not have their own internal models. Our benchmark model was also tested on large banks' analytical credit data collected during the supervisory review process in 2019 also by comparing benchmark PDs with banks' own PD estimates and we examined the differences between the IRB capital requirements calculated with banks' PDs and the IRB capital requirements calculated with the benchmark PDs.

Our results (*Table 8*) show that in 2019 banks' corporate PD estimates were closely aligned with the benchmark PDs presented in this article, and there were, on the whole, negligible differences between the IRB capital requirements calculated using them. In 80 per cent of the various banks' portfolios (in terms of size), the differences between the banks' PDs and the benchmark PDs were within 10 per cent, with the maximum difference falling in the 20–25 per cent band in both the negative and the positive domains.

Table 8
Comparison of large banks' own PDs and the benchmark PDs, as well as the IRB capital requirements (HUF billion and %)

Segment	Exposure (HUF billion)	Institution's PD	Benchmark PD	IRB: capital requirement calculated with institution's PD (HUF billion)	IRB: capital requirement calculated with benchmark PD (HUF billion)
Micro enterprises	209	3.89%	4.02%	14	15
Small and medium-sized enterprises	2,250	2.35%	2.72%	144	152
Large corporates	2,881	1.29%	1.10%	198	189
Total	5,339			356	357

7. Summary

In this study, we describe the process of building a corporate benchmark PD model – based on the model developed by *Inzelt et al.* (*2016*) – that can be reliably used for capital requirement calculations as part of the supervisory review process. The model has excellent explanatory power and is well aligned to the observed default rates in each size category and industry: we are convinced that in the large corporate segment it yields PDs more reliable than those estimated by banks' models. Our model enables the homogeneous, consistent measurement of all corporate portfolios at all banks. This benchmark model makes it possible for the MNB to calculate the capital requirement in a risk-sensitive manner even for institutions without advanced rating systems, or whose rating systems are not reliable. Accordingly, the authors of this article managed to successfully apply the benchmark PDs even in calculating small banks' capital requirements.

Use revealed certain shortcomings of the model which can only be resolved on a case-by-case basis. Regarding groups of companies, integration of the group/parent company PD into the final PD with an adequately conservative weight may be contemplated. The financial indicators of holding companies and companies established for the purpose of acquiring shareholdings do not always adequately reflect the given company's risks. In such cases, expert judgement may be exercised and may result in a revised PD. In the case of large companies with an international background, EBA benchmark PD values – available for MNB – may also be taken into account.

Based on lessons drawn from supervisory reviews and model validation procedures, we are aware of the main differences between the PD benchmark model presented herein and banks' PD models. Banks' corporate models always include qualitative ("soft") elements in addition to objective financial indicators, including management's experience, customer track record, companies' market positions, etc. Group/parent company influence may also be taken into account in banks' models, and deflection by experts ("overruling") may also play a substantial role. Without disputing the value added by such expert elements, we emphasise that our benchmark model provides an adequate risk level on average, which may be revised in individual cases. Supplementing the model with qualitative perspectives may significantly increase the model's explanatory power, and therefore this may be an important development direction.

Finally, a note on PD models' PiT/TTC aspects. Current financial indicators are bound to add a cyclical element to PD estimates. To be able to measure risks regardless of cycles and to avoid the customary underestimation and overestimation of risks during upswings and downturns, respectively, the model definitely needs improvement towards the TTC direction. 'More TTC' may be added to the model

by a variety of solutions, whether by calculating averages of financial indicators or based on the relations between the variables during the given year, but these might be examined in another study.

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Principles of Proportionality in Credit Institutions' Operational Risk Management*

Norbert Kozma

Operational risk is a natural risk inherent in credit institutions' activity, and the scope of this risk is becoming increasingly broad. In parallel with banking practices, supervisory authorities have continuously attempted to identify potential risks and ensure that the capital requirement provides sufficient cover for them. In the practical implementation of this, the regulation regards proportionality as a fundamental principle; however, the interpretation and implementation of this into supervisory practice encounters difficulties. Relying on a wide-ranging analysis of operational risk management applied by small, medium-sized and large banks, this paper provides assistance in the proper application of the principle of proportionality, although it cannot undertake to resolve the dilemmas related to the principles of proportionality. In addition, it contributes to the improvement of the operational risk framework and thereby to reducing the range of continuously growing natural risks, based on the analysis of Hungarian credit institutions' data, the analysis of the EU regulatory and Hungarian supervisory requirements and an assessment of credit institutions' practices.

Journal of Economic Literature (JEL) codes: G21, G32, L25

Keywords: banking regulation, operational risk, principles of proportionality, supervision

1. Nature and measurement difficulties of operational risk

In the past decade, the operational risk management of commercial banks has undergone major changes. The sector survived the crisis that commenced in 2007, during which banks primarily strived to mitigate credit risks, while numerous operational risk factors were also identified that had to be addressed. In addition, digitalisation and – the previously unknown – operational risks originating from it, have also come into focus. In parallel with banking practices, supervisory authorities have continuously fine-tuned their expectations in order to identify potential risks and ensure that the capital requirement provides sufficient cover for them. In

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the practical implementation of this, the regulation regards proportionality as a fundamental principle; however, the interpretation and translation of this into supervisory practice encounters difficulties.

Operational risk is a relevant risk, which affects all operating institutions, companies and organisations, i.e. it follows from its nature that it is not bank-specific. Nevertheless, since it can generate serious losses for financial institutions, the EU regulation applicable to banks[1] (hereinafter: CRR) classifies it as a significant risk. According to the definition applied by CRR, operational risk means the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events.

1.1. Definition of operational risk

In view of the fact that it is a risk which is difficult to delimit, the definition of operational risk calls for additional explanation. As follows from its definition, operational risk is the same age as mankind, as human errors can be identified in any period of history. Despite publication of the regulations governing the risk affecting credit institutions in 2007,[2] there are still interpretation issues concerning the definition. As regards credit institutions, the regulation has treated legal risk as an operational risk from the outset. Hungarian solution to foreign currency credit issue, one of the biggest economic and social problem of economic history and the threat to the stability of the financial system – the reduction of retail foreign currency loans with the possibility of final repayment, then the introduction of the exchange rate barrier and complete derecognition of retail foreign currency loans from balance sheet of households (conversion to HUF) – identified new types of operational risks in the banking sector. The significant risks of the foreign currency credit issue have become known as conduct risk (*Tamásné 2018*), while the operational risks originating from digitalisation, i.e. from information and communication technology, are referred to as ICT risk within operational risks.

The presentation of modelling risk and reputational risk as a kind of operational risk can generate disputes, as it is not always explicit which of those risks we regard as operational risk in the classical sense. The incorrect use of models or running them on erroneous database can be regarded as operational risk, but the inadequacy of the model's predictive power, the under- or overestimated risk returned as a result, the profitability and capital adequacy risks are more model risks, rather than modelling risks to be classified as operational risk. Reputational risk can be often measured on a qualitative scale; it frequently has no financial impact or is difficult to quantify the loss that may be expected from it, and thus it is difficult to fit this risk into frameworks

[1] *Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012.* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN. Downloaded: 18 January 2020.

[2] *200/2007. (VII. 30.) Korm. rend. a működési kockázat kezeléséről és tőkekövetelményéről* (*Government Decree 200/2007 (VII. 30.) on the Management and Capital Requirement of Operational Risk*), http://www.jogiportal.hu/index.php?id=25fu72fwcag00y5z8&state=20131230&menu=view. Downloaded: 18 January 2020.

applied for operational risks. In line with the nature of the risks, the central bank of Hungary (Magyar Nemzeti Bank, MNB) – in its capacity as the institution performing the prudential oversight of the credit institution sector – regards all of the aforementioned risks (legal, conduct, ICT, modelling, reputation) as operational risk.

In order to better capture operational risks, CRR also defines by topics what exactly is regarded as operational risk. According to this categorisation, external and internal fraud, improper employment and market practices, infrastructural shortcomings as well as individual and process errors in the execution of banking operations should be regarded as operational risks. In operational risk control, these seven categories are referred to as Basel event types. This is usually one dimension of operational risk data collection.

1.2. Measurement difficulties of operational risk

The definition of operational risk is difficult not only in terms of content. Measurement of the risk is equally difficult, since the operational risk exposure is hard to define and measurement reliability is also very low. Operational risks can be measured according to two risk parameters: one of them is the frequency (probability of event (PE)), while the other one is the severity of the event (loss given event (LGE)), which shows the size of loss that the occurrence of an event may cause for the institution (*Homolya 2011a*). The expected loss (EL) can be defined by the product of multiplying these two factors. However, it is often difficult to determine the size of the event's severity and frequency, since two operational risk events are very rarely similar, while the severity cannot be measured for several incurred and potential loss events – e.g. upon the breakdown of IT systems – or can be quantified only on the basis of expert estimations.

Another problem is that it is also difficult to manage the identified events in statistical terms, further complicating measurement of the risk. Operational risk events belong to two categories in statistical terms: i) cases of high frequency and low severity (e.g. fraud committed with retail bankcards), and ii) cases of low frequency and high severity (e.g. payment of claims resulting from product fault). This categorisation is also presented in *Table 1.*

Table 1
Types of operational risk events

	Low frequency	High frequency
High severity	Key losses (may also be extreme, difficult to understand and forecast)	Not relevant (under such risk profile it is advisable to suspend the activity)
Low severity	Insignificant	Moderate events (strong threat, easy-to-understand, measurable)

Source: Homolya (2011a)

The key losses and more moderate, but frequent events constitute distinct groups, which call for different treatment in terms of risk management, since in the first case it is advisable to reduce the frequency, while in the latter case reduction of both the severity and frequency parameter significantly reduces the expected loss.

1.3. Management of operational risks

It follows from the nature of operational risks that that the risk management options also include various methods, such as quantitative and qualitative risk management tools. Qualitative tools may serve the purpose of keeping the management of operational risks in the desired channel through process-integrated and subsequent controls: inherent risk can be substantially mitigated by well-regulated processes, process-integrated manual controls or controls enforced by the IT system, by the management through business continuity and risk-mitigating measures and by the transfer of risk (*CEBS 2009*). One feature of operational risks is that they can never be reduced to zero: part of the inherent risk survives in all organisations even after the controls. This is why it is essential that institutions also cover their residual operational risks, for the assessment of which CRR provides institutions with three methods:

- *Basic Indicator Approach* (BIA): this specifies the size of the minimum capital to be held as 15 per cent of the three-year average of a relevant indicator based on the bank's income. No organisational and methodological requirement is linked to the methodology.

- *Standardised Approach* (TSA): the capital requirement is specified as the aggregated value of 12–18 per cent (depending on the business line) of the three-year average of the relevant indicator by business line. Use of this method is subject to the approval of the supervisory authority; in addition to breaking down income by business lines, the incurred operational risk losses must be collected, and these activities require the development of competences and responsibilities, as well as an organisational framework. Within this method, there is also an *Alternative Standardised Approach* (ASA), relevant for banks characterised by the prevalence of retail and commercial banking.

- *Advanced Measurement Approach* (AMA): the institution calculates the capital requirement based on its own mathematical-statistical model with the use of four mandatory input factors (internal and external loss data, scenarios, business environment and internal control factors). Implementation of the method is subject to supervisory authorisation, which is preceded by validation of the model. Application of the method is conditional on meeting strict qualitative requirements, including the expected level of the organisation's risk awareness, the establishment of an independent risk management function and the application of risk management principles in daily practice.

The difficulties of risk measurement and management, and the different capital requirement calculation methods raise a number of questions, both for institutions and regulatory authorities. Institutions must decide which method to use for the quantification of the operational risk capital, the identification, measurement and management of their risks and the manner of developing the institutional risk management framework. Supervisory institutions, having a view of institutions at the sector level, have the requirement to be able to somehow compare institutions in terms of the adequacy of risk management. In order to be able to do this, institutions must be differentiated based on size and profile, for which they need to learn the nature of the risk, i.e. whether there is any correlation between the size of the institution and the operational risk. If there is, proportionate supervisory requirements must be developed and applied in practice for the institutions. After development of the requirements –since those may be implemented in several ways – in order to ensure sector neutrality, comparability and harmonisation of the results must be achieved. I have tried to find answers to these questions and dilemmas, based on the analysis of the data of Hungarian credit institutions, the analysis of EU regulatory and domestic supervisory requirements and an evaluation of credit institutions' practices.

2. Comparison of institutions based on size and risk

The more simple capital calculation methods stipulated by CRR, which regulates the management of operational risks,[3] define the volume of the capital requirement as a percentage of the income earned by the bank, thereby suggesting that there is a positive correlation between the operational risk and the size of the bank. Based on this logic, the larger the bank, the higher its operational risks, and due to this the size of the capital requirement must be also increased proportionately.

2.1. Operational risk and institution size

Beyond the interpretation of the spirit of the regulation, the link between operational risk and institution size has been examined by several Hungarian and foreign researchers, and regulatory authorities are also continuously contemplating how to formulate proportionate requirements for institutions. These studies were also based on the assumption that operational risk is proportionate to the size of the credit institution: larger banks have larger operational risk exposure, since:

- operational risk events occur *more frequently* at larger institutions, as they have a larger workforce, IT infrastructure and branch network, and thus there is more room for potential errors,

[3] BIA and TSA

- the average operational risk *loss* of larger institutions is *higher:* they execute a larger volume of transactions, have tangible assets of larger value and more complex operating models than smaller institutions,
- larger institutions sell more *complex products and services* and the operational risk exposure stemming from these may be also higher (e.g. investment banking activities are much more complex than e.g. retail deposit collection and lending activity).

The above correlation was also confirmed by the European Banking Authority (EBA), since in its analysis issued in 2016 it emphasised the correct interpretation of the principle of proportionality for the credit institution sector. In the EBA's opinion, the principle of proportionality requires

- that the objectives and principles set forth in risk management should not exceed the necessary and realistically achievable objectives,
- if an institution can choose from several methods, it should be allowed to choose the method that represents the least burden for it,
- the cost of the implementation of the set goals must not be higher than the benefits resulting from that (*EBA 2016*).

In an international context, the research of *Na et al.* (*2005*) and *Dahen – Dionne* (*2007; 2010*) found that there is a positive, significant correlation between total operational risk loss and the size of the institution (primarily gross income). In these analyses, the researchers found that it is the frequency of the events rather than the severity of the events that is determinant in the correlation. In Hungary, the correlation was analysed by *Homolya* (*2011b*). As a result of his research, he also found that there is a significant correlation between the institution size based on gross income and the total loss from operational risk, in a given period. During the analysis – based on the loss data included in the banking sector's non-public supervisory reports – he also found that the volume of individual losses is determined by institution size to a lesser degree and depends more on the bank's business line and the type of the loss.

In analysing the correlation between institution size and operational risk, we also face two measurement uncertainties: how to determine the institution size and how to measure the volume of operational risk. In addition, analyses are also complicated by the fact that public data provide limited information on a bank's operational risk exposure. The size of a financial institution can be characterised by asset and profit/loss indicators, defined on the basis of the balance sheet and profit and loss statement of the public annual reports or of a credit institution's internal data (e.g. resources used). Based on the several options available, pros and cons

may be weighed up based on the advantages and disadvantages as well as on ease of access; these factors are summarised in *Table 2.*

Table 2
Indicators determining institution size

Indicator	Advantage	Disadvantage
Total assets	No major volatility between individual financial years, easily accessible	Does not take into consideration the risks of asset components
Risk-weighted assets (RWA)	Takes into consideration the risks of asset components (risk-sensitive)	Asset indicator of the same type as total assets
Earnings before taxes	General profitability indicator, easily accessible	Substantially influenced by one-off, extraordinary items
Relevant indicator	Generally accepted in the technical literature on operational risk	May fluctuate between financial years

If size is determined as the volume of the institution's assets, it can be measured by total assets. The advantage of using total assets as an indicator of size is that it shows no major fluctuations between individual financial years and thus may be suitable for comparison. On the other hand, it has the disadvantage that operational risk losses are essentially realised in income rather than in assets, in the form of expenditures or forgone profit. In the assets approach, the size of a bank – as an alternative – can be also measured by risk-weighted assets, the volume of which does not differ significantly from total assets, but which takes into consideration the risks of individual asset components. However, this information is included in the risk reports rather than in the annual accounts and is difficult to interpret by those not proficient in the Basel risk management framework.

Should we wish to use a profit/loss indicator, the size of the institution can be determined the easiest based on earnings before taxes. However, the disadvantage of this easily accessible indicator is that one-off items may substantially influence its size. If we want to minimise this effect, the institution's relevant indicator may be used for the measurement of profitability, which – according to CRR – is the sum of the net commission and fee income, income from securities, net income on financial transactions and other operating income. As mentioned earlier, the regulation in force applies this indicator as the basis for the simpler, non-risk-sensitive capital calculation methods.

Compared to determining institutions' size, determining the operational risk exposure is a more complicated issue, as it is difficult to quantify and because the risk data belong to the institutions' sensitive information, which are published only to a limited degree or not at all. The size of the capital to cover the risk, the amount of the losses incurred in a given period or the total operational risk exposure may

be suitable for measuring operational risks, and the advantages and disadvantages of these are summarised in *Table 3.*

Table 3
Indicators determining the size of operational risk

Indicator	Advantage	Disadvantage
Regulatory capital	Easily accessible	Not risk-sensitive in all cases (BIA, TSA)
ICAAP capital	Includes an institution's risk assessment	Often corresponds to the regulatory capital requirement
SREP capital	Includes the supervisory authority's risk assessment	Difficult to measure the risk of unexpected losses Not public
Annual realised loss	Risk-based approach	Only show an institution's historical risks
Total operational risk exposure	Best approximation of an institution's operational risk	Results of the individual methodologies cannot be aggregated

The size of the regulatory capital forms part of the statutory[4] information to be published in connection with operational risks; however, the volume of it – if the institution applies basic approaches for defining the size of the capital – depends on the relevant indicator, i.e. it is not risk-sensitive. The institution may revise the regulatory capital during its Internal Capital Adequacy Assessment Process (ICAAP) based on its real risk, which is then reassessed by the supervisory authority, followed by determining the volume of SREP[5] capital. However, these three different capital categories are the same at several institutions, or the unexpected part of the losses is difficult to forecast, for which the capital – in addition to the expected loss – should provider cover.

Of those discussed above, the operational risk exposure – which cannot be quantified, or can be quantified only with major difficulties and inaccurately – is the most suitable indicator; however, these data are not available either at the level of institutions or at the sector level, since it should be determined as the sum of historical losses also relevant in the future and the future potential losses. Of this exposure, only one part – the historical losses – can be used, since financial institutions collect operational risk losses either for the purposes of regulatory requirement or for the assessment of the operational risk profile. When these losses are aggregated at an annual level we arrive at the annual realised loss, which may serve as a basis for the analysis.

[4] *Act CCXXXVII of 2013 on Credit Institutions and Financial Enterprises,* https://net.jogtar.hu/jogszabaly?docid=a1300237.tv, and *Regulation (EU) No 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012.* https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN. Downloaded: 18 January 2020.
[5] SREP: Supervisory Review and Evaluation Process

2.2. Correlation of linkage measured on Hungarian data

Considering the potential advantages and disadvantages, in the interests of identifying the correlation between institution size and operational risk exposure, out of the potential alternatives I used four variables for this analysis: the total assets and the relevant indicator, the SREP capital and the annual realised loss. The time horizon of each indicator was one year in the analysis.

I performed the quantitative and qualitative analyses on the 17 institutional groups[6] overseen by the MNB that are subject to comprehensive and focused ICAAP-SREP review. The institutions include Hungarian-owned credit institutions as well as credit institutions operating as the Hungarian subsidiaries of foreign parent companies. Some of them have a traditional past in the Hungarian banking market, while others were transformed into commercial banks from small, local saving banks. Accordingly, the institutions involved in the analysis show major heterogeneity, which is also evidenced by the descriptive statistical analysis (*Table 4*).

Table 4
Descriptive statistics of the institutions

Indicator	Total assets	Relevant indicator	Annual realised loss
	HUF millions		
Mean	2,173,625	124,470	2,191
Standard deviation	3,501,398	238,791	5,567
Median	1,547,157	68,987	462
Range	14,551,825	988,030	22,772
Sum of values	34,778,430	1,991,520	35,056

Note: The SREP capital is not included in the descriptive statistical analysis, due to the sensitivity of the data linked to the variable.

The descriptive statistical analysis shows that the total assets of the credit institutions involved in the analysis amount to HUF 37,778 billion in aggregate. The high standard deviation value – compared to the mean – shows the heterogeneity of the participants in the sector, also well reflected by the range indicator (difference between the minimum and maximum values).

[6] Since the analysis also includes the credit institutions' non-public loss data, this paper shows only those data of the institutions that are public for all (e.g. total assets).

