4 FINANCIAL AND ECONOMIC REVIEW

December 2016
Vol. 15. Issue 4.

Financial and Economic Review

Scientific journal of the Magyar Nemzeti Bank

Publisher: Magyar Nemzeti Bank
Publisher in Charge: ESZTER HERGÁR
H-1054 Budapest, Szabadság tér 9.
www.hitelintezetiszemle.hu
ISSN 2415–9271 (Print)
ISSN 2415–928X (Online)

Cover design: MARIANNA IZSÓNÉ BIGAI

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Published regularly in every three months.
HU ISSN 2415–9271 (Print)
HU ISSN 2415–928X (Online)

Page setting and printing:
Prospektus – SPL consortium
H-8200 Veszprém, Tartu u. 6.

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Identifying the determinants of housing loan margins in the Hungarian banking system

Ákos Aczél – Ádám Banai – András Borsos – Bálint Dancsik

In recent years, the average spread on newly extended housing loans above the 3-month interbank interest rate has been consistently higher compared to spreads in neighbouring countries. This paper investigates the reasons behind it by using econometric tools and simple statistical examinations. In our two-step approach, we first identify the determinants of spreads based on Hungarian transaction-level and bank-level data, and then examine the Hungarian banking system's sectoral performance relative to other European countries in the main determinants identified. Our findings reveal that the higher spreads currently mainly stem from the high proportion of products with initial rate fixation of over one year, the relatively large stock of non-performing loans, and credit losses. High operating costs in international comparison may also have an impact on the setting of spreads. According to our estimates, demand-side attributes also contribute to the emergence of high spreads, as does the low level of competition in certain regions.

Journal of Economic Literature (JEL) codes: G02, G20, G21

Keywords: new loan contracts, housing loan, interest rate spread, spread

1. Motivation and literature

Interest rate level of household loans plays a pivotal role in shaping households' financial decisions. The interest rate, which is in fact the cost of funding, defines — along with the loan amount and maturity — the burden that debt servicing represents for the borrower, and thus a relatively higher interest rate can hinder a significant portion of households from accessing credit. Given that the Hungarian population tends to prefer property ownership as opposed to property rental (*MNB 2016*), the pricing of housing loans is of particular importance in Hungary.

In recent years, the average spread on newly contracted HUF-denominated housing loans has significantly exceeded the spreads seen in other regions of Europe (in

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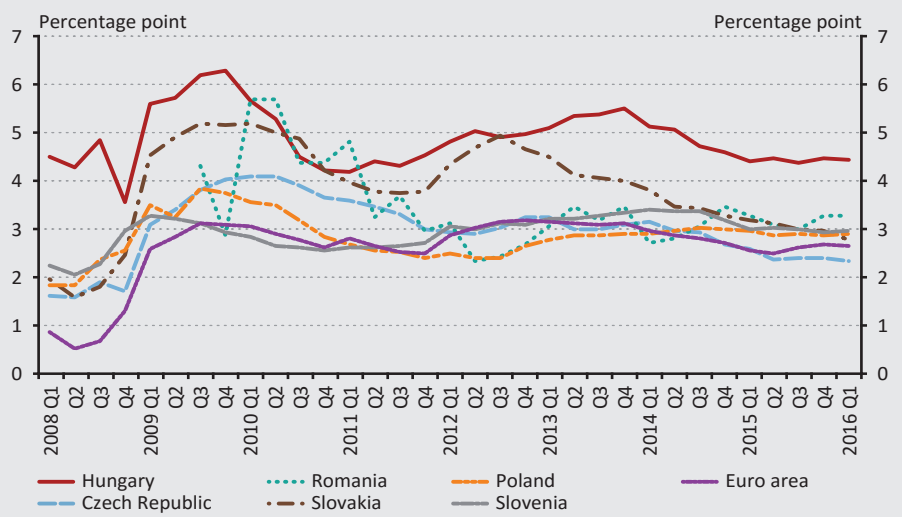
The manuscript was received on 6 October 2016.

this study, the spread refers to the difference between the interest rate on loans and the 3-month interbank interest rate). Although the difference between the average annual percentage rate (APR) on new housing loans and the 3-month money market interest rate has narrowed materially since 2014, the spread still exceeds the regional average by 1.6 percentage points and the euro area average by 1.8 percentage points (*Figure 1*).