As mentioned earlier, the correlation between size and operational risk exposure was analysed using four variables:[7]

- the size with the total assets and relevant indicator,
- the risk with the annual realised loss and the amount of SREP capital recognised to cover it.

The method of the analysis is correlation calculation, performed by the data analysis module of MS Excel. The correlation between the institution size and operational risk capital variables is shown in *Table 5*.

Table 5
Correlation matrix

	Total assets	Relevant indicator	Realised loss	SREP capital
Total assets	1			
Relevant indicator	0.99	1		
Realised loss	0.90	0.93	1	
SREP capital	0.94	0.96	0.98	1

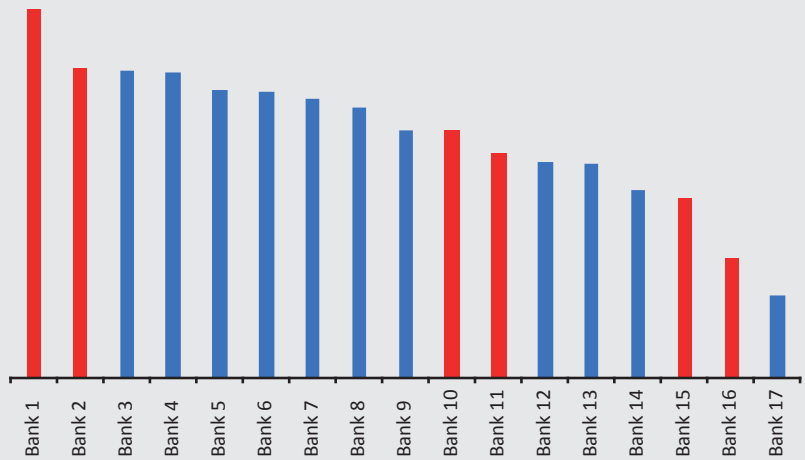
The correlation analysis shows that there is a very strong positive correlation between the institution size and the operational risk exposure, regardless of whether the size is expressed in terms of assets (total assets) or income (relevant indicator). In addition, there is also strong correlation between the size indicators: institutions with higher assets also have higher profitability. Furthermore, the SREP capital correlates better with the size indicators than the realised loss. This proved the correlation identified in the data of previous professional literature also on data from 2018 applicable to 17 Hungarian banking group.

2.3. Relative comparison of institutions

If there is a correlation between the size and the risk, the individual institutions can be compared by creating relative indicators, as then the absolute differences disappear. Size-proportionate capital and the indicators measuring the coverage of losses are suitable for making the institutions comparable. The 17 analysed institutions show the picture presented in *Figure 1* based on size-proportionate capital, i.e. the SREP capital projected on the relevant indicator and total assets.

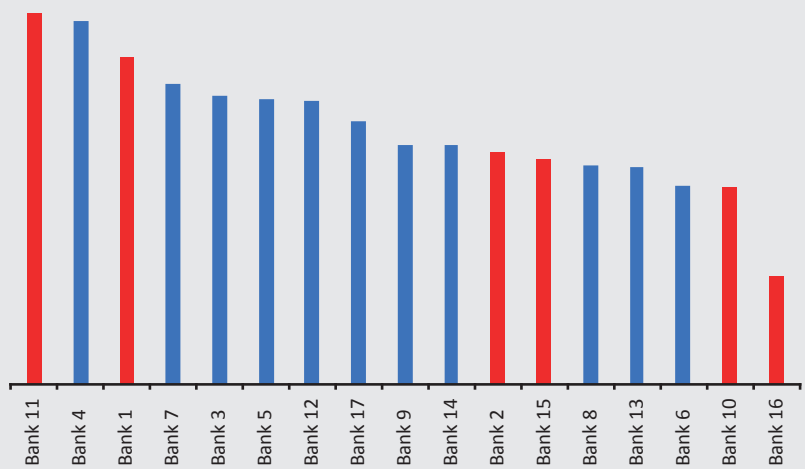
[7] The value of the variables involved in the analysis come from the credit institutions' data published or provided for 31 December 2018.

Figure 1
SREP capital as a percentage of total assets



The columns of different colour on *Figure 1–4* institutions using different capital calculation methods, indicating institutions that use basic approaches with blue colours and those using advanced approaches with red colours. Based on this it can be concluded that the selected operational risk capital calculation methodology has no impact on the size of total assets as a percentage of capital. The ranking of the institutions is different when the SREP capital is compared with the relevant indicator (*Figure 2*).

Figure 2
SREP capital as a percentage of the relevant indicator



Credit institutions differ based on the total assets and the capital as percentage of the relevant indicator, because they have different asset and profitability positions, and the size of the capital may be also influenced by individual effects, which may materially influence the ranking of individual credit institutions. However, it can be concluded that – in respect of indicators as a percentage of capital – the sector shows major heterogeneity, which does not depend on the selected capital calculation method.

Since the operational risk losses should be covered by the SREP capital and the profit/loss – measured in this analysis by the relevant indicator – it is also worth comparing the credit institutions based on their loss as a percentage of capital and profit/loss. The results are shown in *Figure 3*.

Figure 3
Annual realised operational risk loss as a percentage of the relevant indicator

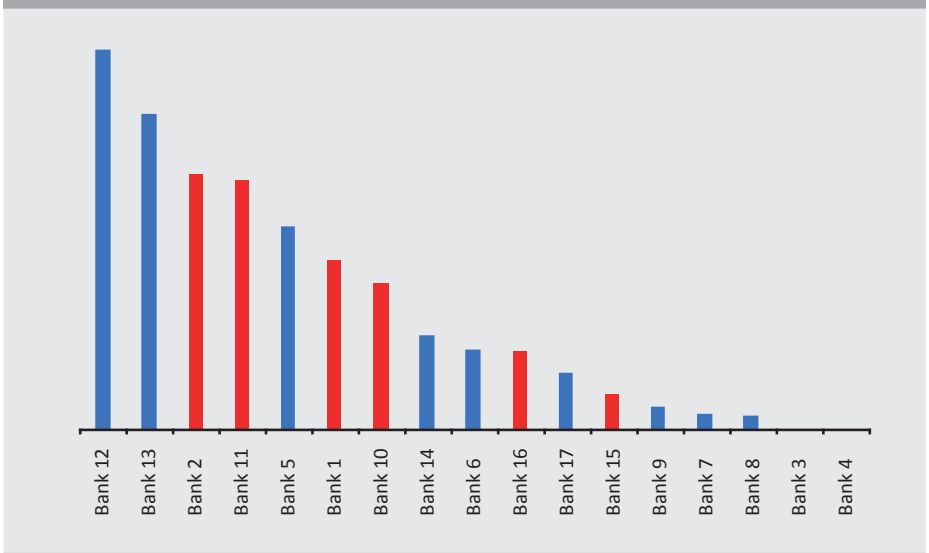
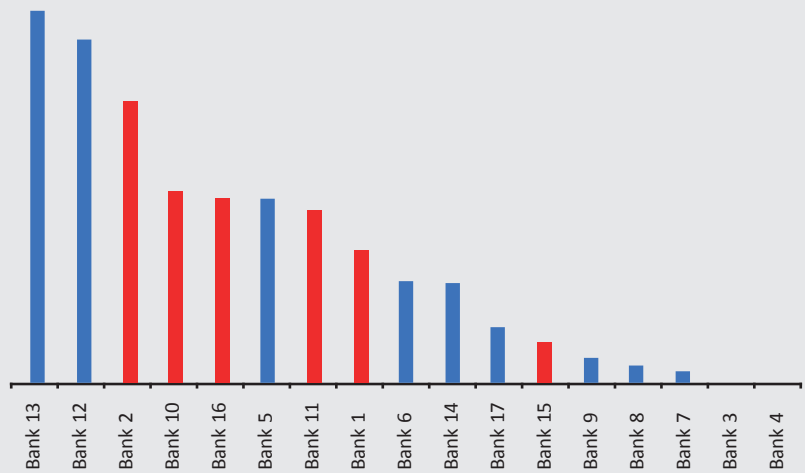


Figure 3 shows that institution size has no significant influence on the coverage of the loss, provided that we regard the loss data reported by banks as reliable. However, since the collection of loss data is not required by all capital calculation methods, the completeness of data collection may be an area for improvement in the Hungarian credit institution sector. Comparison of the annual loss with the SREP capital returns a similarly varied result (*Figure 4*).

Figure 4
Annual realised operational risk loss as a percentage of the SREP capital



As a result of the analysis, the following may be concluded:

- the correlation analysis performed on the data of Hungarian institutions subject to comprehensive and focused ICAAP review clearly shows close, positive correlation between institution size and operational risk,
- no difference can be identified between the analysed institutions based on the capital calculation approach they use,
- based on the relative indicators (operational risk capital as a percentage of assets and income, loss coverage by capital and profit/loss) the institutions become comparable,
- in order to ensure the reliability of the relative measurement of operational risk, the data collection of operational risk loss must be improved and harmonised across the sector.

Since we realised that there is a correlation between the operational risk and institution size, and the institutions become comparable based on relative indices, it may be worth examining how institutions of various size define their own operational risk activity and whether, on the basis of that, is it necessary to use different type of oversight approaches for institutions of different size.

3. Oversight of operational risk management and the practice of banks

In view of the fact that it is proven that operational risks are proportionate to institution size, it may be assumed that the capital calculation methodology selected by the various institutions and their established risk management practice is also proportionate to size.

3.1. Feature of banks' selection of methodology

When subjecting the practice of the institutions under review to a qualitative assessment it can be concluded that there is a regularity between the selected capital calculation method and the institutions' risk management practice, as also shown by *Table 6.*

Table 6
Selection of Pillar 1 capital calculation methodology by institutions subject to comprehensive or focused ICAAP review

Institution	Total assets* (HUF millions)	Method**	Category of method
OTP	14,590,288	AMA	Advanced
K&H	3,198,727	TSA	Basic
UniCredit	3,058,539	AMA	Advanced
Erste	2,563,507	AMA	Advanced
Raiffeisen	2,417,257	TSA	Basic
Integráció***	2,324,024	BIA	Basic
CIB	1,905,081	TSA	Basic
MKB	1,857,579	TSA	Basic
Budapest Bank	1,236,735	AMA	Advanced
Fundamenta	555,267	TSA	Basic
Sberbank	365,837	TSA	Basic
Gránit	353,544	BIA	Basic
Magnet	151,200	BIA	Basic
Duna	88,564	BIA	Basic
Sopron	73,819	BIA	Basic
Polgári	38,463	BIA	Basic

*Note: * Data on 31 December 2018. ** Applied method in 2019. *** Magyar Takarékszövetkezeti Bank Zrt. and the savings banks subject to consolidated supervision together.*

Source: Compiled based on information published by the credit institutions.

The table above sorts credit institutions by the volume of total assets. The data show that there is a major difference in magnitude between the credit institutions in terms of assets, based on which they can be divided into two major groups: credit institutions with total assets over and below HUF 1,000 billion. For the purposes of the analysis, banks in the first group are regarded as large banks and those in the

latter as small banks. Based on the data disclosed by the credit institutions, it can be concluded that all of the small institutions use the basic approach. Large banks show a mixed picture, but it can be stated that the advanced approach is used only by large banks. This means that larger institutions allocated more resources to the identification, measurement and management of operational risks than small banks, which may have multiple objectives:

- more accurate definition of the operational risk profile to prevent the realisation of the identified risks, thereby minimising losses;
- conscious optimisation of the operational risk capital requirement as the application of the advanced approaches may result in lower capital requirement;
- strengthening reputation by applying the advanced capital calculation approach, which entails a positive perception by owners, supervisory authorities and other stakeholders (e.g. professional investors, lenders, etc.).

3.2. Link between the size of the institution and the risk management practice

Beyond the institutions' choice of methodology, experiences from the MNB's annual ICAAP-SREP review also confirm that there are major differences between the operational risk management activity of small and large banks, as summarised in *Table 7.*

Table 7
Different risk management practice of small and large banks

Characteristics	Large institutions	Small institutions
Awareness of operational risk management	Calculated, independent of other risks	Less calculated, integrated with other risks
Organisational features	Have independent operational risk management organisation	Have no independent operational risk management
Diversity of the applied risk management methods	Typically they cover the entire spectrum of the operation risk management instruments	Focus on incurred losses through the collection of loss data
"Driver" of operational risk management	Identified risks derived from the risk profile	Economies of scale benefits
Method of mitigating risks	Proactive and reactive (through the incurred losses and identified risks)	Reactive (only through the incurred losses)

In addition to the foregoing, the reviews also found that it is typical of small institutions that – although the organisational and regulatory framework for operational risk management has been established – it is often not applied in daily risk management practices. Accordingly, the collection of loss data – which according to the experiences forms part of all institutions' risk management practices – is a well-defined activity, but in practice it is implemented only on ad-hoc basis, and

the subsequent control of it is only performed rarely. In addition, it is typical of small institutions that their risk assessment methodologies related to the present or future are underdeveloped, and they typically focus on preventing the repeat occurrence of losses incurred in the past. It follows from this that the mitigation of the identified risks also follows the same pattern: the risk mitigation actions are ad-hoc and monitoring of their implementation is not comprehensive. This is due to the fact that they do not have sufficient resources for the operation of the framework of large banks. However, it should be noted that the above findings should not be generalised: in the Hungarian credit institution sector there is also a foreign-owned small bank that uses advanced measurement approach and framework; however, stable parent company background and methodology are essential for this.

In contrast to small banks, the framework of large banks is advanced and integrated into the banks' organisations, with well-defined competences and responsibilities. However, due to the different interpretation of the effective regulation and the wide-ranging parent company expectations, the output of the operational risk management methods varies in the individual institutions. However, it can be also observed that the implementation of the risk management methods introduced several years ago may become a routine, and the regular review of such may be neglected and, as a result of this, new operational risks appearing in the business environment may not be identified and assessed by the institution. As regards the registration and monitoring of risk mitigation actions, the practice of large institutions also varies: some institutions manage them similarly to the audit points, while others handle them according to competences allocated to organisational units.

3.3. Presence of the principle of proportionality in the supervisory expectations

The differences outlined in the previous sections also justify the application of different methods in the oversight of operational risk management between small and large banks, considering the principle of proportionality; additionally, it is also necessary to harmonise the different practice of institutions in parallel with preserving operating good practices. However, practical formulation of the principle of proportionality is not an easy task, as is also underlined by the results of the Basel Committee's 2019 research. This research identified the following difficulties and potential threats in connection with this:

- the definition and application of the principle of proportionality complicates the comparability of the individual institutions,
- the definition of the principle of proportionality may jeopardise free competition, providing certain institutions or groups of institutions with advantages,
- the differentiation of expectations calls for the development of segments, the practical implementation of which may be cumbersome (selection of measurement methods, integration of quantitative and qualitative elements, etc.),

- banks taking unjustified advantage of the potential benefits stemming from the differentiated requirements, which may widen the gap between the risk profile and the expectations (*BIS 2019*).

Bearing in mind the aforementioned risks and the principle of proportionality, the MNB – in its capacity as the institution overseeing operational risk management – revised its requirements and published these for the institutions in the ICAAP Manual for 2020 (*MNB 2019*). The revised expectations apply to the Pillar 2 risk assessment procedure, beyond the statutory expectations applying to the Pillar 2 risk assessment, and were formulated at multiple levels:

- they contain risk management principles, the practical implementation of which is mandatory for all institutions (independently of size and profile),
- they define the expectations – enforcing the principle of proportionality – that are mandatory for small institutions,
- they make recommendations to large banks with a view to maintaining good practices and harmonising methodological differences.

The expectations are summarised in *Table 8* and detailed explanations are presented in the following part of this section.

Table 8
Methodological expectations towards small and large banks

Category	Components of the framework	Large banks	Small banks
Basic requirements	Regulation	x	x
	Capital requirement calculation	x	x
	Operational risk report	x	x
	Risk governance (Committee)	x	x
	Risk mitigation actions	x	x
Methods connected to Pillar 1	Collection of loss data	x	x
	data collection controls	x	x
	regular training	x	x
	Scenario analysis	x	x
	Risk self-assessment	x	
	Key risk indicators (KRI)	x	
Methods linked to ICAAP-SREP	Product inventory	x	
	Model inventory	x	
	Reputational risk management	x	x
	ICT risk management	x	x
	Conduct risk management	x	x

Source: MNB (2019)

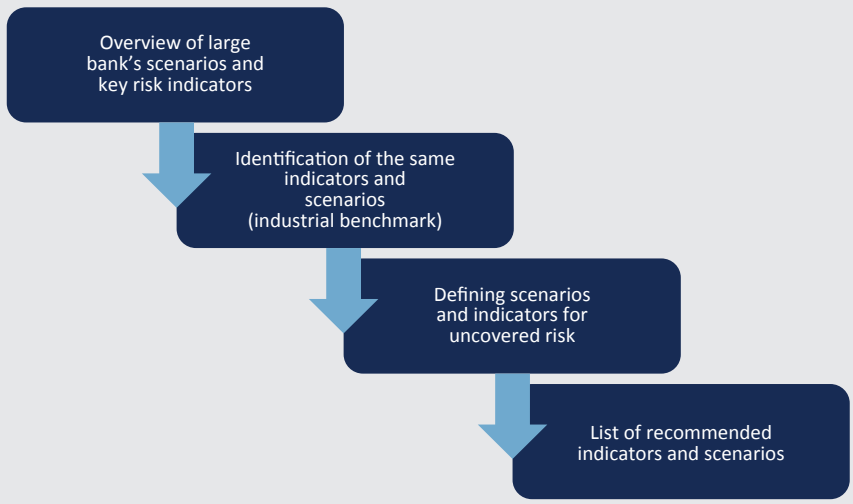
As regards the management of operational risks, it is a basic requirement for all institutions that they be able to assess their own operational risk profile and the bank's management must take into consideration the assessed risks in the decision-making process. To this end, it is essential that risk management is a well-defined, calculated and regulated activity in the credit institution and apart from historical risks, current and future risks are also taken into consideration (*Figure 5*). Institutions are also expected to attempt to consciously reduce their operational risk exposure and to define and identify new types of operational risks (e.g. conduct, reputation and ICT risks) in the institutions. As regards the expectations, the supervisory authority must ensure that none of the institutions incurs competitive disadvantage vis-à-vis other institutions in respect of the applied methodologies; in addition, the principles of proportionality must be taken into consideration upon the development and assessment of the framework.

When formulating the expectations, it was stipulated that both small and large institutions must collect loss data, as the losses incurred in the past serve as a skeleton for the development of the operational risk profile. The prevention and/or mitigation of the effects of losses thus identified is key to a bank's proper long-term operation and profitability. Small institutions are also expected, in addition to data collection, to introduce at least one method that measures present and future risks. This method may be – as also shown in *Figure 5* – the risk self-assessment, the definition, measurement and monitoring of key risk indicators (KRI) and the analysis of the operational risk scenarios. The risk-based model and product inventory, implemented in domestic practice, may be also suitable for the quantification of operational risks. However, in respect of the expectations related to the selected method, the expectation does not differ based on institution size.

Figure 5
Time horizon of operational risk management methods

Large institutions should preserve good practices and harmonise the individual methods. It is important that all supervised institutions assess the operational risks that are typical for the industry and identify in their framework the risks that appear as new in the market from time to time. Since the key objective is to prevent future risks, the MNB intended to support this by creating the list of recommended scenarios and KRIs for the sector, which was published in the 2020 ICAAP manual, and defined in accordance with the logic outlined on *Figure 6*.

Figure 6
Process of defining the proposed scenarios and indices



After processing 721 key risk indicators and 172 scenarios of ten domestic credit institutions, the MNB recommends scenarios in 17 topics and key risk indicators in 21 topics to be developed by the institutions, which standardises the most frequently applied indices of the domestic small, medium-sized and large banks as the best practice of the sector, and also includes the following new types of risks:

- since at sector level the provision of labour force of proper quality and quantity represents difficulties, it is proposed to perform regular backtesting of the losses arising from the exit of key personnel, and the number of vacancies and the average time of hiring,
- the assessment of risks related to digitalisation should cover the existing infrastructure (ratio of obsolete IT systems), risks originating from erroneous IT developments and related project management and the related system failures,

- due to the cross-border payment transactions carried out faster and faster, money laundering risks should be taken into consideration,
- potential operational risk events and losses arising from non-compliance with the EU data protection regulation (General Data Protection Regulation – GDPR) also qualify as an operational risk, and thus the measurement of such must also form part of the operational risk framework.

As a result of the foregoing, the ICAAP Manual for 2020 formulated the following lists of KRIs and scenarios (*Table 9* and *Table 10)* for the supervised institutions broken down by risk categories.

Table 9
Set of key risk indicators recommended by the MNB

Category	Recommended KRI
Improper employment and market practices	Number/duration of vacancies
	Staff turnover rate
	Number of complaints received
	Number/amount of litigation
	Number/amount of penalties paid
Internal and external fraud	Number/amount of prevented/occurred fraud cases
	Number/ratio of money laundering alerts
	Number of internal fraud cases
Infrastructural shortcomings	Availability of IT systems
	Number/ratio of obsolete IT systems
	Number of HelpDesk reports
	Number of BCP incidents
Execution, delivery and process management	Number of data protection of incidents
	Number of missed deadlines (external and/or internal)
	Number/ratio of complaints responded to after the deadline
	Workload indicators (by functional areas)
	Number/ratio of erroneous transactions
	Number/ratio of incomplete loan files
	Lead time of retail/corporate loans
	Number/ratio of overdue audit points
	Number/ratio unrevised regulations

Source: MNB (2019)

Table 10
Set of scenarios recommended by the MNB

Category	Proposed scenario
Improper employment and market practices	Epidemic illness
	Exit of key personnel
	Large-amount administrative penalty
	Erroneous product/model/practice
	Lawsuit for damages (client/partner/employee)
Internal and external fraud	Credit fraud
	Fraud committed with transaction products
	Unauthorised treasury activity
	IT security incident (hacker, virus, phishing)
	Money laundering and terrorist financing
Infrastructural shortcomings	Breakdown of key IT systems/public utility services
	Erroneous IT development and/or project
	Natural disasters
	War or terrorist attack
Execution, delivery process management	High-amount transactions carried out by mistake
	Absence of deadline and/or documentary requirements
	Supplier performance in breach of the contract

Source: MNB (2019)

When the credit institutions assess the proposed scenarios and key risk indicators, it also must be analysed whether those are relevant for the respective institution. The rejection of a proposed scenario or indicator without due justification may result in the institution's failure to take account of a real risk.

If the institutions' risk management practice and the supervisory expectations meet, it will be possible to apply and backtest the principles of proportionality also in the operational risk management activity of the Hungarian credit institution sector, with the following results:

- all credit institutions – irrespective of the size – collect their loss data in full and in a controlled manner, from which the institutional and sector-level operational risk exposure can be determined more accurately;
- all domestic credit institutions perform operational risk analysis for the present and future, in addition to the historical focus; risk management improves;

- operational risks that affect all financial institutions and the new types of operational risk are also identified in addition to the regularly assessed risk factors by prescribing the application of best practices;
- the mitigation of operational risks by measures takes place in accordance with identical registration and procedural criteria, both at the level of institutions and at the sector level.

4. Summary

In this paper, I present how operational risk control and oversight activity can be developed applying the principle of proportionality that is capable of identifying and efficiently mitigating risks irrespective of the institution size, at the same time taking due account of the operational and resource differences resulting from the size.

In order to determine the principles of proportionality, it had to be examined whether there is any correlation between the magnitude of the risk and size of the credit institution. The strong correlation was also proven by the statistical analysis performed on the data included in the Hungarian and international professional literature and on the data of institutions subject to comprehensive and focused ICAAP-SREP review process. In addition, credit institutions' choice of methodology – according to which larger institutions tend to opt for advanced operational risk management methods – also confirm that the interpretation and scope of the operational risk control activity varies depending on the size of the institutions.

In order to apply the principles of proportionality in practice as well, supervisory authorities must provide specific guidance. Firstly, general principles must be formulated that are essential for the identification of an institution's operational risks and for the decision whether the institution accepts, mitigates or transfers the risk. These general principles include the creation of the regulatory framework, the development of the reporting lines, the creation of dedicated competences and responsibilities and the monitoring and management of identified risks.

After formulating general principles, applicable to all institutions, it is advisable to manage small and large banks separately, since – as seen – their operation is implemented through different organisational solutions and complexity, and their resources also differ. While large banks may be expected to use all operational risk assessment methodologies, in the case of small banks it may be sufficient to use at least one instrument – in addition to collecting historical loss data – that identifies their future potential risks.

In the case of larger credit institutions, harmonisation of the applied methods and the identified risks may be set as an objective by sharing the good practices that can be regarded as an industry benchmark. The set of key risk indicators and set of scenarios, proposed in the paper, provide banks with the opportunity to measure and manage their risk uniformly across the sector.

The paper tries to apply the principles of proportionality in practice in the area of operational risk management. The practical application of these will strengthen institutions' risk-based operation and risk-based oversight by the supervisory authority. This contributes to the stability of the financial system and to increasing its shock-absorbing capacity. In addition, both the regulation – included the new capital calculation requirements (*BIS 2017)* being finalised – and the range of potential operational risks are continuously changing, for the implementation of which it is essential to create stable common foundation in the present operational risk management practice.

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Mortgage Bank Refinancing – Proposals for Implementation of the European Covered Bond Directive in Hungary*

Gyula László Nagy – Zsombor Incze – Erik Landgraf

In this study, we summarise the operational models of mortgage banks and the new EU mortgage bond regulations. We analyse the most important challenges facing refinancing mortgage banks in the current framework. These are basically grouped into three subjects: (*1*) *for historical reasons, the characteristics of refinancing loans do not support more efficient portfolio refinancing;* (*2*) *the refinancing loan guarantee scheme does not ensure fulfilment of the conditions laid down in other legislation in case of statutory portfolio assignment;* (*3*) *overcollateralisation in the current purely refinancing model cannot be achieved from ordinary collateral. On this basis, we propose the development of an alternative regulation for "refinancing mortgage banks", while fully maintaining the current operation; with this alternative regulation, a revised collateral system would help to solve the problems and develop a more efficient mortgage loan structure.*

Journal of Economic Literature (JEL) codes: G28, G21, K22, K23

Keywords: covered bonds, mortgage banks, mortgage bonds, mortgage loans, refinancing

1. Introduction

One of the defining events in the history of consumer mortgage lending in Hungary in the period following the conversion of foreign currency loans into forints was the introduction of the Mortgage Funding Adequacy Ratio. This regulatory step also marked the future direction of mortgage banks' business operations, in which refinancing activities became dominant. At the end of 2019, on the occasion of

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

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the 250th anniversary of the creation of the mortgage bond, the VDP (Association of German Pfandbrief Banks) held a large-scale celebration in Berlin. After long preparations and extensive negotiations, exactly 250 years earlier Prussian Emperor Frederick II announced the creation of the first mortgage bond and promulgated a decree allowing the first successful issuance of a *Pfandbrief*, which significantly contributed to the consolidation of Prussia's financial situation at the time. The first mortgage bond programme was followed by successful issuance in other European countries in the 19th and 20th centuries. The success story of mortgage bonds or covered bonds as they are currently known continues to this day. Over the past 20 years, covered bond volumes have grown dynamically. According to *Kullig et al.* (*2019*), at the end of 2018, the total stock on the European capital market amounted to EUR 2,600 billion. This represents the second largest market for investors after the government securities market.

In Hungary, mortgage bonds began to be issued in the 1840s. The history of mortgage bond-based financing is elaborated in more detail by *Kovács* (*2004*). Following the political transition, *Act XXX of 1997* (hereinafter: Jht.) established the operating framework of the current mortgage banks, which, in addition to *Kovács* (*2004*), was also presented by *Vincze* (*2002*) and *Király – Nagy* (*2008*) for example, while *Fóriánné Horváth* (*2019*) summarized it comprehensively. The event with the greatest impact on mortgage bank operations in recent years was the introduction of the Mortgage Funding Adequacy Ratio (MFAR) announced by the Magyar Nemzeti Bank (MNB) in 2015 (*MNB 2015*) and introduced on 1 October 2016, which brought about the appearance of two new mortgage banks (Erste Mortgage Bank, K&H Mortgage Bank) and also laid out the new role of these specialised institutions for the long-term. The impacts of the MFAR regulation on the banking system, the size of new issuances induced by the regulation and the investors' profile was presented by *MNB* (*2016*), *MNB* (*2017*) and *MNB* (*2018*) in details.

In this article, we present the operating models of mortgage banks, as well as the separate parts of the new EU mortgage bond regulation and its highlights included in the CRR (Capital Requirements Regulation, (EU) No 575/2013 of the European Parliament on prudential requirements for credit institutions and investment firms, *EU 2013*). Following this, we analyse the main aspects of the current Hungarian operating model, highlighting the structural challenges, for which we propose solutions (following the example of the European and the Swiss mortgage banking systems). Implementation of our proposals may become possible with the domestic implementation of the new EU directive. We also aim to initiate a professional dialogue on efficiency issues that can be addressed by fine-tuning the regulatory environment. Remedying these can simultaneously improve the situation for both mortgage bond investors and mortgage loan borrowers.

2. Mortgage bank operating models

2.1. Overview

Before examining Directive (EU) 2019/2162 (*EU 2019a*, hereinafter: the Directive) and the related CRR modification Regulation (EU) No 2019/2160 (*EU 2019b*, hereinafter: CRR Amendment) in detail, let us outline some of the Member State models operating within the scope of these regulatory instruments. One of the most significant summaries on the topic in recent years was written by *Stöcker* (*2011*), who has been engaged with the topic for a long time. Although it is difficult to arrange each model according to uniform criteria, Stöcker distinguishes five different mortgage bank operating models. *Tóth* (*2017*) provides a somewhat simpler summary using three different models, while *Papp* (*2005*) outlines four models using a different argumentation, which is also adopted by *Fóriánné Horváth* (*2019*). We summarise the findings of *Stöcker* (*2011*) in *Table 1*, supplemented with the statements of *Tóth* (*2017*).

Table 1
Mortgage bond financing – Five European models

	Model 1	Model 2	Model 3	Model 4	Model 5
Legal Status	Specialised credit institution	Specialised credit institution	Universal bank	SPV*	Specialised credit institution
Method of financing	Collateral assets acquisition from parent bank	Loan disbursement to customers	Loan disbursement to customers	Collateral assets acquisition	Legal transfer of assets or their liens
Implementing countries (partial list)	Ireland, Norway, France, Finland, Sweden	Hungary, Luxembourg, Poland, Denmark	Austria, Denmark, Finland, Germany, Greece, Spain, Portugal, Czech Republic, Slovakia	Italy, Netherlands, United Kingdom	Austria, France, Denmark, Germany, Hungary, Spain, Switzerland
Affected domestic mortgage banks		OTP			Takarék, UniCredit, K&H, Erste, OTP

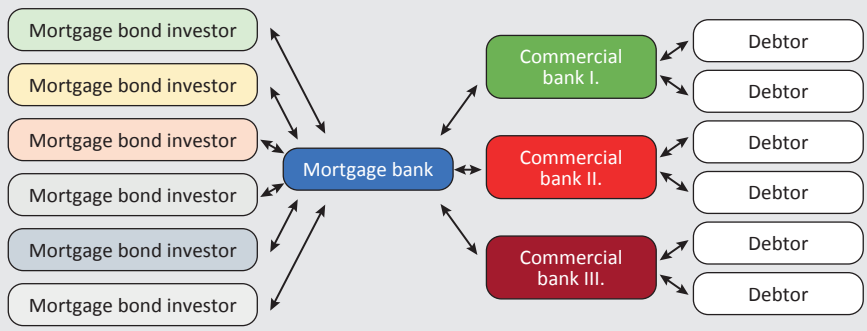
*Note: * SPV – Special Purpose Vehicle*
Source: Compiled based on Stöcker (2011) and Tóth (2017)

Currently, Model 2 and 5 are active simultaneously in Hungary, but direct customer lending is only actively used by OTP Mortgage Bank (Model 2).

2.2. 'Pooling' model

The logic of the pooling model is fundamentally based on the fact that the mortgage bond issuer raises a large amount of long-term funds on the capital markets and allocates this resource to the banks that originate mortgage loans and thus provide funding for it (*Figure 1*). The allocation mechanism can be extremely simple and straightforward (e.g. Switzerland) or it can take place through maturity or interest rate transformation (e.g. Hungary).

Figure 1
Structural operation of the pooling model



Source: Compiled based on Stöcker (2011:37)

According to *Stöcker* (*2011*), there are significant requirements for the smooth functioning of the pooling model. On the one hand, close cooperation between the refinancing mortgage bank and the refinanced commercial bank is essential to maintain the proper quality of the cover pool, and, on the other hand, an extremely strict and well-functioning legal mechanism is needed to maintain collateral coverage at all times.

According to *Kemmish et al.* (*2017*), this structure is used in many European countries in different regulatory frameworks that differ mainly in the identity of the issuer (specialised credit institution, universal bank or a special entity established by law). In Hungary, refinancing, which can also be described as a pooling model, also operates in a special structure, not used elsewhere, where refinancing takes place through the sale and simultaneous repurchase of independent mortgage liens.

3. The new European covered bond regulation

3.1. Background

With regard to covered bonds, the previous EU regulation was found in Article 52(4) of EC Directive 2009/65/EC (*EC 2009*), which sets out the general requirements for covered bonds. Article 129 of CRR added additional conditions to the above

directive and allowed credit institutions to hold less capital when investing in covered bonds. As a result of this regulation, in the past, the conditions for investing in covered bonds can be considered harmonised within Member States, but there has been a lack of harmonisation at the EU level in terms of issuance conditions.

As a result of the review process launched in 2012 with the recommendation of the European Systemic Risk Board (*ESRB 2012*), a uniform new EU regulation of covered bonds was created by the end of 2019, which affected both the directive and the regulation. However, during the review, a basic principle remains unchanged in the current regulations: a covered bond can only be issued by a credit institution. This sets a clear line that separates these securities and their issuers from other securitisation operations regulated by Regulation (EU) 2017/2402 of the European Parliament and the Council (*EU 2017*). The purpose of the regulation is also unchanged: to regulate the conditions under which credit institutions may issue covered bonds as a financing instrument by establishing product requirements and specific product supervision for credit institutions in order to ensure a high level of investor protection.

As a result of several years of preparatory work, the European Covered Bond Directive (*EU 2019a*) was adopted and promulgated last year. Closely related to this, the CRR, regulation (EU) 2019/2160 on prudential requirements for credit institutions and was amended, which also means an obligation to adapt in Hungary. Mandatory implementation of the new Directive and the obligation to apply the CRR Amendment make it essential to review the existing domestic rules and adapt them to the constantly evolving market requirements. The new rules provide sufficient preparation time for both:

- the regulatory authorities of the Member States, with an implementation period of 18 months for the Directive until 8 July 2021,
- and market participants, which are given an additional 12 months to prepare,

and thus, the *uniform starting date for application of the new rules* will be *8 July 2022*.

3.2. Main provisions of the Directive

The Directive sets out harmonised rules for covered bonds in Europe, building on elements of previous regulation. The basic pillars of the regulation are:

- *dual recourse principle* – according to which investors can enforce their claims against both the issuer of the covered bond and the cover assets;
- *bankruptcy-remoteness principle* – the enforcement of which guarantees that the insolvency or resolution of the issuer of the covered bonds will not result in the maturity of the mortgage bonds.

The key areas of regulation of the Directive are:

3.2.1. Collateral and liquidity rules

One essential element of the covered bonds regulation is that it defines the rules for eligible cover, eligible collateral and their mandatory separation, that is, the rules for collateral registration. It is important to distinguish between a cover asset and a collateral asset, which are overlapping concepts. According to Article 3(4) of the Directive "'cover assets' means assets included in a cover pool", that is, exposures that have been placed using appropriate collateral. According to Article 3(5) *"collateral assets' physical assets and assets in the form of exposures that secure cover assets" that are able to guarantee a high level of return on cover assets.* With regard to the regulation of cover assets, it is important to emphasise that the Directive distinguishes between (i) loans secured by collateral assets and (ii) loans to or guaranteed by public undertakings. Among the loans secured by collateral assets, two subgroups have been regulated: loans that meet the strict requirements of the CRR Amendment (*EU 2019b*) and loans that meet the somewhat milder but still high-level requirements of the Directive (*EU 2019a*). The latter is also an important distinction because, along these lines, the new brand introduced by the Directive in the European single market in future will include two categories:

- the 'European Covered Bond', logo may be used (not obligatorily) by a covered bond that fully complies with the requirements of the Directive;
- the 'European Covered Bond (Premium)' logo may be used (not obligatorily) by a covered bond that meets all the requirements of the CRR Amendment.

One key area of cover regulation is the issue of collateral valuation. In this context, there is a uniform requirement for Member States to have a valuation standard agreed by experts in each Member State and to have a register suitable for recording the ownership and encumbrances of collateral assets, which is accessible to the public (in practice, this means an authentic public real estate and maritime registry).

As part of the cover pool, the Directive also defines two special cover assets, derivative contracts and liquid assets. The latter will be given high priority in the renewed regulation, because it considers liquidity risk mitigation to be crucial to ensure the protection of covered bond investors. In line with this regulatory objective, it will become mandatory for covered bond issuers to establish a liquidity buffer to cover the maximum cumulative net liquidity outflow over the next 180 days.[1] The introduction of this new requirement is intended to address risks of

[1] According to Article 3(16) of the Directive *"net liquidity outflow' means all payment outflows falling due on one day, including principal and interest payments and payments under derivative contracts of the covered bond programme, net of all payment inflows falling due on the same day for claims related to the cover assets".*

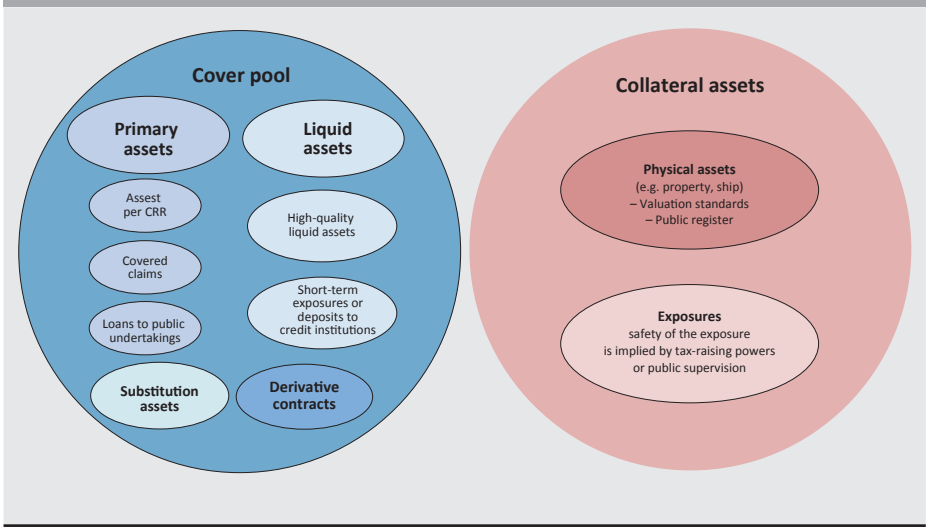
liquidity shortage, such as mismatches in maturities and interest rates, payment interruptions, commingling risks, payment obligations attached to derivative contracts and other operational liabilities falling due within the covered bond programme. Therefore, the liquidity buffer for the cover pool differs from the general liquidity requirements imposed on credit institutions in accordance with other Union legal acts, as the former is directly related to the cover pool and seeks to mitigate liquidity risks specific to it. In view of the parallel liquidity requirements for credit institutions, the Directive allows Member States not to enforce the cover pool liquidity buffer requirement in their regulations until the harmonisation of such rules. This way the credit institutions may avoid having to cover the same outflows with different liquid assets during the same period, but only if under its period of validity Union law imposes no other liquidity requirement on the credit institution.

In addition to the above, an essential part of the coverage regulation is the cover register, which is a key instrument for the implementation of both principles, the dual recourse principle and the bankruptcy-remoteness principle. Accordingly, the mandatory separation of cover assets from the issuer's other assets and their priority control by a cover pool monitor (as defined in the Hungarian legal system, 'asset controller') are important parts of the directive.

In addition to limiting the composition and the separate registration requirement of the cover pool, determination of the minimum level of coverage is another important scope of the collateral regulation of the Directive. It is important to note that Article 15(6) of the Directive (*EU 2019a*) provides a specific calculation rule only for aggregate principal amount, and only as a minimum rule when it states: *"The calculation of the required coverage shall ensure that the aggregate principal amount of all cover assets is equal to or exceeds the aggregate principal amount of outstanding covered bonds* (*'nominal principle'*)*".* In addition, of course, the cover pool must provide coverage for the interest on the covered bonds in circulation, the payment obligations related to derivative contracts placed as collateral, as well as the expected maintenance and administration costs of the liquidation of the covered bond programme. However, no specific calculation rule for these items is laid down in the Directive, which Member States are entitled and obliged to define during implementation within the framework of the prudential requirements of the Directive. Although the overcollateralisation of covered bonds is now commonplace based on market experience, this expectation does not appear at the basic regulation level. However, as shown in *Section 3.3*, this is already a mandatory element in the regulation of the CRR Amendment, i.e. in the category of 'European Covered Bond (Premium)'.