Figure 1
International comparison of spreads above the 3-month interbank interest rate on housing loans extended in domestic currency



Note: APR-based spreads. Newly extended loans.
Source: MNB, national central banks.

Setting the interest rate is a complex process that depends both on the institutional background of a country and its banking system and the bank's own attributes (*Figure 2*). The interest rates applied must be capable of covering the bank's costs associated with lending (*Button et al. 2010*).

Funding costs. Financial institutions fund their operations through other economic agents, and so the price of the funds they receive plays a role in setting the price at which they lend credit. The price of funds may differ based on loan type, maturity and type of interest rate. Deposits are generally the most stable and cheapest form of funding for loans. In addition, covered bonds, of which mortgage bonds constitute a subcategory, also play a major role in several countries (*EMF 2012).* Prior to the onset of the crisis, securitisation was on the rise across Europe *(ECB 2009)*, however it fell short of the degree observed in the United States. Funding costs can also be

shaped by various state subsidies. Housing loan support schemes are common, for instance, sometimes in the form of liabilities side interest subsidies. Due to these factors, it is very likely that the international comparison of spreads calculated based on interbank rates contain biases.

Interest rate risk. The diverging interest rates on assets and liabilities represents a risk linked to, but distinct from funding costs. The various countries differ according to (1) the interest rate characteristic of various transactions and (2) the other unique characteristics associated with mortgage lending within the region. For instance, transactions with rates fixed over the longer term are predominant in Belgium, Germany and France, while products that are repriced within one year are predominant in Portugal, Poland and Ireland. The stability over time of the proportion of various interest-bearing products also differs: while this proportion is relatively stable in certain countries, in others, consumers actively switch between floating and fixed-rate products depending on which seems more beneficial at the time (*Johansson et al. 2011*).[1] This is relevant because consequently, the spread may differ between two banks with identical funding structures because one of them mainly extended loans that are re-priced every three months, while the other extended loans with a rate fixed for ten years. For the latter, there is a significant risk of interest rate levels rising substantially over the ten-year period, which is also reflected in future funding costs. This must be taken into account in the interest spread of extended loans. Prepayment by customers is also a source of risk, which compels banks to extend the prepaid amount and interest rate environment differently — and typically lower — than the one prevailing at the time of original loan extension. This may be particularly problematic in countries where the administrative costs of switching banks and prepayment are low.[2]

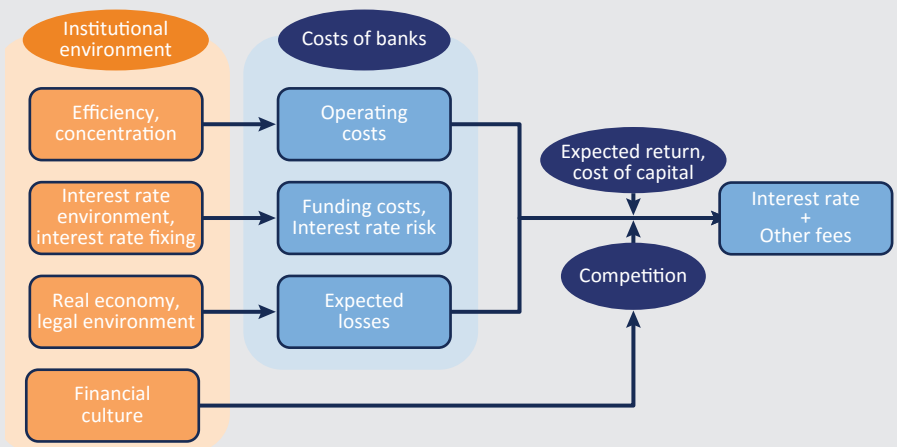
Operating costs. The upward impact of operating costs on interest spreads has been demonstrated by many studies using various target and control variables (*Gambacorta 2014*, *Valverde – Fernández 2007*). The impact of operating costs may be particularly significant on household loans, as households are still primarily served personally, which requires the maintenance of significant infrastructure (such as a branch office network), and the cost of this is reflected in spreads. For this reason, the efficiency at which banks use their infrastructure is relevant, because a significant relative price decrease (for instance through digitalisation) may be reflected in credit spreads.