As an overview summary of the above rules, the set of cover assets representing the cover pool and the system of collateral assets in the regulation of the Directive are illustrated in *Figure 2*.

Figure 2
Composition of cover and collateral assets under EU Directive 2019/2162



3.2.2. Information for investors

In order to facilitate informed investor decisions, credit institutions issuing covered bonds must provide information on their websites at least on a quarterly basis on, *inter alia*: the value of the cover pool and outstanding covered bonds, the geographical distribution and type of cover assets, their loan size and valuation method, the maturity structure of cover assets and covered bonds, the levels of required and available coverage, and the levels of statutory, contractual and voluntary overcollateralisation as well as the percentage of distressed loan or loans overdue for more than 90 days.

In addition to issuers, organisations supervising covered bonds are also required to provide information. An essential element of investor protection is to ensure that competent authorities publish regular information concerning the provisions of national law transposing the Directive and on the manner in which they perform their covered bond public supervision, in order to strengthen market confidence in covered bonds.

3.2.3. Public supervision of issuers

The requirement for special public oversight of covered bond issuers was already a key element of covered bonds pursuant to Article 52(4) of Directive 2009/65/EC. The Directive considered it necessary to harmonise the components of such public oversight of covered bonds and to clearly define the roles and responsibilities of the national competent authorities responsible for financial supervision.

Public supervision of covered bonds is *different* from the EU supervision of credit institutions, accordingly, Member States are entitled to designate other national competent authorities responsible for the financial supervision of covered bonds, which may be different than the competent authorities responsible for the general supervision of the credit institution. The main task of financial supervision is to authorise the issuance of covered bonds by credit institutions (covered bond programme) and to protect the rights and interests of covered bond investors in the event of issuer insolvency or resolution proceedings, in cooperation with, but with clear separation from, the other competent authorities, by ensuring that the ongoing or reliable management of the covered bond programme is ensured during insolvency or resolution proceedings.

The Directive obliges Member States to provide for effective, proportionate and dissuasive administrative or criminal sanctions and to define procedural rules which give priority to the protection of the covered bond market, while respecting the protection of the interests of issuers.

3.2.4. Highlights of implementation

In addition to the topics highlighted in separate chapters, the domestic transposition of framework regulations defined at the EU level offers regulatory opportunities in several professional issues and requires regulatory adaptation, which can be matured in important and exciting professional discussions. In our view, the following issues deserve special attention:

a) Joint funding (*Article 9 of the Directive*)*:* This model makes the issuance of a mortgage bond as a special security applicable to market conditions where the original loan operation and its collateral securitisation are separated. This regulation can be an excellent basis for the regulatory differences of the so-called refinancing model, which actually represents a significant part of Hungarian market practice, to be more pronounced, during which the current practice can be modernised. This regulatory approach fits well with the dual structure that currently exists in domestic regulation, i.e. simultaneously regulation of the direct financing ("OTP") model and the refinancing ("FHB")[2] model;

[2] FHB Mortgage Bank Plc became member of the Takarék Group and was renamed to Takarék Mortgage Bank Co Plc.

b) *Range of institutions that can be refinanced* (*Article 9*(*3*) *of the Directive*)*:* The Directive offers Member States the possibility of extending the range of institutions that can be refinanced to non-credit institutions. This authorisation allows, for example, the mortgage loan portfolio of mortgage houses to be taken over as collateral, an option which, in our opinion, is not justified in the domestic environment, neither based on market conditions nor on the previous experience of recovering such portfolios;

c) *Collateral protection in the event of issuer resolution* (*Article 12*(*2*) *of the Directive*): The Directive sets out as a clear requirement for transposition in the Member States that the separation of mortgage bonds and thus their independence from the issuer must be ensured in both liquidation and resolution. This requirement imposes a task for domestic implementation, as collateral protection is currently not provided in the case of the resolution of mortgage credit institutions. In doing so, in our opinion, the scope and manner of extending the quite well-developed domestic regulations still valid for insolvency must be implemented with careful consideration;

d) *Continuous high quality of cover assets* (*Article 15*(*4*) *of the Directive*)*:* Under the Directive expectation system, the inclusion of distressed loans as collateral is prohibited, which is completely absent from current Hungarian regulations. *Jht*. pays close attention to inclusion as collateral and imposes a number of strict, sometimes excessive requirements on a mortgage loan as to when it may become collateral, but does not set legal requirements for the period after inclusion as collateral. Thus, the development of domestic regulation can be considered an important task in this regard;

e) *Renewal of the coverage supervisor institution* (*Article 13*(*3*) *of the Directive*): The Directive provides an opportunity to consider whether a Member State should employ a coverage supervisor (‘cover pool monitor’ in the Directive’s definition). According to this innovative approach, this important task should not necessarily be performed by a person separate from the credit institution and its auditor, but by ensuring direct financial supervision of the supervisory board, i.e. by enforcing the criteria governing internal control, an employee could also be entrusted with such a task. Taking into account the current practice experience, it is recommended to consider introducing this new option in Hungary as well, since ensuring this work within the organisation mainly as an administrative task, i.e. certifying the correctness and authenticity of the collateral register, can improve the efficiency of the mortgage credit institution. In this context, however, the assessment of investors and rating agencies should also be considered, but we

believe that this should not be enforced in the scope of regulation in principle, but rather in the scope of practical application.

f) Extendable maturity structures (*Article 17 of the Directive*)*:* The Directive has elevated the long-standing voluntary regulation on the European mortgage market into the legal framework, allowing Member States to have the so-called 'soft bullet'. According to this, a Member State may provide for the possibility of issuing a mortgage bond, the maturity of which could be extended to a predetermined extent in the event of the occurrence of objective events defined by law, independently of the discretion of the mortgage issuer. We recommend that this issue be considered during transposition of the Directive, taking into account further detailed conditions, since such an option suggested by the issuer may improve the rating of domestic mortgage bonds;

g) Match funding requirement (*Article 3*(*15*) *of the Directive*)*:* This requirement is related to the regulation of the 'liquidity buffer' introduced by the Directive, which is of great importance in its effect as it results in an exemption from the formation of the buffer, but its regulation is by no means detailed: apart from the legal definition, it does not appear among the provisions of the Directive. It is known that it appears in EU legislation in view of the peculiarities of the Danish mortgage bond market, i.e. a perfectly synchronised system of mortgage bonds and mortgage loans. At the same time, we do not see any obstacles to its applicability in the case of the domestic refinancing model, which is detailed in *Section 4.3.3.*

3.3. Main provisions of the CRR Amendment

Article 129 of CRR (*EU 2013*) currently provides for the preferential treatment of covered bonds with regard to capital requirements, subject to certain conditions. Given that the Directive re-regulates the main elements of covered bonds and provides for a common definition of covered bonds, it has also become necessary to update the related prudential requirements. The fact and amount of the capital discount on exposures in the form of covered bonds is not affected by CRR Amendment (*EU 2019b*), but the following main modifications are set out as required conditions to benefit from this discount.

3.3.1. Overcollateralisation (OC)

In order to further improve the quality of covered bonds receiving preferential treatment, CRR Amendment (*EU 2019b*) makes such preferential treatment conditional on overcollateralisation, and thus the collateral level of the covered bond must exceed the coverage requirements set out in the Directive. The clear purpose of overcollateralisation is to mitigate the most significant risks in the event of the insolvency or resolution of the issuer.

As a general rule, CRR Amendment (*EU 2019b*) sets an overcollateralisation level of 5 per cent, but Member States may set a lower minimum overcollateralisation level for covered bonds of at least 2 per cent if the calculation of the overcollateralisation is based on a formal approach that takes into account the underlying risk of the assets or valuation of assets is subject to the mortgage lending value.

3.3.2. Loan-to-value ratio (LTV)

To ensure the credit quality of covered bonds, limiting the loan-to-value ratio has so far been an essential element of regulation. The CRR Amendment (*EU 2019b*) does not change the current limits on the loan-to-value ratio, but CRR (*EU 2013*) does not specify how that ratio is to be applied. CRR Amendment (*EU 2019b*) clarifies that limits on the loan-to-value ratio should be applied as soft collateral limits, meaning that the size of the underlying loan is not limited, but all loans can only be accepted as collateral within the limits on the loan-to-value ratio of the related assets. Accordingly, the regulation clarified that the limits on the loan-to-value ratio determine the part of the loan that contributes to the coverage of the covered bond. As a further clarification, CRR Amendment states that the limits on the loan-to-value ratio should apply to the entire term of the loan.

3.3.3. Revaluation of collateral

The requirements for assets that serve as collateral for covered bonds are related to the general quality characteristics that ensure the strength of the cover pool and are therefore set out in the Directive. Consequently, the provisions on the valuation method did not need to be formulated in a separate CRR requirement.

However, for the real estate collateral of covered bonds these *must be monitored* regularly and at least *annually for all real estate*. In the case of residential real estate where, as a general rule, real estate value monitoring has so far taken place every three years, this can be considered a significant and major change due to its large scale. Although some mortgage banks in Hungary already perform revaluations more often than every three years (using statistical methods), a rule of a general nature can help to improve the accuracy and automation of statistical methods, making them more widely available and more efficient.

4. Revision of refinancing options during implementation

4.1. Basic principles

Hungary is classified as a properly regulated country within the EU by the regulations set out in *Jht.* (*1997*), so no significant transformative impact of implementation is expected on the institutional and financial supervision structures. It is important, however, that in case of four out of the five mortgage banks, mortgage loan origination is no longer carried out by them, but their refinanced commercial

banking partners. The activity of the mortgage banks is mainly limited to raising funds on the capital market and transferring the necessary long-term funds to the commercial banks.

In light of the above, transposition of the Directive should therefore seek, on the one hand, to maintain the existing, well-functioning framework and, on the other hand, to modernise domestic mortgage bond regulations in order to further improve market conditions and efficiency, taking advantage of the opportunities and special aspects offered by the Directive. Examining the details of the new regulation in accordance with these basic principles, in our opinion, the following areas deserve special attention during implementation.

4.2. Challenges in the current refinancing system

4.2.1. Features of refinancing loans

The unique structure of domestic mortgage bank refinancing can be described as follows:

- mortgage loans are provided by commercial banks to their own customers, on the basis of which they establish an independent mortgage lien on the collateralised real estate;
- keeping their mortgage loans on the balance sheet, the lender bank sells the individual mortgage liens registered in its favour to the refinancing mortgage bank, which purchases them for an amount not exceeding the outstanding principal of the secured loan covered by the lien;
- at the same time as the sale of the independent mortgage lien, the commercial bank enters into a reverse repurchase agreement with the mortgage bank, in which it agrees to repurchase the independent lien from the mortgage bank at least in instalments corresponding to the instalments which the customer is obliged to repay the mortgage loan to the commercial bank;
- the repurchase price of the independent mortgage lien is the claim of the mortgage bank against the commercial bank, secured by statutory assignment, due the mortgage bank according to *Jht.* (*1997*). Based on this, in the event of non-payment or insolvency of a commercial bank, by the force of law the mortgage bank becomes the direct holder of the mortgage loans which it refinanced.

In the current Hungarian model, a transaction between a refinancing and a refinanced bank can be defined as low risk and therefore – as also recognised by CRR (*EU 2013*)[3] – as a low-capital interbank loan, which is suitable for inclusion in the strict collateral system of mortgage bonds. In line with the regulatory interest

[3] See *Article 402(3) of Regulation (EU) No 575/2013*

associated with the transfer of the state interest subsidy for housing being a decisive factor in its formation, the refinancing creates coherence at the micro level, i.e. at the level of each mortgage loan, between the refinanced and the refinancing transaction, in the interests of making the full amount of the state subsidy applicable through the issuance of covered bonds available to all borrowers. The consequence of the construction is that as the individual mortgage loans in the books of the commercial bank decrease month by month due to the continuous payment of principal, and the monthly partial repurchase of the independent lien in the books of the mortgage bank continuously reduces the repurchase price of the independent lien, which also results in continuous amortisation of coverage of a mortgage bond. Thus, in the model, the maturity and repayment schedule of the refinancing loans of the mortgage bank are inevitably linked to the refinanced loans. This creates a situation as if the refinancer were the direct lender, and thus portfolio-level management of refinancing is not supported by this structure.[4] This feature also has a significant impact on the balance sheet structure of mortgage banks, as refinancing loans inevitably deviate from the maturity and repayment schedule of the mortgage bonds, thus generating risks in mortgage banks' balance sheets.

The legal framework for refinancing loans was significantly affected by the new Civil Code (*Polgári Törvénykönyv 2013*), which entered into force on 15 March 2014. *Section 5:100* of this legislation introduced the institution of the so-called separate mortgage lien, replacing the independent mortgage lien. This substantial change in the lien rules had a beneficial effect on mortgage bank refinancing in that the liens based on real estate by the refinanced bank were no longer the subject of the refinancing (as a transaction item), but rather the collateral. This change made it possible to implement a business model in which the mortgage bank provides a portfolio refinancing mortgage loan to the refinanced bank in a 'collateralised interbank transaction', which separates the collateral for this credit operation from its real estate lien claims and transfers them to a mortgage bank. However, the institution of the separate lien could not play this role permanently in the domestic legal system, even though it was established precisely in view of mortgage banks' refinancing loan operations. The separation of the lien from the underlying transaction had the compelling consequence that the unconditional relationship between the debtor of the original loan and the mortgagor (ancillary to the lien at the time of formation) was terminated. This appeared to be a legal risk of double performance, i.e. the repayment of the debtor was not necessarily accompanied by the termination of the mortgagor liability, which is inherent in an independent lien as well, but could be better addressed in its regulatory framework.

[4] Portfolio refinancing is already present in the domestic market, during which the parties agree on a lump sum and pre-determined refinancing, but even in this case, the continuous amortisation of the repurchase price of individual liens must be managed through recurring lien sales.

In view of this, and also due to the need to clarify the legal effects of the lien in liquidation proceedings, the separate lien was rescinded after about 2.5 years of operation. From October 2016, mortgage bank refinancing once again operated on the basis of an independent mortgage lien, with which the model resulting in the above detailed micro-level coordination has returned.

4.2.2. Collateral scheme for refinancing loans

The regulation of collateral assets in the Directive primarily applies to the default structure, i.e. in the case where the issuer of the mortgage bond is also the originator of the mortgage loan. In our opinion, the rules applicable to domestic conditions, which can be considered as exceptions, are contained in Article 9 of the Directive (*EU 2019a*) ('joint funding'), which allows the issuance to be co-financed by two or more credit institutions. In such a case, for the issuance of covered bonds by a credit institution, several credit institutions pool cover assets together in such a way that the lending bank sells the mortgage loan portfolio or transfers it to the issuing credit institution as collateral through a financial collateral arrangement (*EC 2002*). The aim of the Directive is also to make it possible to achieve the highest possible issuance volumes; therefore, according to the *Beaumont* (*2019*) report, a joint cross-border mortgage bond issuance programme has been launched for the Baltic countries as an experiment.

Both portfolio transfer techniques are already in force under *Jht.* (*1997*), since the purchase of portfolios by mortgage banks, as well as refinancing in addition to the transfer of bank portfolios as collateral are also regulated events. From this practice, the dominant solution is the transfer as collateral: the collateral of the refinancing resources provided by the domestic mortgage banks is the assignment of the refinanced mortgage loans.[5] This collateral position is vested in mortgage banks as provided by law. Therefore, if the refinanced bank breaches any of its payment obligations to the mortgage bank resulting from the refinancing, with or without the MNB initiating its liquidation, the assignment will take place under the law, thus making the mortgage bank a direct creditor of the mortgage loan transactions it has refinanced thus far. Based on the value of the portfolio thus taken over and the amount of the debt from the refinancing, a settlement obligation arises between the parties, during which the net value of the portfolio (reduced by impairment, approved by an auditor) can be taken into account. In order to minimise possible mortgage bank losses during such a settlement, it is a legal requirement that the amount of the refinancing loan may never exceed the amount of the refinanced loan.[6] On this basis, we consider that the current regulation can be implemented in accordance with Article 9 of the Directive, and so in this respect transposition does not necessarily result in a need for amendment. However, with regard to

[5] See *Section 8(6) of Jht.*
[6] See *Section 8(5) of Jht.*

assignment, it is worth examining its efficiency in more detail. One of the most important critical findings is that the statutory assignment does not create a legal succession for each loan agreement, only for the claims arising from it, so it would be appropriate to apply the contract transfer rules. However, even in the case of this necessary rule change, it becomes mandatory to include individual mortgage loans in the mortgage bank balance sheet when the conditions occur, during which the requirements expected by the *MNB* (*2020*) cannot be met as follows:

- due to the collateral nature, the portfolio must be taken over even if the own funds requirement and the business plan for its management (pursuant to Credit Institutions and Financial Enterprises Act (*Hpt. 2013*), these two are separate conditions for the authorisation of a portfolio transfer) are not provided by the mortgage bank;
- in the case of mortgage banks operating in purely refinancing models, no actual mortgage loan and related workout takes place, so typically neither banks' IT systems nor its organisational conditions are prepared for such a takeover;
- in the process, consumer protection guarantees cannot be enforced, as both the mortgage bank and the parties concerned only become aware of the date of the assignment[7] after the fact. In this case, the right of borrowers to terminate the contract free of charge, and even the right to prior information, cannot prevail in the face of unavoidable unilateral contract amendments.

4.2.3. Implementing overcollateralisation

With respect to structured securities, *Fabozzi et al.* (*2006*) define overcollateralisation as essentially an internal credit enhancement mechanism based on the principle that the value of collateral assets that cover securities exceeds the value of the securities. With this structure, it is possible to prepare for the situation that one or a few individual loans go bankrupt behind a security, while the remaining collateral assets (additional loans) can still provide bondholders with timely interest and principal payments.

However, in the pooling model, the above risk typically appears differently. The refinanced commercial bank may have to repurchase the defaulting individual customer loans from the mortgage bank and replace them with new ones. Thus, from the credit risk point of view, the pooling model can be considered safer for mortgage bondholders, since in the case of direct lending, the credit loss arises directly in the balance sheet of the mortgage bank, whereas in the pooling model the loss appears in that of the commercial bank. This is more advantageous for

[7] According to *Section 8(6) of Jht.*, the date of assignment is "the date of submission of the application for liquidation to the court", which can be known only when the order initiating the liquidation proceedings is published.

the mortgage bank and for the commercial bank for the same reasons: the capital market providing the ultimate funding will continue to fund an impeccable quality mortgage portfolio, so the capital market investor will determine the funding costs accordingly.

It is also important to note that, in contrast to a 'classic' securitisation, where a 'seemingly risk-free' transaction (*Marsi 2008:488*) can be established, according to the 'originate to distribute' model presented by *Király – Nagy* (*2008*), the pooling model also encourages commercial banks to restrain themselves. The reason for this is that even if a commercial bank places 'doubtful' mortgage loans in the mortgage bank collateral pool, no actual transaction occurs, so they will not be mortgage bank assets, and it may even have a repurchase obligation to the mortgage bank on the day it becomes a distressed loan. The stock of non-performing loans thus appears on the balance sheet of the original creditor commercial bank, motivating them to adopt more prudent lending practices.

However, overcollateralisation is currently expected by the credit rating agency, even in the case of the appropriate orientation of the interest schemes summarised above, and in the future the legislator, as summarised in *Section 3.3.1*.

In the case of 'Joint funding' as presented in *Section 3.2.4*, the Directive (*EU 2019a*) offers the possibility for assets to be transferred between partners through a collateral agreement, and accordingly – similar to the current domestic refinancing mortgage banking operation – the original loan remains on the lender balance sheet and the mortgage bank should 'only' acquire collateral entitlement. For this type of portfolio takeover, the fundamental issue is to assess whether the assets taken over should be considered as cover assets or collateral for the issued mortgage bonds. If they can be considered as cover assets, they can also be considered as overcollateralisation, while if they can be identified as collateral assets, they cannot be taken into account in meeting the cover level of the mortgage bonds. Arguments can be made for and against both positions on this fundamental issue of interpretation, but in our interpretation, in the case of joint funding, these assets taken over by the issuer can be considered as collateral for covered bonds. The correctness of this interpretation is reinforced by the reasoning in Preamble Paragraph (21) of the Directive that states: *"That would provide for the pooling of cover assets by several credit institutions as cover assets for covered bonds issued by a single credit institution…".*

In the case of refinancing, the current regulation of *Jht.* (*1997*) considers only the claim against the refinanced bank as ordinary coverage for mortgage bonds; it interprets the mortgage loan portfolio taken over from the refinanced bank as collateral assets. However, this regulation has the serious disadvantage that no matter how much the refinanced bank increases the assets it transfers, that is, to

whatever extent it exceeds the amount of mortgage loans transferred as collateral the refinancing capital received, they cannot result in overcollateralisation by the issuer, as they do not directly qualify as collateral for mortgage bonds. For this reason, purely refinancing mortgage banks, during their normal course of operations, are unable to meet the overcollateralisation from mortgage loans disbursed by the refinanced partner bank, they must also use additional capital to cover overcollateralisation, even if the refinanced bank has already effectively provided overcollateralisation with the 'surplus' mortgage loan provided as collateral. The additional capital, by its nature, cannot be low-cost mortgage bonds funding, but can only be raised from equity and/or as unsecured capital, making it more costly. In this way, the current domestic operating environment generates unjustified additional costs on the part of mortgage banks, thus making mortgage loans more expensive.