[1] *Badarinza et al.* (*2014*) demonstrated that the choice between floating- and fixed-rate loans is mainly shaped by the interest spread prevailing between the two product types at a given point in time, and the spread expected in the short run. A volatile inflationary environment should also be mentioned: more volatile prices are generally associated with a lower number of fixed-rate loans.

[2] According to Hungarian regulations, the early repayment penalty is capped at 2 per cent of the prepaid amount. However, the debtor may terminate and prepay his debt at the end of the interest period or the interest spread period free of charge if the interest rate or the spread are set to increase.

Credit losses. An inherent element of bank operation is that some debtors will not be able to service their debt. Banks must offset the losses incurred on these loans through their interest rate spreads (and specifically, the risk spread). So the larger the expected loss on a portfolio, the higher the interest spread that may be necessary. Expected loss is shaped partly by economic fundamentals (unemployment, changes in GDP, housing price developments) and partly by the efficiency of the legal institutional system. It is important to note that expected credit losses are calculated based on historical data, as a result of which a high volume of non-performing loans may have a lasting impact on pricing. This means that despite a far better quality of currently extended loans, the bank may price them as riskier based on its experiences derived from historical data. Although the bank may incorporate forward-looking variables in its pricing model, the samples often available to banks contain observations from the crisis period, and thus these models may possibly capture a higher average risk level.[3]

Figure 2
Main institutional and bank factors determining the interest rate



Source: own edit.

Banks' legal environment also has an impact on spreads. Mortgage loans are collateralised products, which means that in the event of late payment by the debtor, banks can hope to recover their loss by selling the property backing the loan. The rate of recovery depends not only on changes in property prices, but also on the strength and efficiency of the tools available to financial institutions for enforcing their rights on the collateral. If legislation impedes foreclosure (for instance through long and costly foreclosure proceedings or other administrative

[3] *Carlehed and Petrov* (*2012*) offer an in-depth discussion of the aspects of this topic that affect risk models.

constraints), banks' expected losses and thus the spreads they apply will also be higher. The international literature demonstrated this effect both by examining net interest income (*Demirguc-Kunt – Huizinga 1999*) and spreads on new loans (*Laeven – Majnoni 2005*). Creditor banks' option for changing the interest rate through the duration of the contract also has significance. If a bank is able to unilaterally amend the interest rate at any point during maturity, it does not have to include all expected future losses into the price at the time of contracting because it has the option of responding flexibly. These types of loans were prevalent in Hungary prior to the onset of the crisis, but significant steps have been taken in recent years to even out the balance of power between consumers and financial institutions.[4]

In addition to the foregoing, the interest rate must also include a profit margin allowing the institution to generate the return expected by shareholders. The size of the profit margin may depend on market structure, the level of competition, the institution's market power and the level of information held by potential borrowers. If competition is weak and future debtors have poor financial literacy and low price elasticity, then stronger market participants are able to enforce costs and high profit goals in margins. Besides the impact of competition, *Ho and Saunders* (*1981*) also mention the risk aversion of management, average transaction size and the variance of interest rates. However, there are contradicting views on competition: *Maudos and Fernández de Guevara* (*2004*) found that increasing market power is associated with decreasing spreads.