4.3. Opportunities to improve efficiency

4.3.1. An alternative to refinancing loans

In connection with the *MFAR* regulation, there is a realistic need between mortgage banks and refinanced institutions for refinancing to take place at the portfolio level, i.e. the refinanced institution should receive a lump sum of long-term funding from the mortgage bank, with which the actual lenders manage their long-term funding needs at the portfolio level. The efficiency of such an interbank loan can be significantly improved if the legislator does not expect the purchase and repurchase of individual independent liens, but allows the provision of so-called refinancing mortgage loans. This concept is already known in *Jht.* (*1997*) regulation, as the legislator has previously defined the activities of mortgage banks as an interbank loan when regulating refinancing with separate lien collateral. This notion should be corrected to the extent that, in the renewed refinancing mortgage loan regulation, the collateral for this loan, as described in *Section 4.3.2*, could be the mortgage right of the refinanced loans (as receivables).

With regard to this proposed new refinancing item, it should be noted that the only exception to the 'Large Exposures' regulated in Part Four of CRR (*EU 2013*) is refinancing through the transactions of independent liens.[8] Due to this regulation, the new model may be an efficient method of refinancing any bank by complying with the large exposure limits, and by ignoring these limits, refinancing can work within the banking group without taking into account the large exposure limits, if the exemption for large exposures under Article 400(2)(c) of CRR (*EU 2013*)[9] can

[8] See *Article 402 (3) of CRR.*

[9] (Competent authorities may fully or partially exempt the following exposures:) *"c) exposures, including participations or other kinds of holdings, incurred by an institution to its parent undertaking, to other subsidiaries of that parent undertaking or to its own subsidiaries, in so far as those undertakings are covered by the supervision on a consolidated basis to which the institution itself is subject, in accordance with this Regulation, Directive 2002/87/EC or with equivalent standards in force in a third country;"*

be applied in the banking group concerned. However, as the proposed new model is fully equivalent to the current model in terms of risk-taking content and is an issue that is also relevant at the EU level as an impact on the transposition of the Directive, it seems justified to initiate a correction of the CRR regulation, which may become a realistic option in view of it entering into force on 8 July 2022.

4.3.2. An alternative to the refinancing collateral system

The dilemmas explained earlier raise the basis for renewing collateral rules in refinancing. Based on the relevant provisions of the EU (*EC 2002*) and the Civil Code (*Polgári Törvénykönyv 2013*), it may be suitable collateral for refinancing the *lien on refinanced claims secured by real estate mortgages.* In the course of this new collateral regulation, similarly to the current assignment rules of *Jht.* (*1997*), it is still justified to establish these mortgage rights not by contract, but by legal provision on the basis of the Civil Code, however, the establishment of such also requires entry in the collateral register. Mortgage rights based on this claim may also be registered with circumscription in accordance with the Civil Code, that is, it shall not be recorded separately for each mortgage loan transferred as collateral, but for all mortgage loans created in the course of refinancing cooperation. In order for this legal solution to be appropriate, it needs to be clarified whether a claim-based mortgage can be properly established for the future at the start of refinancing cooperation, as it would provide a workable structure for a mass pledge of mortgage claims and thus for efficient refinancing. Futurity should be examined in terms of both the refinancing loan, i.e. the collateral claim, and the mortgage claim given as collateral, as in the ideal model neither exists at the time of registration. With regard to the secured claim, we consider the position, based on *Section 5:89(5)*[10] *of the Civil Code*, that: *"… a lien is created even if, at the time of the conclusion of the lien, the contractual relationship from which the future claim arises does not yet exist. However, the claim or the legal relationship must be identifiable in some way in this case as well.* […] *This means that at least the subjects and title of the fundamental relationship* (*e.g. loan*) *must be known.* (*Bodzási 2015:555*). We also share the view that *"Future claims may be secured not only by a contractual lien but also by a legal lien."* (*Bodzási* (*2015*:556). The futurity of mortgage claims provided as collateral is also not an obstacle to the proposed pledge, as according to *Vékás – Gárdos* (*2014*): *"In the case of a mortgage based on moveable things, rights and claims […] due to the nature of these assets and the nature of the collateral register, the mortgage may be registered even if the pledged property does not exist, it is not owned by the mortgagor, or the mortgagee does not otherwise have the right of disposal over it* (*Section 5:112*). *Therefore, in connection with the existence of a lien,*

[10] *"The claim secured by lien shall be specified in a manner allowing it to be identified by making a reference to the underlying legal relationship or relationships and by specifying the amount, or by any other way allowing the identification of the secured claim. The specification may also include a claim that has not yet been established."*

in the event of a dispute, the question to be examined independently is whether the mortgagor was the owner of the given property. If this condition is not met, the lien may not be created, notwithstanding the completion of the underlying transaction. However, it is not necessary for this condition to exist when the lien is established; a mortgage may be established in respect of things to be acquired in the future, with the exception of immovable property and other registered property, and the lien shall also be created if the mortgagor acquires title to the lien after the lien has been established."

On this basis, well-functioning collateral legislation can be established, where the refinanced bank would create a mortgage loan based on a claim under *Jht.* (*1997*) for mortgage loans offered to the mortgage bank as collateral for the entire duration of the refinancing cooperation, which may be entered in the collateral register by circumscription for each refinanced bank on the basis of a refinancing cooperation agreement, even before the commencement of refinancing. This collateral structure may have the following significant benefits:

- By entering the claim-based mortgage into the collateral register, by the force of law under *Jht.* (*1997*), in respect of a mortgage on immovable property established as security for a pledged claim, a sub-lien is created in favour of the mortgage bank. The creation of this sub-lien does not require the conclusion of a separate lien agreement or the transfer of a lien in the case of an independent lien, the lien is created as a legal lien in favour of the mortgage bank;

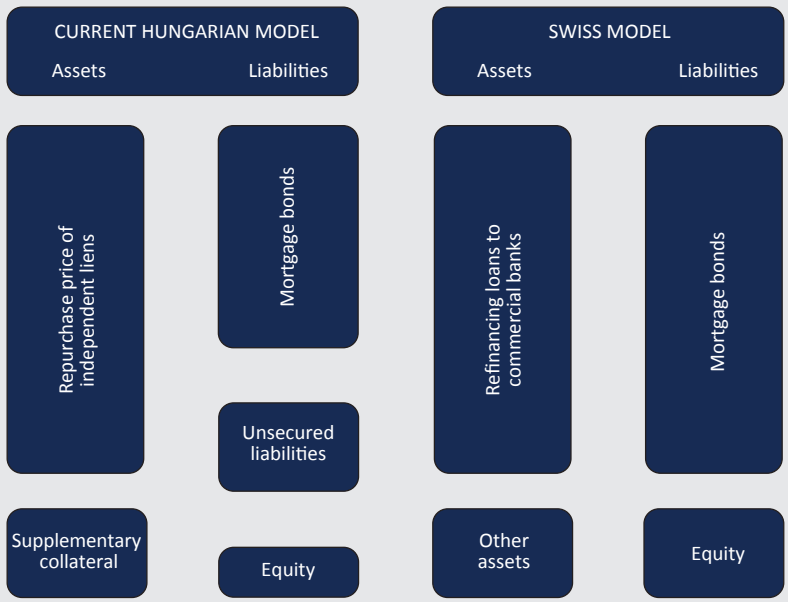
- Unlike assignment, when the lien is opened, i.e. in the event of non-payment, insolvency or resolution of the refinanced bank, the pledgee mortgage bank does not need and cannot have the collateral, that is, to acquire ownership of the receivables, i.e. there is no need to carry out a complicated transfer process;

- Instead of the immediate settlement obligation that accompanies the assignment, that is, when the net value of the stock taken over by the mortgage bank as a buyer at the time of takeover has to be compared with the amount of the receivable from the refinancing, which may result in a loss, the current net value of the pledged mortgage loan in favour of the mortgage bank does not have to be examined at the opening of the lien and there is no prompt settlement obligation, so the risk of loss can be reduced.

4.3.3. Mortgage bond collateral system

To address the dilemma of the mortgage bond collateral system, we examined several European mortgage bond markets, which are presented in the most comprehensive way by *Kemmish et al.* (*2017*). We found the largest non-EU mortgage bond market, the Swiss market, which was about EUR 119 billion at the end of 2018, according to *Kullig et al.* (*2019*), to be the most efficient and simple, and thus, for the sake of illustration, clear and understandable (*Figure 3*).

Figure 3
Schematic balance structure of the current Hungarian and Swiss pooling models



Source: Compiled based on Jht. (1997) and PfG (1930)

In Switzerland, only mortgage banks operating according to the pooling model can issue a *Pfandbrief*, which is a protected mortgage bond brand.

According to the summary *of Bossert* (*2008*), a *Pfandbrief* in Switzerland is covered by a refinancing loan and collateralised by a lien on a commercial bank mortgage loan, which ensures that in the event of non-payment by a commercial bank, loans to customers are removed from the commercial bank insolvency estate and transferred to the mortgage bank.

Literally interpreting the concepts of cover and collateral, the Swiss solution thus means that the mortgage bond cover is the refinancing loan granted, while the collateral of a mortgage bond is the pledged mortgage loan. Overcollateralisation means that there must always be more pledged mortgage loans on the mortgage bank records than refinancing loans (*Figure 4*). This system allows for free-of-charge 'OC' generation (there is no need to buy government bonds or supplementary cover from expensive, unsecured funding or even more expensive capital). It is important to emphasise, however, that the 'OC' created in this model does not consist of the assets on the issuer balance sheet, but of the assets transferred to it as collateral,

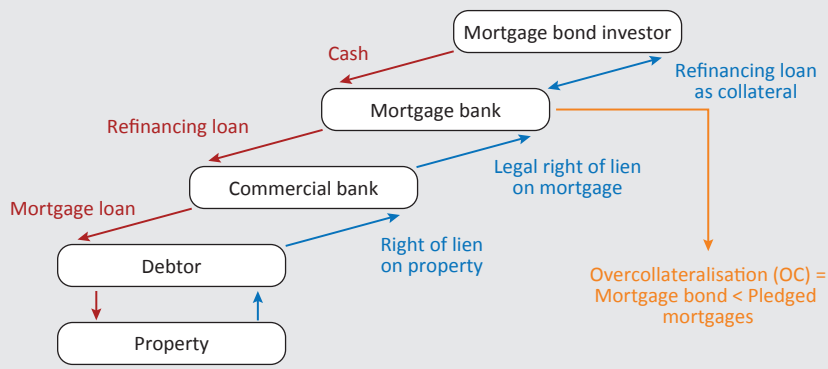
i.e. it results in off balance sheet overcollateralisation, on the other hand, the requirement for overcollateralisation is that the overcollateralisation provides added value in the event of the insolvency of the issuer, which in the current domestic regulation means overcollateralisation within the mortgage bank balance sheet. For this reason, the question arises as to whether a purely refinancing mortgage banking model based on the Swiss model can provide investor protection even in the event of a mortgage banks insolvency, since in the event of a mortgage bank bankruptcy where the commercial bank performs properly, the overcollateralisation instruments would not be available to mortgage bond investors.

However, another element of the examined Swiss model provides a solution to this. According to *PfG* (*1930*), the asset side of the mortgage bank balance sheet consists exclusively of refinancing, secured interbank loans, while the liability side consists exclusively of mortgage bonds (excluding the bank equity and its investment in liquid assets in a regulated manner). These loans, also according to *PfG* (*1930*), are obligatorily harmonised with the mortgage bonds in their maturity and amount, so that the mortgage bank is essentially market risk free. And by meeting these two criteria, the regulatory environment guarantees that the mortgage bank alone will not become insolvent towards mortgage bond investors, as this would only happen if a refinanced bank goes bankrupt. In this case, however, the liens would already be open in respect of the collateral, i.e. the pledged mortgage loans, taken into account in the context of the overcollateralisation, that is, these collateral would already cover the mortgage bonds of the mortgage bank.

Switzerland, as a non-EU Member State, is not part of the European banking regulatory framework, but given the high quality they represent, its regulatory principles and operational experience should be taken into account during implementation. However, the framework is broad enough for a similar system to work in the EU. For example, the Finnish legislation (*KLPL 2010*, in English: *CBA 2010*) is familiar with the concept of 'intermediary credit', which is a mortgage-backed credit granted by a mortgage bank. According to *Section 16 of CBA* (*2010*), the total amount of mortgage loans offered by the debtor of the 'intermediary credit' to cover the mortgage bonds must always exceed the principal amount of the 'intermediary credit'. This is equivalent in nature and operation to the operating principle of the Swiss pooling model. In the case of the Finnish example, according to *Section 12 of CBA* (*2010*), only mortgage loans, loans to the public sector or supplementary collateral can be used as collateral for mortgage bonds, so it is necessary to separate them from the 'intermediary credit' which is in the balance sheet.

We deem the regulatory principle explained above presented with the almost 'laboratory-clean' Swiss example and reinforced by the Finnish example within the EU, worthy of consideration during implementation and elaboration in the framework of professional discussions covering the detailed rules. The definition of 'match funding requirements' in the Directive and the related legislation provide an appropriate basis for this. As a result of the innovative regulation, it would simply be sufficient to create overcollateralisation for mortgage loans financed by a covered bond once. It is important to emphasise, however, that such a regulatory step could not even potentially lead to a devaluation of mortgage bonds, and therefore, with key financial supervision, we see this overcollateralisation principle as feasible for mortgage banks that meet all the requirements of the model. To this end, from a regulatory and authorisation/supervisory point of view, we clearly recommend distinguishing between purely refinancing mortgage banks and mortgage banks that also carry out their own lending, which may be subject to different rules on certain issues, including overcollateralisation. In our opinion, the legal requirements for the status of a 'purely refinancing mortgage bank' (asset and liability side restrictions and their mandatory harmonisation) can be laid down in the new regulation, the fulfilment of which requirements would be established by the MNB as a licensing authority in a separate official licensing procedure, and it would be obliged to monitor its continuous fulfilment. In addition to the model that has worked well thus far and will be preserved in the future, this solution would create an alternative that could serve the development of the domestic mortgage bond market by ensuring the collateral security of mortgage bonds at the same level as at present, strengthening investor confidence.

Figure 4
The fourfold chain of security of the mortgage bond investor in the proposed new model



Source: Compiled based on Bossert (2008) p. 3 and legal adaptation

5. Summary

With a detailed analysis of the new Directive and the related CRR Amendment and using the practical experience of the domestic model, we came to the conclusion that an alternative refinancing model can be defined during the implementation within the framework of *Jht.* in Hungary, which, while maintaining the current well-functioning model, can be summarised as an optional alternative, as follows:

- commercial lending operation by a refinancing mortgage bank: the provision of a refinancing mortgage loan to a credit institution that has a cooperation agreement with it and carries out mortgage loan activities for its customers;
- collateral for refinancing mortgage loans is the mortgage rights of mortgage loans granted by a refinanced credit institution that fully comply with the CRR Amendment and the requirements for cover assets set out in the Directive, which mortgage encumbering a claim is established by *Jht.* as a statutory lien in favour of the mortgage banks and which is entered in the collateral register by circumscription. The opening of this lien should be mandatory not only for non-payment of the mortgagor, but also for insolvency or resolution proceedings.

The above-mentioned alternative model to refinancing may be suitable for the efficient execution of refinancing already at the moment of its introduction, with the restriction that it can operate between institutions outside the banking group within the limits of the large exposure limit, within the banking group without this restriction. In the refinancing area of non-banking group institutions, the new model would be a transaction with exactly the same risk as the current model defined as an exception currently under CRR (*EU 2013*), so we believe that a CRR amendment could be initiated to extend the individual exception to large exposures.

Another important conclusion of the study is that in the case of a purely refinancing mortgage bank, it is possible to specifically regulate the mortgage bond collateral system, necessarily taking into account the specific features of this model, especially the fact that the issuing mortgage bank is a special intermediary which securitises the mortgage loans of its partner banks with long-term mortgage bonds in favour of those banks. In the current operating environment, refinancing mortgage banks are not able to create overcollateralisation from their ordinary coverage during normal operation, and therefore, for reasons of cost-effectiveness, it is justified to examine the possibility of legislative corrections. Thus, in purely refinancing mortgage banks, the securitisation of refinanced credit institution assets, even if not in the refinancing mortgage bank balance sheet, but in the collateral registry there is an overcollateralisation, which can guarantee a high level of investor security. Accordingly, in such mortgage banks, which can be defined as a separate subtype, it is appropriate to regulate the mortgage bond collateral system in two

layers, where the first layer is the assets appearing in the mortgage bank balance sheet (mainly refinancing mortgage loans), against which the legal requirement must be at all times at least equal to the nominal value of the mortgage bonds in circulation. The second collateral layer is the refinancing mortgage loans collateral, i.e. pledged mortgage loan by a refinanced bank or mortgage loan that is handed over by assignment, the resulting principal and interest claims of which must exceed the principal and interest amount of the refinancing mortgage loans to the extent required by the overcollateralisation requirement. In such a new model, we consider it a guarantee element that the risk of insolvency of the issuing mortgage bank is minimised, which can be determined in the mandatory reconciliation of refinancing loans granted and mortgage bonds issued and in the supervisory control of these requirements.

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Transformation of Global Supply Chains in the Manufacturing Industry as a Result of the Coronavirus Pandemic*

Róbert Hausmann

This essay seeks to find out how the coronavirus pandemic may change the international organisation of economic value creation and promote its ongoing transformation. Today's production and service activities are built on international outsourcing and low stocks. Global production organisation has extended supply chains, with different production functions being performed on different continents, and supply chains have also become strongly exposed to Chinese imports. Industries where safety stocks last shorter are hit harder by the economic crisis that has emerged on the back of the pandemic. This poses serious challenges to business models built on the just-in-time system and the lean approach. In response to the current problems, global supply chains may become shorter and more regional during the economic recovery, and they may use multi-sourcing and increase safety stocks. Digitalisation and automation may accelerate, since supply chains will need more data, faster decisions and feedback to ensure a more flexible safety stock policy and more automated production and warehousing. Automation also transforms jobs, making it crucial to develop the skills of workers and to retrain them.

Journal of Economic Literature (JEL) codes: M21, O33, F60

Keywords: global supply chains, digitalisation, robotisation and automation, business economics, coronavirus pandemic

1. Introduction – In which framework can 21st century production organisation be interpreted?

Products and services are not created in distinct companies but rather according to the principles of the international division of labour and efficiency, complemented by safety and business continuity considerations. The examination of value-adding activities is based on the theory of comparative advantages by Adam Smith and the

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division of labour built on that, due to which the different phases of the production process are separated and performed by different actors and firms. The decision on exactly which company should perform a particular production phase depends on several factors (geographical location, business profile, company size, technological preparedness), but ultimately this production organisation issue is decided based on business efficiency. Nowadays, the efficiency of international corporations and supply chains cannot be interpreted within state borders, and it has become inseparable from international trade. *'The flow of goods and services creates the link between the different locations in the division of labour: raw materials flow to parts manufacturers, then from there intermediate goods flow to the producers of final goods, then final goods flow to consumers through wholesalers and retailers'* (*Ilyés 2016:51*). However, similar to the lower levels of Maslow's hierarchy of individual needs, in particular safety and physiological needs, the division of labour and corporate efficiency can be only enforceable if physical and human capital can flow freely, business continuity is ensured, and international trade is not hindered by one-sided or mutual obstacles. Fulfilment of these conditions is increasingly uncertain due to the coronavirus pandemic; therefore, a focused analysis is warranted regarding long-term and current developments influencing the operation of supply chains and the resulting potential ways and phenomena for supply chains. Nevertheless, due to its topic and for reasons of brevity, this article does not seek to provide an in-depth analysis of the various approaches to value chains and supply chains, the latest research results on supply chain management and trends in the discipline of production management.

Global supply chains are one of the models for business operations, in which the different stages and phases of value-adding activity are performed by different firms in different countries. "Supply chains should not be confused with value chains. Supply chains are interconnected networks of companies providing specific activities, in which the activities of each of the actors involved serve the needs of the final consumer. In other words, the supply chain is an … interconnected series of corporate value chains…" (*Juhász-Dóra 2016:24*). The concept of value chains is attributable to *Michael E. Porter* (*1985*), who attempted to pinpoint the source of competitive advantages by highlighting the value added of corporate activities, regardless of the organisational background of the division of labour. The term *value chain* refers to organising the processes necessary for creating a product or a service, such as research and development, design, production, marketing, distribution and support to the final consumer, into a chain (*Gereffi – Fernandez-Stark 2011*). In Porter's approach, these value-adding activities can be divided into 'primary activities' (production, logistics, marketing, sales and services related to sales) and 'support activities' (infrastructure, human resource management, technological development, procurement) (*Porter 1991*). The term 'global' suggests that today a major part of value-adding activities is based on the international division of labour and the utilisation of comparative advantages, however *Gereffi*

– *Fernandez-Stark* (*2011*) note the role of regionalisation and local solutions in establishing the suppliers of the value chain. In global production organisation, activities are not coordinated automatically. *Hernández – Pendersen* (*2017*) present the options for governance and organising tasks within value chains. In the case of manufactured goods, 50 per cent of international trade and approximately 70 per cent of the cross-border trade in services comprise intermediate goods and services, which means trade within global supply chains (*Ilyés 2016*).

Supply chain management deals with the strategic decisions made to ensure the operation of supply chains; it endeavours to improve the competitiveness of the ties among the participating organisations. Supply chain management may be assisted by various tools. These tools can be divided into two categories: *the management of real economy processes and the management of risks.* Real economy processes are sought to be managed by decisions regarding outsourcing, keeping corporate activities within the firm or insourcing. The same purpose is served by the decisions on ad hoc or strategic partnerships (few or many suppliers, the presence or absence of the coordination of information and plans, which also depends on geographical features), adjustment to fluctuations in demand (demand management) and the use of a complex order fulfilment process. Companies can choose from two types of supply chains for their optimal operation: the lean[1] supply chain ensuring the steady flow of goods, or the flexible (agile) supply chain guaranteeing rapid response to shifts in demand. Risk management involves intracompany and intercompany internal disruptions, supplier risk and longer transit times, as well as the consequences of political instability and the consequences of unexpected natural or health disasters (*Gelei 2010*).

Another approach is production management, which examines value creation from the perspective of firms or at the micro level, in contrast to the aggregate, macro-level framework (value chain, supply chain). According to the definition by *Chase et al.* (*1995*), *production and service operations management* deals with the design, operation and improvement of the production system that creates and delivers the firm's primary products or services. Production management is an interdisciplinary field between management and engineering, and as such, it is one of the most typical basic fields of technical management. The scientific basis of production management is provided by *operations research,* which is based on mathematical foundations. This discipline, focuses on the characteristics of the 'just-in-time' production and the pull mechanism that serves to control the flow of materials in this production system, which is a central feature of the operation of global supply chains (*Koltai 2006*). Although the just-in-time system reduces the costs of inventories to a minimum, it increases business continuity risks (*Gelei 2010*).

[1] As in 'streamlined'

2. What are the main features of global production organisation and supply chains?

As one of the main consequences of globalisation, which intensified from the 1980s, companies transformed their business models in line with the principles of the just-in-time system and lean management.[2] The just-in-time system is an inventory management and production organisation model that serves the current needs necessary for production, thereby reducing the unnecessary costs related to inventory investments. In connection with the just-in-time production organisation, one can mention the lean corporate management and governance concept, which aims to remove from the production process the steps that do not create value for (corporate or household) consumers. The volume of inventories and warehousing dropped due to the introduction of this approach; however, production was complemented with a new aspect, namely *outsourcing.* The principle of outsourcing states that firms should perform all activities necessary for production by ensuring the lowest possible costs (*Figure 1*). *Onshore outsourcing* is when a part of the production process is delegated to a domestic company, and *offshore outsourcing* refers to a situation where a phase of the value-adding activity is assigned to a foreign company within the supply chain. The reduction in the costs of international transportation and foreign trade (duties and other costs) entailed businesses in distant countries being integrated into production. As a result, *every third German industrial company has a major Chinese customer, and 81 per cent of German firms have a Chinese supplier in one form or another.* Only four per cent have no ties to China at all (*Klöpfel Consulting 2020*).

Figure 1
Current business management model of globalisation in the manufacturing industry

[2] Lean management is a method of corporate governance that improves the efficiency of the production process, while also shortening it, by identifying and minimising losses. It focuses on satisfying customer needs as efficiently as possible.

The fact that value creation is becoming more cost-effective due to global production organisation benefits both consumers and shareholders; however, this strong interdependence may turn into a detrimental dependence in crisis situations, even in strategic industries. The international division of labour that emerged during globalisation led to a mutual dependence between states, in other words *interdependent business and trade relations.* Under specific circumstances, this model – which is based on comparative advantages and the level of economic development – is favourable from the perspective of the expansion in the volume of trade, economic development and international cooperation. It makes production cheaper, creates jobs in developing countries and strengthens multilateral ties between countries. However, the operation of global supply chains is exposed to several risks: natural disasters, terrorism, armed conflicts, state regulation, an absence of innovation, the macroeconomic environment and shifting consumer needs. Furthermore, the operation of global supply chains also has to live up to the endogenous financial and production organisation challenges within the chain (*Lessard 2013*). During a crisis, long supply chains crossing multiple continents can be disrupted, and some final goods and services may be impossible to produce or provide as a result of the application of the production organisation principles described above. If this occurs in strategic industries (e.g. the health industry), it could jeopardise the basic needs of a country, the performance of public tasks and ultimately the self-sufficiency of the country.

3. Which changes in the global production organisation that have already started may intensify in the future?

Changes in the business mindset induced by the coronavirus pandemic may lead to the shortening of the long global supply chains that have emerged in the past decades and the spread of import-substituting solutions. The *German National Industrial Strategy* published in 2019 and the *new EU industrial strategy* presented in March 2020 both include *import substitution*, the need to *replace foreign supplier capacities*, *reduce corporate concentration* and *prevent foreign acquisitions,* especially when it comes to strategic industries. One of the conclusions of the German National Industrial Strategy is that German companies operating in key industries should be protected against any hostile takeover attempts from outside the EU. To this end, nationalisation is recommended if all other options have been exhausted in the most important industries, in a partial and temporary manner. Key industries include the automotive, steel and aluminium industries, the chemical and pharmaceutical industries, mechanical engineering, the optical industry and manufacturing of medical devices, the green economy, the defence industry, the aerospace industry and additive manufacturing technology (*BMWI 2019*).

The aims of the new EU strategy include addressing the distorting effects of third-country subsidiaries on the EU's internal single market and the development of legal mechanisms that can be used to restrict the access of – mostly state-owned – companies from third countries to the public procurement and funding of the European Union (*European Commission 2020*). This strategy and the views described in it are reflected in the statement by Margrethe Vestager, the EU Commissioner for Competition, that she has no objection to EU countries appearing on the market and acquiring stakes in a company, provided that this prevents a foreign takeover by a company from a third country (*Espinoza 2020*).

The coronavirus pandemic may also trigger the inclusion of more partners in the undiversified network of suppliers and the reduction of its one-sided dependence. According to Alex Capri, a visiting senior fellow at the National University of Singapore and a former advisor of KPMG, a massive restructuring of supply chains is to be expected in the wake of the coronavirus pandemic. The researcher expects to see developing countries remain important in terms of sales and suppliers, but firms are foreseen to diversify their sourcing (*Tan 2020*). This phenomenon is referred to as the reconsolidation of purchases, in other words the reduction of purchases from the same partner (*Gelei 2010*). The economic concepts of *tradable* and *non-tradable categories* may have to be revised, because with regard to previously internationally tradable goods and activities the coronavirus pandemic has shown that they can only be traded without limitations if specific conditions are met (scheduled transportation, sufficient stocks, no state restrictions, constant demand). Moreover, among the values of business models, the priorities of low material and labour costs and the international division of labour may be superseded by substitutability within the company, company group or the state border, the maintaining of various transport routes and the increase of inventory reserves.

In recent years, several analyses have argued that global supply chains are expected to shorten and the number of participating companies and countries linked to a supply chain may decrease. The current operation of global supply chains may change as a result of the *so-called equalisation effect,* i.e. the process whereby the return on equity declines in developing and moderately developed countries as their wage costs increase. Similar implications can be expected based on the *paradox of specialisation,* or the rejection of the thesis that one of the cornerstones and key efficiency-boosting features of global production is the division of value-adding activities into smallest possible units and organising them into specialised units. The paradox of specialisation not only concerns production organisation but also leads to a shift in the need for training human capital, among other things. Instead of educational and training programmes focusing on individual industries or business

functions (e.g. assembly), complex competence-based educational programmes developing problem-solving skills are increasingly in demand. After completing them, people enter the labour market with knowledge that can be applied well in practice and an ability to solve complex challenges, adapt and acquire new skills (*Ilyés 2016*). Pankaj Ghemawat, a business economics professor at New York University, claims that the shortening of global supply chains is attributable to the equalisation effect as well as chains' fragility. According to Ghemawat, when the SARS virus ravaged Asia in the early 2000s, there were disruptions in several supply chains. As a result, the supply chains consisting of 30–40 phases have substantially shortened. Furthermore, Ghemawat believes that larger stocks are needed due to outsourcing to foreign countries, which could be significantly reduced by domestic or regional production (in contrast to the policy of manufacturing products in different continents and keeping low inventories).[3]

The factors contributing to the simplification and shortening of global supply chains have become more numerous since 2008, and their effects are accelerated by the coronavirus pandemic. Global multi-stage production processes emerged while taking into account the *low barriers to trade and the increasing risk of economic interdependences. Global supply chains often include four or five levels,* from the original equipment manufacturer (OEM) to Tier 1, Tier 2, Tier 3 etc. suppliers. There are often no or only very loose and indirect links between the OEM at the head of the chain and the Tier 4 or 5 suppliers. According to Peter Guarraia, a partner at Bain&Company in Chicago and global supply chain expert, 60 per cent of the managing directors of the largest companies involved in global supply chains are not aware of the supply chain processes beyond the Tier 1 suppliers (*McGee – Edgecliffe-Johnson 2020*). Therefore, if disruptions arise in sourcing or production, the OEM is not informed about the difficulties faced by suppliers and end suppliers are also informed about problems that surface at OEMs only with a delay. In global supply chains, *developments which encourage rethinking the international division of labour already started proliferating in the 2010s.* These included the global financial crisis from 2008, the introduction of Chinese export quotas on rare earth metals in 2010, the volcano eruption in Iceland in the same year, the earthquake and tidal wave in 2011 in Eastern Japan, the flooding in Thailand in 2011 and the trade conflict between the United States and China that has been unfolding since 2018. This process is reinforced now by the disrupted and, in certain cases, disintegrating supply chains due to the coronavirus pandemic (*Shih 2020*). As a result of the processes described above, 12.9 per cent of the value creation of the world

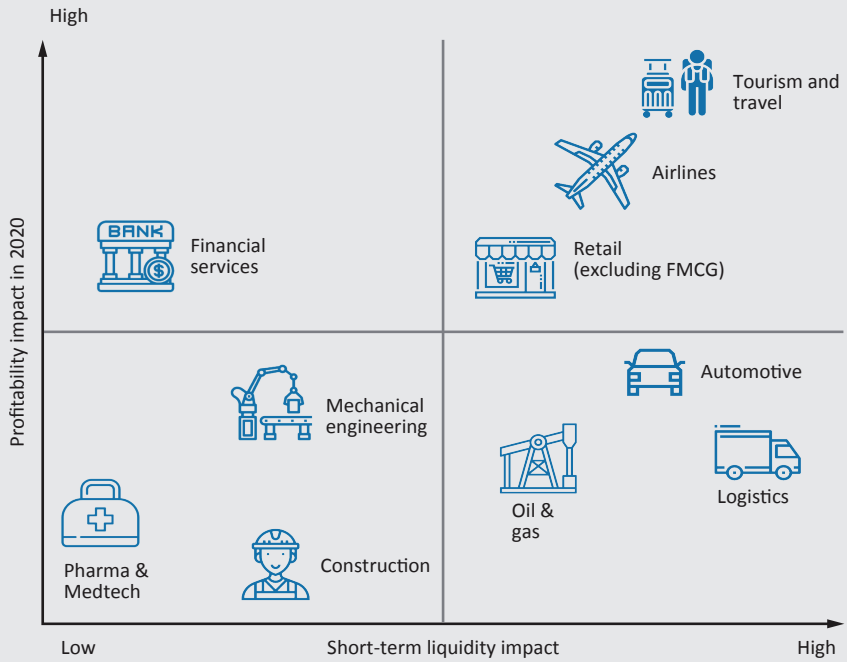
[3] *Multinational manufacturers moving back to America*. Economist, 12 May 2011. https://www.economist.com/business/2011/05/12/moving-back-to-america. Downloaded: 15 April 2020.

economy occurred in global supply chains in 2017, which was 0.5 percentage points lower than in 2007 (13.4 per cent). However, the values of the different countries vary widely: most Eastern and Central Eastern European countries managed to increase their share within supply chains between 2007 and 2017. For example Hungary's value added produced within global supply chains grew by 4.8 percentage points in this period, rising from 23.0 to 27.8 per cent (*Li et al. 2019*).

4. Which sectors and supply chains are affected the most negatively by the coronavirus pandemic and why?

From a liquidity and profitability perspective, the sectors that are most affected by the negative economic consequences of the pandemic are tourism, air transport and retail trade; those moderately affected include the automotive industry, logistics, the oil and gas industry as well as financial services; the least affected may be the pharmaceutical industry, construction and machinery (*Figure 2*). The expected sales revenues and profit outlook of tourism and travel services are dampened by the fact that tour operators need to cancel some of the trips planned for the high season. In air travel, a prolonged shutdown causes liquidity problems for the firms, and balance sheet adjustment becomes harder due to aircraft purchases that are based on continuous borrowing and the use of flexible ticket pricing models. With the exception of fast-moving consumer goods, even retail trade may show a marked liquidity shortage and a drop in profits. *In the automotive industry, logistics and the oil and gas industry a massive short-term liquidity shortage may arise, but the profitability of these sectors is probably less at risk.* In the automotive industry and transportation, firms' exposure to the crisis also depends on company size and their position in the supplier chain. The unit price of oil has lost more than three quarters of its value since the onset of the crisis, which may cause short-term liquidity problems for businesses active in the sector, however, these difficulties may ease as demand gradually picks up. *The economic crisis triggered by the coronavirus pandemic may weigh heavily on the profitability of the financial sector, whereas the pharmaceutical industry, construction and machinery (with the exception of the automotive industry) are expected to feel less of the negative effects.* The profitability of the financial sector could fall mainly due to low interest rates, monetary policy measures, the introduction of temporary credit moratoriums and the drop in lending activity (*Roland Berger 2020*).

Figure 2
Unfavourable effects of the coronavirus pandemic on the liquidity and profitability of certain sectors

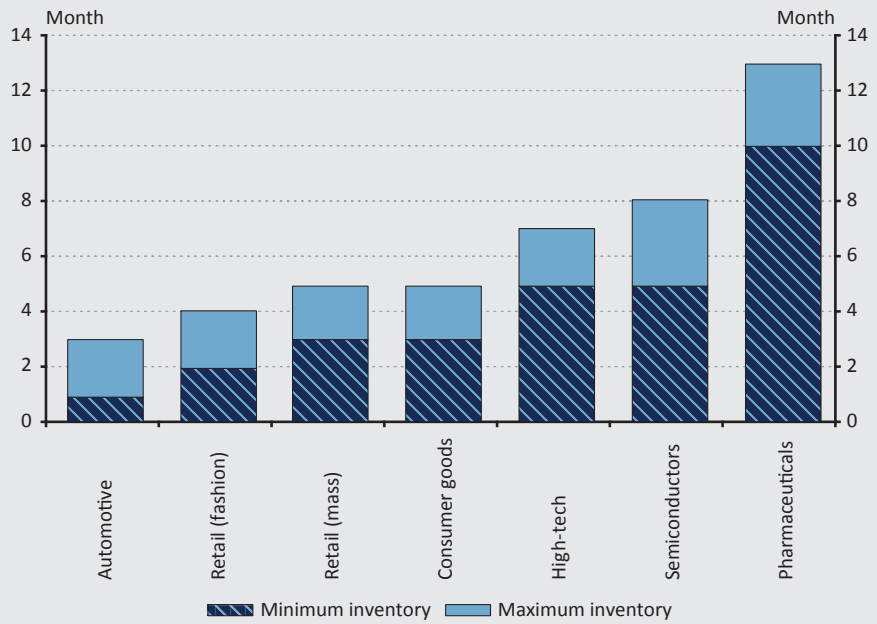


Note: The effects reflect economic shutdowns/disruptions between three and twelve weeks.
Source: Roland Berger (2020)

The exposure of industries to the economic crisis triggered by the coronavirus pandemic correlates with their inventory amounts and stockpiling policies. A correlation can be detected between the size of inventories observed in the different industries and the negative effect of the crisis on the given industries. In the industries where *inventories last longer and therefore no further imports are needed, the crisis may exert a more moderate impact.* Lower inventories, which have typically emerged in the spirit of the just-in-time system, lean management and optimisation, are not sufficient to maintain the same level of production in a period of temporary liquidity shortages and insufficient demand, so the factories in these industries are forced to shut down earlier. Globally, the automotive industry has inventories that last only one to three months, which is one of the lowest in the industrial sector, making it the most vulnerable for example when there is a risk of a pandemic. Commercial firms offering clothing, mass products and consumer

goods have inventories that last two to five months, which may be enough to weather even a moderately long shutdown. The inventories of companies that mainly produce high-tech products and use semiconductors last for five to eight months, while pharmaceutical corporations can continue production for ten to thirteen months (*Figure 3*). Inventories lasting for more than six months allow a longer economic shutdown to be overcome. Detailed data on the inventory policies of the different industries are also available (*Alicke et al. 2020*) (*Table 1*).[4]

Figure 3
Depletion time of built-in inventories in the case of certain economic activities



Note: The minimum inventory means the average minimum reserve amount that value chains active in the given field/sector have. The maximum inventory (aggregated with the minimum inventory) means the average maximum reserve amount that value chains active in the given field/sector have.

Source: Compiled based on Alicke et al. (2020)

[4] The calculations were performed while examining the disruption or absence of Chinese supplies due to the coronavirus pandemic.

Table 1
Depletion time of built-in inventories by activities within the supply chain in certain sectors (days)

	Automotive industry	Retail (fashion)	Retail (mass product)	Consumer good	High-tech	Semi-conductors	Pharmaceutical industry
Tier 2 supplier	30–40	–	–	20–30	40–60	–	35–70
Tier 1 supplier	7–17	15–35	60–90	60–90	55–70	70–110	120–140
Assembly/ Packaging	2–12	15–29	10–17	10–17	19–45	60–90	55–100
Regional distribution centre	–	15–23	15–17	14	–	–	80–90
Market buffer	0–30	21–28	7	–	24–40	20–30	–
Total inventory	**39–99**	**66–115**	**92–131**	**104–151**	**138–215**	**150–230**	**290–400**

Note: Empty cells indicate missing data.
Source: Compiled based on Alicke et al. (2020)

5. What changes in corporate governance and production organisation are expected as a result of the coronavirus pandemic?