In the following section, we seek to identify the determinants of the relatively higher average spreads on *newly extended housing loans* in Hungary. To identify these determinants, we used econometric methods applied to several databases alongside simpler statistical tools.[5] Unfortunately, the available databases do not include any that could provide a direct and certain answer to our question (*"Why are spreads on new housing loans elevated by international standards?").* We are only able to use banking system aggregates in international databases, and are thus unable to control for either creditor or borrower composition. Data available only at a low frequency and for relatively short periods make it even more difficult to obtain reliable results.[6]

[4] The legislative amendment on "transparent pricing" effective from April 2012 is one such measure, which substantially reduced banks' leeway to unilaterally amend contracts. In keeping with this trend, the "ethical banking system" regulation introduced in 2015 only allows the amendment of lending conditions based on predefined indicators approved by the MNB.

[5] E.g. the examination of the composition effect.

[6] Considering the available data, it is no surprise that the target variable of most papers published on the subject is the net interest income role of profit and loss account, rather than the interest spread of newly extended loans (see for instance *Maudos – de Guavera 2004*, *Demirguc-Kunt et al. 2003*, *Saunders – Schumacher 2000*, *Valverde – Fernández 2007*). Using the profit and loss account as the point of departure enables the use of bank-level international data, but from the perspective of this study, this is too broad of a category that also contains non-relevant information.

As a result, we have opted for the following strategy: we attempt to explain heterogeneity of *Hungarian banks'* pricing behaviour using bank-level and transactional-level variables, and then examine the main variables identified within the Hungarian sample in an international comparison. We believe that a Hungarian bank sets a higher spread compared to other banks based on a specific own attribute, and then if the Hungarian banking system differs from the international average in terms of this variable, it may provide an explanation for the higher spread relative to other countries. However, it should be noted that this strategy is only indicative and offers indirect evidence for the investigation of internationally high spreads, *but does not provide a clear explanation in methodological terms.*

To answer our central question, we performed estimates for three databases. We examine the impact of bank credit supply and the contract-level attributes of extended loans using a linear regression applied to microlevel data available for 2014–2015 and using a panel model estimated for bank-level data between 2004–2014 for bank attributes. We then analyse the impact of demand attributes using microlevel data available for 2015 using a multi-nominal regression. We use various databases and methodologies in an effort to present and investigate the broadest range of aspects of the issue. This approach obviously comes at the price of sacrificing an in-depth examination of the different sections that would be possible if we dedicated a separate paper to each part. We are aware of this drawback, but nevertheless believe that this comprehensive approach will yield the greatest benefit in light of the relative underrepresentation of the topic in the literature.

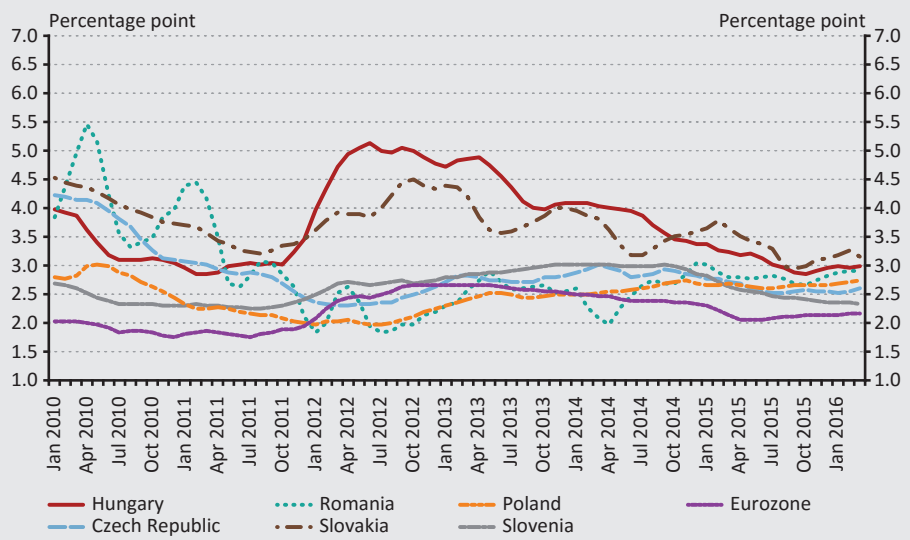
2. Role of new loans' composition on spreads