Due to the negative impacts of the coronavirus pandemic on supply chains, many companies are expected to transform their business models after the crisis. Key aspects of the anticipated transformation may be as follows:

a) *Regionalisation of production, shortening supply chains: The supplier base necessary for production will be localised in the OEM's country and its economic region.* Along the model based on the lean approach, the localisation strategy that has been coming into focus in Japan since the 1970s may become preferred. The production system of Toyota operates based on this principle. Its headquarters are in Japan, and its suppliers are mainly based in neighbouring countries rather than on other continents. Toyota's subsidiary in the United States also operates with a similar approach. Out of their suppliers related to their plant in Georgetown, Kentucky, 350 are located in the United States, and 100 of them are within the state of Kentucky (*Shih 2020*). If German industrial firms applied a similar approach in their production on account of the economic crisis triggered by the coronavirus pandemic, Hungary may be prioritised over other production sites that are located farther away. Germany's openness towards the regionalisation or localisation of supply chains is reflected in the statement by Peter Altmaier, the federal minister for economic affairs and energy, from the spring of 2020, according to which it is wise to reduce one-sided dependence

in certain areas to reclaim national sovereignty. Besides the regionalisation of production, Altmaier also emphasised the importance of common European projects, primarily in pharmaceuticals production.[5] The foundations and ideological basis for the localisation and regionalisation of production and the shortening of supply chains can already be found in *Small Is Beautiful: Economics as if People Mattered* by *Schumacher* (*1973*).[6] The shortening of supply chains would not only increase security of supply but also promote local job creation, increase tax revenues, and it may reduce emissions and the ecological footprint of production due to falling transport volumes (*Jackson – Morrow 2020*).

b) Multi-sourcing and accumulating safety stocks: Involving numerous suppliers in the supply chain that produce the same product and strategic stockpiling may ensure business continuity in a crisis. Although the *diversification of suppliers* and obtaining the same product from several firms operating in different countries as well as *safety and strategic stockpiling* entails additional costs, based on the lessons learnt from the current crisis, these measures may reinforce business continuity and *reduce the vulnerability of global supply chains.* Of course, there are industries where this is not feasible due to geographical or other factors, such as the production processes focusing on the use of rare earth metals. However, in the pharmaceutical industry, the Danish Novo Nordisk, which produces 50 per cent of the world's insulin stock, already has *inventories for five years in preparation for a shutdown* (*Shih 2020*). The practices of the Danish corporation may serve as an example when transforming the business strategies of other sectors and companies.

c) Economies of scale and changing the product mix: The principle of 'one factory, one product' may be replaced by 'one factory, multiple products'. The global organisational principle of automotive manufacturing is that one production plant manufactures one model. For example, the BMW X series is manufactured exclusively in Spartanburg, South Carolina, and 70 per cent of the cars produced there are exported. Geographical concentration in production is widespread not only in the automotive industry, it has also caught on globally in the case of electronic devices and fast-moving consumer goods in recent decades, because this solution has maximised production efficiency. If one factory produced more than one product at the same time, it would facilitate the regionalisation of production organisation and could ensure the uninterrupted functioning of supply chains in the event of an emergency (*Shih 2020*).

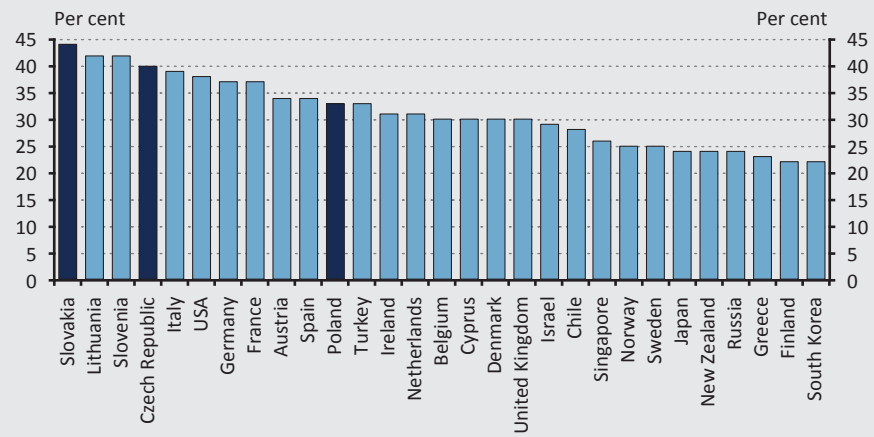
[5] *Germany would like to localize supply chains, nationalization possible, minister says*. Reuters, 13 March 2020. https://www.reuters.com/article/us-health-coronavirus-germany-pharmaceut/germany-would-like-to-localize-supply-chains-nationalization-possible-minister-says-idUSKBN2101BH. Downloaded: 8 April 2020.
[6] In Hungarian: A kicsi szép (Tanulmányok egy emberközpontú közgazdaságtanról)

d) *Establishment of centres coordinating the operation of supply chains: OEMs should manage the internal processes of the supply chains and the decisions pertaining to the overall supply chain together with the other firms in the chain.* This can be achieved in several ways (*Faria et al. 2020; Alicke et al. 2020*). At the level of supply chains, *working groups should be established* where the main participants in the supplier chain are represented, and they should also be temporarily expandable with the representatives of employer and employee stakeholder groups and financing parties, in particular lending banks, as well as experts, if necessary. The working group can utilise big data (a large dataset based on actual data) to obtain real-time information in a crisis about the production, employment and financial position of the companies within the supply chain, and it can also explore the consumer environment and the external conditions, which allows it to intervene in a more rapid and targeted manner to maintain uninterrupted production, if necessary. These centres coordinating operation should not hamper the independence of the firms in the supply chain or the exercising of ownership rights, and they may not interfere with decisions of companies not pertaining to the operation of the supply chain. When the crisis is over, the centres and working groups coordinating the operation of supply chains should not be abolished, as they can continue to ensure the flow of information within the supply chain, the assessment of the continuously incoming data and the overall coordination of the processes related to production. This may take the form of a so-called *supply chain control tower,* the main aim of which is to ensure and maintain *transparency* within the supply chain and *address* the arising *risks* (*Deloitte 2019; Trzuskawska-Grzesińska 2017*).

e) *Digitalisation and automation in activities of supply chains: The automation of the less complex activities of production lines and the enhancement of the business model with digital solutions may improve corporate efficiency and productivity.* The coronavirus pandemic may encourage producers to replace the easily automatable production processes that require the on-site presence of workers with robots. This could affect those countries more where firms perform lower value-added activities within global supply chains. According to the analysis by *Hawksworth et al.* (*2018*), automation may unfold globally in *three overlapping waves* rather than in a linear way: the *algorithm* wave (focusing on simple processes) is already under way, the *augmentation* wave (pertaining to repeatable processes) may be completed in 2020, and the *autonomy* wave (focused on complex workflows requiring substantial human capital) may culminate in the 2030s. In Hungary's Visegrád peers (dark columns in *Figure 4*), the share of jobs affected by the three waves of automation is 40 per cent, which is high by international standards. This is because the proportion of low value-added manufacturing activities is higher in these countries than in Western European states. The *process of automation is accelerated by economic crises,*

because low-skilled workers become costly for many businesses as corporate revenues are dented, and it is often worth replacing them with robots, or these firms increase their productivity by using higher qualified workforce (*Jaimovich 2012; Muro et al. 2020*). Moreover, the detrimental effects of the pandemic may encourage producers to increasingly incorporate digital solutions in their business models. These include *cloud-based solutions,* the *5G* mobile internet and the *Internet of Things* (IoT), production organisation based on *big data* solutions, *artificial intelligence,* the deployment of *ERP*[7] *and CRM*[8] *software* supporting the course of business and the widespread application of *e-commerce solutions* and *cybersecurity software.*

Figure 4
Share of jobs that can be automated by the mid-2030s in an international comparison



Source: PwC – OECD PIAAC data collection (Hawksworth et al. 2018)

The current condition of global supply chains and the change in their maturity are difficult to measure, because trade statistics do not take into account the features of production organisation and the firms or the trade in goods and services within corporate groups. The *trade in value-added statistics* (OECD TiVA) improve the measurability of supply chains' value-creating capacity, although they hardly quantify the activities at the beginning and end of the production process, even though their value added is among the largest (*Ahmad 2019*). The logic behind the trade in value statistics is used by the *UNCTAD-EORA GVC Database* (*Casella et al. 2019*) and the *World Trade Organization's GVC Participation Index*[9] (*WTO 2018*).

[7] Enterprise Resource Planning
[8] Customer Relationship Management
[9] Trade in Value-Added and Global Value Chains

The latter creates a profile of the countries under review based on the value-added content of exports, the share of exports produced within global value chains, the proportion of services within exports and the share of the trade in intermediate goods. On the other hand, the *Supply Chain Index* – which assesses the maturity of global supply chains and is prepared by Supply Chain Insights – differs from the databases based on trade in value-added statistics, as it *centres on corporate profitability indicators,* examining corporate groups rather than countries and ranking supply chains according to three factors. The first is balance, based on the relationship between the annual growth of the supply chain and the return on the capital invested. The second factor is strength, which assesses the margin within the supply chain and inventory turnover. The third is resilience, which is based on the robustness of the relationship between the two factors examined by the strength aspect, the margin and inventory turnover. Based on the change in the three factors between 2010 and 2016, supply chains in the automotive industry, the chemical industry, the food industry, other retail trade, the pharmaceutical industry and telecommunications are ranked. According to the results, 40 per cent of the ten most successful supply chains in the automotive industry are European, 40 per cent are Asian and 20 per cent have American ties. In the ten most successful chemical industry supply chains, there is only one European one among the Asian and American peers, and it is placed 10th. There are no European ones among the most successfully developing food industry supply chains, and there are only two Europeans among the distributors of other retail products. There are merely three European chains among the pharmaceutical industry supply chains exhibiting the most successful growth, and there is no supply chain from the old continent among those active in telecommunications (*Cecere – Breskovna 2018*).

In the 2010s, most of the dynamically developing supply chains that became longer and more complex were related to East Asia and the United States; therefore, as a result of the coronavirus pandemic, the supply chains operating in these regions should make their operating models more modern and efficient. Since in the 2010s the supply chains related to East Asian and North American OEMs developed the most (see the results of the Supply Chain Index in the previous paragraph), their length, complexity and the number of companies participating in them have increased considerably. The negative economic effects of the coronavirus pandemic principally impact long and complex supply chains that comprise many companies: therefore, East Asian and North American supply chains should also revise and possibly shorten their operating models. However, this shift is easier in East Asian countries, because the companies in the supply chain are more concentrated geographically than their peers in North America. East Asian countries have the capacity and the corporate network to perform both higher and lower value-added activities, whereas North American supply chains are structured in a way that they perform high value-added activities efficiently in the country of the OEM, while

they outsource the lower value-added activities in the supply chain to another continent or region (for example to East Asia) (*Gelei 2010:430*). Accordingly, North American countries need to consider transforming their supply chains and making lower value-added activities more competitive to successfully regionalise their production activities. Although in Europe relatively fewer supply chains became longer and more complex in the 2010s, this is attributable to the shortcomings of the European corporate model in innovation and competitiveness; therefore, it is time for European supply chains to be made more innovative and digitalised and their creativity and research and development capacities to be boosted.

6. Features of digital supply chains – the Supply Chain 4.0 model or the supply chains of future

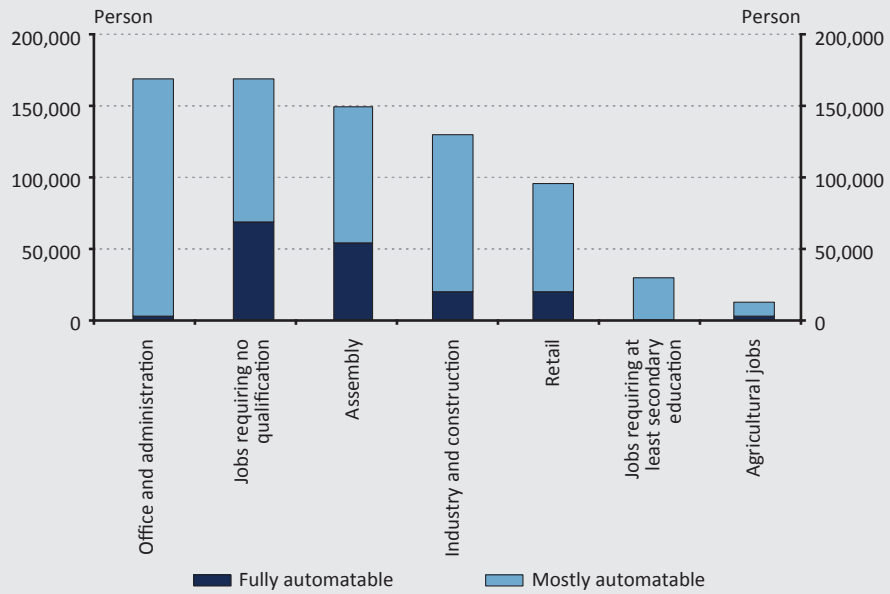
In supply chains operating on the basis of Industry 4.0 which use the solutions of automation and digitalisation, decision-making is faster and rests on more detailed information, thereby facilitating adjustment to different situations. Besides shortening supply chains, the most crucial impact of the coronavirus pandemic on the operation of supply chains may be the all-encompassing digitalisation. The *change in activities within supply chains may be accelerated* by the availability, compilation, structuring and forecasting (and nowcasting) of data related to current production activities and future economic activities, expected demand and external conditions (macroeconomic developments, weather). For average products, forecasting should be performed weekly, while in the case of fast-moving consumer goods it should be done daily to ensure the efficient functioning of supply chains. This is the main channel of big data analyses in corporate activities. More detailed information is necessary because *the personalisation of corporate products and services is increasingly important,* as consumers are looking for products and services that increasingly match their individual needs. This requires microsegmentation and mass personalisation in business planning. In addition, the efficiency of supply chains' operation may also be improved by integrating artificial intelligence solutions into business processes, which may facilitate the automatic correction of supply chains' potential operational shortcomings and errors. Furthermore, *robots* play an increasingly central *role* in digital and automated supply chains, as they can increase the number of completed products in a unit of time in loading, manufacturing and logistics (*Alicke et al. 2016*). In the supply chains that are transformed as described, *the nature of information flows also changes.* Formerly linear information flows are replaced by bidirectional and multidirectional data flows between the activities that constitute the supply chain. This is also referred to as *Supply Chain 4.0* (*Ferrantino – Koten 2019*).

The coronavirus pandemic accelerates digitalisation processes in the economy, because its business implications necessitate a more flexible safety stock policy as well as more automated production and warehousing. Digital supply chains are supply chains where the value-creating activities as interpreted by Porter are performed using 21st century infocommunication technologies. Automatic supply and inventory management allows for the *continuous adjustment of the amount of the safety stock* within a supply chain, depending on internal and external circumstances. To ensure the automation of warehousing and logistics, the use of *programmable robots and transport equipment* and the deployment of *sensors and radio frequency identification* (RFID) *systems* becomes crucial (*Alicke et al. 2016*). Since the operation of these technologies requires fast and reliable internet access with a low lag and massive data traffic enabling communication between the equipment, the related infrastructure must be developed before they appear on a large scale. This calls for further enhancing 5G technology, *opening up new 5G frequencies, network development* and *the widespread application of small cell systems.* To reduce the demand for human labour in production, the acquisition of *humanoid robots* (exoskeleton) and huge amounts of *3D printers* are required, generating substantial *investment demand*. However, in connection with substituting human capital with technological solutions, studies have shown that robotisation will not replace human labour-based production but rather supplement it (*Ferrantino – Koten 2019*).

Estimates show that automation within supply chains would affect approximately one-fifth of the employed persons in the Hungarian economy, and therefore their retraining and further training are of key importance. Besides making the course of business more efficient and improving corporate productivity, automation also fundamentally transforms the *labour market.* According to a study prepared by the Institute for Economic and Enterprise Research of the Hungarian Chamber of Commerce and Industry, the jobs of 165,000 employed persons could be replaced completely with robots and automation solutions, and there are another 567,000 employed persons who could be partially replaced (4 and 15 per cent of total employed persons, according to the data of the National Tax and Customs Authority of Hungary), as they perform mostly automatable subtasks. The largest share of Hungarian employed persons, 28 per cent, work in a profession where automation can play a supplementary role, while 27 per cent of employees work in positions that can hardly be automated or not at all (*Nábelek – Vági 2019*). The most automatable positions include those in office and administrative fields, agriculture and forestry, industry and construction, as well as those of machine

operators, assemblers, drivers and unskilled workers (*Figure 5*).[10] Since the coronavirus pandemic is expected to strengthen automation, the *opportunity for retraining and further training* should be offered generally and in particular in the employment groups listed above, by providing financial state subsidies. Over the medium term, *increasing the proportion of tertiary graduates* may prove to be a solution for maintaining employment levels.

Figure 5
Number of people employed in professions involving mostly or completely automatable subtasks in Hungary, by major groups in employment



Source: Nábelek – Vági (2019)

[10] A similar conclusion was drawn by a study prepared by *Fine et al.* (*2018*) at McKinsey on the automation opportunities of Hungarian jobs. According to their analysis, 24 per cent of the current jobs in Hungary can be potentially automated by 2030, if an average scenario is realised. Based on this, automation could affect the jobs of approximately one million employed persons.

7. Summary – trends and incentives in the transformation of global supply chains

This descriptive analysis presented the effect of the coronavirus pandemic on international production organisation as well as the related long-term transformation processes of the operation of global supply chains. While there is no optimal and universal method for economic value creation, the essay concludes that five trends can be identified that significantly influence the operation of global supply chains, partly as a result of the continuously developing production management, and partly as an effect of the pandemic. The first trend is the regionalisation of international value creation and the simultaneous shortening of supply chains. This is followed by multi-sourcing and accumulating safety stocks, as well as the shift from production focusing on a single product towards manufacturing several products. Another trend is the establishment and development of centres coordinating the operation of supply chains, as well as boosting digitalisation and automation within firms and in intercompany relations. The findings on the regionalisation of supply chains and the geographical dimension of their operation are related to *Hernández and Pendersen* (*2017*). Moreover, the analysis expands the field of supply chain management with practical and empirical insights and conclusions (*Gelei 2010*), with a special focus on risk management. The examination is based on the trends and experiences from previous years on the one hand and, and on the forecasts of advisory firms on the other hand, as there are no actual data for the corporate developments for the entire present year. When the actual data become known, it may be worth returning to the assessment of the changes in supply chains.

Progress in these five trends, the reduction of the adverse effects in the operation of global supply chains that arose on the back of the pandemic and companies' upgrading of supply chains may be facilitated by several economic policy decisions. These include state subsidies for strategic industries (e.g. the health industry) and the sectors which suffered the biggest losses in the coronavirus pandemic. Additionally, over the long run, the state may also promote the relocation of corporate activities to Hungary that could potentially return to Europe from distant continents by establishing a business environment that is favourable from a taxation and administrative perspective and that rests on e-governance solutions. Economic policy may stimulate the digitalisation of supply chains and the spread of Industry 4.0 solutions from three directions. First, the continuous development of digital infrastructures (state support for developing 5G technology), the facilitation of their corporate integration (state funds for the establishment of infocommunication technologies and mentoring programmes presenting their

application) as well as the enhancement of digital skills of employed persons (teaching competence-based digital skills that support problem-solving and increasing the share of tertiary graduates).

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The Relationship of European Banking and Financial Elites in a Historical Approach*

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Financial Elites and European Banking: Historical Perspectives
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ISBN: 978-615-5884-75-7

The economic crisis that erupted in 2007 and its consequences inspired this book. According to observations, mistrust of the financial sector emerged during and after the crisis, which later intensified. In this context, the issue of the responsibility of financial elites arose, the study of which had not received sufficient attention among economists and economic historians in previous decades. The authors assume that not only does the regulatory structure of financial markets and financial organisations determine the course of action of the financial elite, but to some extent, the financial elite also influence the development of the regulatory structure. According to *Edward Kane,* financial innovation plays a key role in the ongoing conflict of interest between the financial regulatory authority and regulated entities (institutions and individuals). In his view, financial innovations are more commonly used to circumvent the existing regulatory framework. Therefore, innovation plays a key role in the continuous renewal of regulation (it is sufficient to substantiate this claim by considering the current role and impact of FinTech). However, the relationship between regulatory and regulated is more complex. On the one hand, on the regulatory side, for example, there is not necessarily a need to operate in a stricter regulatory environment. In several cases, a less stringent regulatory environment is seen as more effective in reducing arbitrage. On the other hand, regulated entities also have an impact on the regulatory environment, for example through lobbying, where the role of financial elites also cannot be regarded as marginal. The book discusses the direction of actions of the financial

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

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elite in various national economies. Thus, the United Kingdom, France and Italy are highlighted during significant eras (e.g. periods of economic crisis, revolution).

The first study deals with the nature of financial crises. Similarities can be observed between financial crises, regardless of their location or circumstances. *Charles Kindleberger* identified stages that were valid for all crises: improper lending practices, the formation of certain bubbles (lending, real estate, etc.), insufficient financial resources, crisis, withdrawal of funds, perceived mistrust. The Great Depression of 1929–1933 and the crisis that started in 2007 had radically different receptions by and consequences for existing regulation. The impact of the former affected the world's largest economies quite differently. Regulatory responses were much less uniform, and the issue of bank liability emerged distinctly in each country.

Examination of the relationship between ownership structure and profitability in the case of banks leads to interesting findings. Historically, in addition to railway companies, banks were the first companies in Europe to separate ownership and management control functions. According to the book, a strong relationship can be discovered between ownership structure and executive remuneration. At private banks (such as Morgan Grenfell, Schroder, Rothschild, or the Speyer banking house, which is also present and dominant in Hungarian banking history), the remuneration of executives (owners and senior executives alike) generally far exceeded that of "paid" (employed) executives. Nowadays, the situation has changed in part, as the private banking structure is no longer dominant. Managers in employee status are primarily the senior executives at banks, not bank owners. However, this is far from a reduction in remuneration. On the contrary, due to the significant expansion of the financial sector and the complexity of financial transactions (such as M&A transactions), remuneration has in some cases been unrealistic, or at least extraordinary. Employed managers also earned income similar to or in excess of bank owners. In other words, bankers today who risk other people's money had at least as much or higher incomes as bankers who had previously risked their own money.

The next chapter looks back at the period of the French Revolution, the political consequences of which inevitably affected the entire French economy. Traders and bankers not only faced an unfavourable outlook for the French economy (including extremely high public debt and significant inflation), they were also confronted with growing general mistrust. Nevertheless, several individuals were able to gain significant wealth and decisive influence during this period. *Jean-Conrad Hottinguer*, born in Switzerland in 1764, embarked on an outstanding career: after a job as a temporary bookkeeper in Switzerland, he started working for Le Couteulx & C. banking house in Paris, which was headed by the future president of the Banque de France. He then joined the business of another Swiss banker, *Denis Rougemont*, who acted as an agent for Swiss bankers and merchants. However, *Rougemont*'s

business went bankrupt in 1792 due to speculative transactions and as a result *Hottinguer* was forced to leave Paris. He settled in London and then moved to the United States, where he remained until the end of the Jacobin dictatorship. According to some opinions, *Hottinguer* provided significant financial support to Napoleon's rise to power and while this cannot be substantiated with concrete evidence, it is certain that he provided the army with food and clothing, which proved to be a rather lucrative activity. In addition to finance, *Hottinguer* also achieved significant success in the field of commerce; establishing trade centres in two major French cities, Le Havre and Nantes. This led to French wines being successfully exported to the United States. The successful Swiss businessman was elected among the governors of the Banque de France in 1803. Then, in 1808, Napoleon endowed him with the title "Baron of the Empire" for his loyalty and services (this circumstance also reinforced the assumption that *Hottinguer* played a significant role in Napoleon's rise to power). With his death in 1844, *Hottinguer* left behind a network of entrepreneurs with a well-functioning, reliable, and stable clientèle – primarily American, Dutch, British, Swiss, and French – that included a wide range of activities, from finance to wine trading and whaling.

The third and fourth studies take us to 20th century Italy. At the end of the First World War, Italy faced crises in several areas in parallel: a fiscal crisis (public debt rose from 80 per cent of GDP to 160 per cent), a banking crisis (due to a shortage of liquidity and resources), and a currency crisis, as the Italian lira depreciated significantly during this period. The study highlights *Alberto Beneduce* as a newcomer to the financial elite, as he was nominated by the Italian government to represent Italy at the League of Nations. *Beneduce* also had close ties to the president of the Bank of Italy, so he had excellent political connections. Later, in 1920, *Beneduce* also represented Italy at the Brussels Conference, which was seen as a first attempt at post-war international cooperation. *Beneduce* was generally engaged in a wide range of activities which characterised the financial elite at the time, including creation of the first, still operational, specialised credit institution (Crediop S.p.A.) in Italy. *Beneduce* suggested that central banks should work together to preserve the stability of the financial system and currency. Here it is worth noting a domestic parallel, as the first governor of Hungary's central bank, Sándor Popovics, also supported this need and called for the establishment of an organisation within an institutionalised framework as soon as possible, in domestic and international forums.

Also worth mentioning is the Italian and Hungarian parallel in the relationship between industrial companies and banks. According to some opinions, mainly published in the second half of the 20th century, the Italian banking system served in a substitutionary function. Due to the inadequacy of market conditions, banks played the role of investors in the industrial sector due to their adequate ability

to accumulate capital, within the framework of the law. However, the research presented in the study reveals that Italian industrial companies were not nearly as much the focus of banks as previously thought, and that this interest also showed significant fluctuations over time. We have seen such opinions before and recent research (such as studies by *Béla Tomka* and *Ágnes Pogány)* has yielded similar results.

The next chapter returns to France, which in terms of its financial system from the end of World War II to the 1980s is considered one of the most regulated among European financial systems. This is also due to the fact that from the 1960s the French economy was one of the most dynamically developing European economies, achieving annual economic growth of around 5 per cent for three decades. During this period, the financial elite pursued a number of strategies in the context of the regulatory environment: they sought to take advantage of the existing set of rules, while affecting changes to these rules and at the same time trying to circumvent domestic rules by extending banking activities beyond borders through financial innovation instruments. In several cases, these three tools were used together. For example, the emergence of various collective investment schemes, which were not allowed in France for a long time, can be considered a financial innovation. However, due in large part to bank lobbying, the relevant law was amended in 1963, so many such schemes appeared (Crédit Lyonnais, the most dynamically growing bank of the era, for example, introduced several such products). From the late 1960s, banks began to expand their operations abroad to avoid regulations on domestic operations. The development of international currency markets and the emergence of new financial instruments (such as swaps) played a key role in this. In order to take advantage of capital market developments and opportunities, several banks (such as Paribas) established subsidiaries abroad. Thus, there is a kind of duality with regard to French legislation at the time: on the one hand, foreign expansion and risk-taking were allowed, while on the other hand there were strict rules for domestic business. The latter lasted until the 1970s and 1980s, when regulation moved more towards economic liberalisation and deregulation.

Chapters six and seven cover capital market regulatory issues, primarily through the example of the United Kingdom, with particular reference to investor protection and public oversight. The former began to spread to a greater extent at the international level when it became more difficult to maintain trust and informal relations at the local level (especially after 1948). Prior to this, unfortunately, there was not enough emphasis on investor protection, although several circumstances could have provided good reason for it. Perhaps one of the most outrageous cases in 19th century England is attributed to *Gregor MacGregor*, who "issued" bonds for a non-existent country worth about £ 1.3 million. Nevertheless, by international standards, the level of business trust based on personal contacts, acquaintances

and reputation reached an unusually high level in the UK, although not in a generalisable way, and this was the case not only in the capital, but also in rural areas (previously highlighted by *John Stuart Mill).* In this environment, financial intermediaries and advisers played a key role, among which – although the records of intermediaries are unfortunately quite incomplete due to German bombings during the Second World War – we can also find a large number of people belonging to the financial elite. This included *Charles Morrison*, who held senior positions at a number of companies, including the Hounslow & Metropolitan Railway, which expanded London's western metro network (today the Piccadilly Line). He was also a member of the North British & Mercantile Insurance board, which offered fire, water, accident and life insurance on no less than 5 continents (*Morrison*'s full entrepreneurial network is otherwise unknown).

The idea of establishing public oversight had not yet gained ground in 19th century England, but legislation (such as Act CCCX of 1845) also gave shareholders the rights and powers to gain a certain level of insight into the operation of a given credit institution, rather than extending regulatory and supervisory powers. Under the contemporary approach, the control of credit institutions was essentially the responsibility of the shareholders, and consequently the State did not intend to perform the function of the shareholders in part or in full. The financial elite were also particularly essential to this role, acting as financial intermediaries and performing significant tasks in the supervision of credit institutions.

The final two chapters of the volume present the most important international organisations consisting of central bankers and bank supervisors, and their roles. By the end of the 20th century, new supervisory methods had become necessary to effectively control the increasingly complex and international banking activity. Who was responsible for establishing these new supervisory practices at the international level? Perhaps the most important international institution in this regard was the Basel Committee on Banking Regulation and Supervisory Practices (later Basel Committee on Banking Supervision, BCBS). The institution was established in 1974, initially operating in a more informal manner, with the aim of building relationships, sharing information and getting to know each other's supervisory practices. Later, however, it was characterised by an authority-style operation, and in addition to monitoring the international financial system, it made proposals for banking supervision and formalised and raised previously unformulated knowledge to an international level. Given that supervisory practice in the early 1970s was nowhere near as uniform as it is today, common international banking supervision standards have been developed. The BCBS was almost the only institution able to formulate rules for international banking supervision. It has also played an important role in involving overseas authorities, enabling those countries (such as New Zealand)

to become actively involved in international supervisory processes. The BCBS has been able to develop into a growing political force over the years, coupled with a growing role and the broadening scope of the supervisory and regulatory area itself, which has contributed gradually to the banking supervisory occupation becoming a profession.

The nine studies in this volume provide a useful and interesting overview of the activities, influence, and role of broadly defined financial elites without falling into the trap of any "conspiracy theories" that are common today. Instead, we find a social and structural analysis of financial elites, and by measuring their influence and presenting their operational directions – for example, by examining their role in institutional change – we can become familiar with their activities and influence on the banking system. In summary, the economic literature available in Hungarian has been enriched with a valuable book on banking history, which provides answers to a number of questions that had not been examined thus far.

Possible Answers to Hungary's Demographic Challenges*

Emese Kreiszné Hudák

József Benda – Gusztáv Báger (eds.):
Jövőnk a gyermek – Adalékok a népességgyarapodás társadalmi programjához I.
(*Our Future is the Child – Contributions to the Social Programme of Population Growth I*)
Veszprémi Humán Tudományokért Alapítvány, 2019, p. 430.
ISBN: 978-615-5360-13-8

One of the greatest economic and social challenges of the coming decade is demographic trends, i.e. whether the trend of natural population decrease in Hungary can be reversed or at least the rate of decline can be slowed. Back in 1980, the Hungarian population was 10.7 million, compared to which it decreased by a total of about 1 million in the last four decades, until January 2020 (*HCSO 2020a*). The decline in population is mainly due to a significant decrease in the fertility rate, while mortality rates have improved only slightly, and thus the annual number of births cannot compensate for the population decline due to deaths. Population projections using different assumptions all expect that the decline and ageing of the Hungarian population will continue in the coming decades. Based on the results of each projection, the population in Hungary may decrease by another 0.6–1.7 million in the next 40 years, i.e. in 2060 it is expected to be in the range of 8–9.1 million (*Eurostat 2019; Obádovics 2018; UN 2019*).

In order to stop the population decline, i.e. to ensure an unchanged population, it is necessary to achieve and sustain a fertility rate of around 2.1. As a positive development, the number of children per woman in Hungary increased remarkably after 2011 (from 1.23 in 2011 to close to 1.5). Since 2010, the government has supported childbearing through several measures, which is reflected in the increasing amount of budget expenditures on family benefits. Nevertheless, between 2016 and 2019, the fertility rate stagnated at around 1.5. A recent positive development is that since December 2019 the number of births increased for five consecutive months compared to the same period of the previous year:

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

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according to the available data, between December 2019 and April 2020, a total of 2,111 more children were born compared to the same months of the previous year (*HCSO 2020b*). The increase in the number of births may be related to the Family Protection Action Plan announced a year ago, in February 2019. However, the fertility rate remains below the threshold of 2.1 needed for reproduction, and so, in addition to existing family policy measures, further targeted measures may be needed to increase it in the future.

The collection of studies entitled "Our future is the child" focuses on solutions, formulating innovative, cross-cutting proposals to stop population decline. When examining population trends, the book deviates from conventional demographic analyses at two points. First, it takes a transdisciplinary approach, i.e. it examines the causes of population decline through the lens of several disciplines (economics, demography, psychology, sociology, and pedagogy) at the same time. Second, the volume reflects the further need for a change in attitude that has already begun, i.e. it does not view demographic trends as a given, but wants to change the way they develop and presents solutions for doing so. The proposals set out in the book are the result of an expert workshop involving more than 200 experts.

One of the important messages of the volume is that the time factor plays a vital role in the current situation. In the coming years, large female age groups will leave childbearing age, which will significantly reduce the possibility to increase the birth rate over the longer term. With this in mind, the authors classify the proposals presented in the study volume into three groups according to the proposed implementation schedule: they designate short-, medium- and long-term tasks. The measures proposed for short-term implementation aim to support women aged 35–45. According to the authors, the introduction of the Professional Parents Career Model and the development of demographic strategies at national and local levels may be one such effective measure even in the short-term.

In the *Professional Parents Career Model,* parents (mothers) raising at least three children could stay full time at home to raise their children, for which the state would pay a fair amount of wage. József Benda points out in his work that the main objective of the programme is to ensure the healthy upbringing of young children and thus to create unity and stability for families. For one thing, the author bases the new career model on the fact that – according to the results of a questionnaire survey conducted in 2017 on the 35–44 age group's willingness to have children – 25 per cent of the respondents would like to have at least one more child. On the other hand, the justification of the programme can also be supported by the observation that the remarkable decline in the number of families with four or more children plays a key role in the lower number of children compared to previous decades. *In Benda's view, increasing the number of large families is the solution to the current demographic problems.* He argues that the introduction of the programme is also

justified by the fact that young people who, by choosing a large family lifestyle, feel that raising children is their profession, cannot choose full-time parenthood for financial reasons, but instead have to balance between family and work. The analysis is based on the premise that child-rearing should be considered a socially useful occupation, i.e. "invisible" work, and thus wages should be paid for it just like for other types of work. He argues that introduction of the programme could make it possible to conciliate social interests with private ones, i.e. there would be no need to choose or share energies between raising children and working.

The Professional Parents Career Model presented by Benda aims to provide targeted assistance to those with large families, and therefore it could be possible to apply for the programme when a third or additional child arrives. Under the career model, parents would not receive aid but a fair amount of wage from the state, including employment relationship and pension entitlement. Wages under the programme would not be provided as an automatic right when a third or additional child is born, but interested families could apply if the conditions announced by the state are met, and committees would decide on the suitability of applicants. In the first year of the child's life, only the mother could be a "full-time" parent, and from the second year of life, another family member (e.g. the father) could take over the care of the child. Applicants would also undertake to participate in a training programme aimed at improving family and child-rearing skills. Based on the proposal, in the case of three children, full wages would be paid until the youngest child enters school, after which the mother could find part-time employment in the labour market. Families with four or more children could receive full wages from the state until the youngest child is 10 years old.

According to the author's assessment, within a year and a half of its introduction, the programme could produce numerical results in birth rates, and he estimates that the number of newborns could rise to 130,000 per year. The primary target group of the career model can be mothers aged between 35 and 44 with two children. In light of the results of the questionnaire survey, women who are currently only marginally present in the labour market (e.g. part-time workers, recipients of maternity benefits) are primarily interested in participation. One important element of the programme is monitoring: the number of entering families would be continuously monitored by region and district. This may be necessary for several reasons: first, fertility data vary greatly in some counties of Hungary; second, by setting regional quotas, large families living in underdeveloped settlements (villages) could be supported in a targeted way.

One of the important questions about this programme is the following: What budgetary impacts would its introduction have? The evolution of budgetary impacts is determined by the parametrisation of the programme, in particular the number of entrants, the duration of participation and the amount of wages to be paid to

the participants. Based on the calculations presented in the volume – differentiated according to the number of children – full-time parents would receive a monthly net benefit of around HUF 300,000–400,000 from the state in the first 3 years, after which the amount of benefit would decrease by 15 per cent. When estimating impacts, the authors consider two hypothetical scenarios. According to the first version, with the entry of 10,000 persons, the budgetary expenditure incurred would be HUF 42 billion in the year of introduction, while with a quota of 20,000 persons it would be HUF 70–80 billion. Due to the nature of the support, the budget of the programme would increase in the years following its introduction, and in the light of our estimates approximating the calculations of the study, in the case of a large-scale entry of 11,000 persons per year, the annual budgetary impact may total HUF 180 billion after 5 years and HUF 455 billion after 10 years. Estimating the budgetary impacts may require further clarification.

In my view, in order to further elaborate some details of the Professional Parents Programme, it is important to consider several factors. The question arises: For how many years can such a headcount increase rate be realised, considering the size of the families potentially applying for the programme? Based on the proposal, the selection criterion can be the existence of secondary education qualification. According to the detailed birth statistics for 2018 by the HCSO, in 2018 the number of third or additional newborn children of women with at least a secondary education was 11,355 (*HCSO 2020c*), i.e. when examined statically, this figure is likely to be the maximum number of annual applications. On this basis, the version with a lower number of applicants presented in the study may be more realistic. Under the proposal, the mother could stay at home until the third or additional child reaches the age of 18. After such a long absence, it might be difficult for mothers to re-enter the labour market. Further impact studies may be needed to map the labour market impact of the programme. In addition, indexation of wages for full-time parenthood on an annual basis, linked to inflation or wage growth, may be considered, because over such a long period, the established benefit would lose its purchasing power year after year. Finally, the demographic success of the programme may be substantially affected by the conditions of application and the selection process. Instead of a personal assessment, it may be practical to set predictable, universal conditions that families can adapt to when planning to have children.

Achieving the annual birth rate of 130,000 children, that is targeted by the Professional Parents Programme, presupposes a very remarkable increase in birth statistics as 89,200 children were born in Hungary in 2019. According to HCSO data, the last time when the registered annual birth rate in Hungary was around 130,000 children was 35 years ago, in 1985. In that year, however, the fertility rate was 1.85, and the number of women of childbearing age was 2.5 million. Since

then, the number of women aged 15–49 has decreased by more than 300,000, and the fertility rate has fallen to 1.5. The study does not indicate for which year the targeted 130,000 children applies, but it should be noted that for different sized groups of women of childbearing age, different birth rates ensure the fertility rate of 2.1. Based on our calculations, reproduction can be achieved with around 110,000 new-borns in 2030 (*MNB 2019*). According to a study by the *HCSO* (*2020d*), due to the future significant decrease in the number of women of childbearing age, to maintain the current birth rate of around 90,000 children, the birth rate must rise by 24 per cent by 2033, and a birth rate of around 103,000 children is needed to reach the fertility rate of 2.1 in 2033.

Additional, medium-term proposals presented in the volume may increase the birth rate in the 2 to 3 years following introduction. These include tax measures to increase childbearing, the introduction of the National Housing Programme and the concept of the parent bond. Based on a work published by Ildikó Szabó, presenting the possible tax measures, enterprises supporting or operating institutional childcare services could receive tax allowances. In addition, it is proposed that spouses could draw up a joint family tax return based on a French model, which could be accompanied by a special allowance. Regarding consumption taxes, in the case of value added tax, the author proposes a VAT rate of 5 per cent for products related to childbearing.

In the volume, the *concept of the National Housing Programme* presented by József Csomós aims to provide young people with housing and thus to support childbearing. According to the author, the number of dwellings built in Hungary falls short of what is needed, and – due to the difficulties in obtaining housing – young people can only move out of the parental home increasingly later. This shortens the time available to have children. For this reason, supporting access to housing is an important goal from a population policy perspective as well. Among his proposals, the author sets out an expansion of the Family Housing Allowance Programme (CSOK), a social contribution tax refund for housing, including the down payment for home purchase in the personal income tax and a state-subsidised rental housing (leasing) programme.

The volume classifies the introduction of the parent bond as one of the tasks to be implemented in the medium term. As András Monostori points out in his work, the aim of the proposal is that parents who are at a financial disadvantage due to the costs of raising children could receive recognition for their child-rearing work in their retirement years. Under the parent bond, depending on the number of children raised, the state would provide support to parents, from which an additional pension allowance could be paid to them for 15 years following retirement. The 18-year parent bond would be opened at the birth of the first child, and once a year,

the state would credit it with a subsidy of HUF 36,000–240,000 per year, depending on the number of children.

The proposals in the group of *long-term programmes* can reassure families that a secure future awaits them. This includes, for example, the recognition of child-rearing when determining the pension, for which several proposals are presented in the volume. József Botos and Katalin Botos propose the introduction of a points-based pension scheme following a German model. The amount of points would depend on the earnings: for example, an average monthly salary would be worth 1 point, and the resulting score could be further increased based on the number of children. The proposal of András Giday and Szilvia Szegő concerns the introduction of a child-to-parent based pension allowance, which would be received by retired parents from the age of 65, and would mean a monthly pension supplement of HUF 15,000 per child.

As the proposals set forth show, the volume presents a wide range of ideas to stop population decline. These proposals can function as a kind of "menu" for decision-makers when planning future measures. The objective set out in the volume is to strengthen families and increase the birth rate, which appears to be supported social consensus in Hungary.

It is interesting to compare the proposals presented in the volume "Our future is the child" with the family-friendly proposals in the Competitiveness Programme of the Magyar Nemzeti Bank. The MNB's analysis underlines the need for different subsidies for the birth of the first, the second and additional children, which are well adapted to the needs of families of different sizes (*MNB 2019*). Within this, the Professional Parents Programme is specifically aimed at supporting large families. The MNB's proposals affect all types of families, and the intention is also to achieve this with an increase in employment, however, not in the context of employment within the family but rather through market employment. Like the study volume, the family-friendly proposals of the Competitiveness Programme present complex, comprehensive suggestions, the main areas of which are the family-friendly development of the health care system, the support of everyday life for families with small children and the increase of employment-related family allowances. Explanation of the proposals is not the subject of this article but, for the interested reader, it may also be worth reading the Programme of MNB.

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