The MNB's public analyses (mainly the *Trends in Lending* and the *Financial Stability Report*) generally present the difference between the average APR of housing loans extended during a given month and the 3-month BUBOR. However, the pricing of housing loans may diverge substantially based on the term of interest rate fixation by the bank for the reasons addressed in the previous chapter. Interest rates fixed for longer periods of up to 5 to 10 years currently materially exceed the initial interest rate level of floating rate transactions that is tied to the reference rate and thus changes relatively quickly. As mentioned earlier, the main reason for this is that economic agents generally expect interest rate hikes at the bottom of the interest rate cycle, so the cost of bank funds with rates fixed for a longer period is higher than the cost of shorter-term or floating rate funds (such as the 3-month interbank interest rate). Banks may access funds with long-term fixed rates either directly or synthetically by interest rate swaps. In the latter case, the fixed leg of the interest rate swap represents the funding cost for the bank. If the bank finances a fixed-rate loan with floating-rate funds, the higher interest rate risk may warrant

a higher spread. Based on the distribution of new loans by the type of interest rate, Hungary has a relatively high ratio of loans with initial rate fixation of over one year, especially by regional standards (*ESRB 2015:28*; *EMF 2016*).

Loans with initial rate fixation of over one year play a key role in explaining spreads that are high even by international standards. While the above-BUBOR spreads of transactions with floating rates within one year already approached the levels of other regional countries (*Figure 3*), the spreads of products with initial rate fixation of over one year above the 3-month money market interest rate far outstripped regional levels (*Figure 4*).[7]

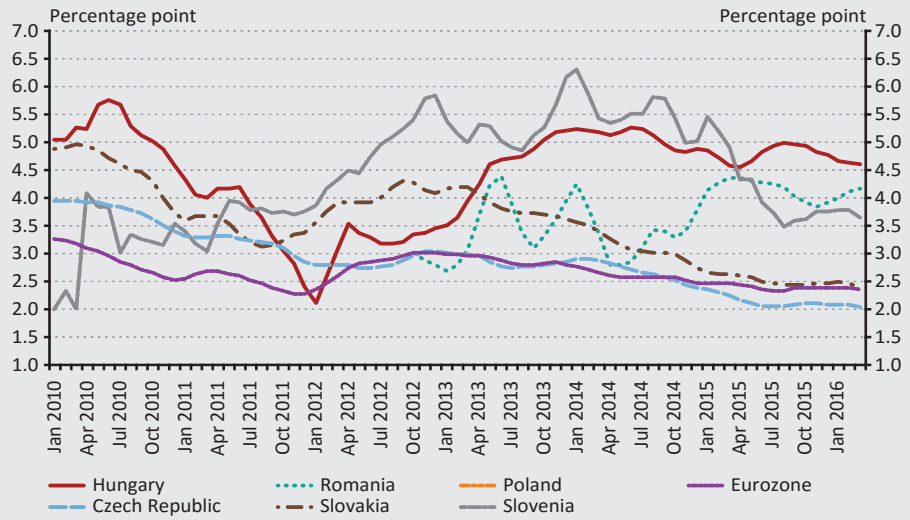
Figure 3
Spreads above the 3-month interbank interest rate on housing loans extended in domestic currency with floating rates within one year in an international comparison



Note: spread above the 3-month interbank interest rate, interest rate based. Newly extended loans.
Source: MNB, national central banks.

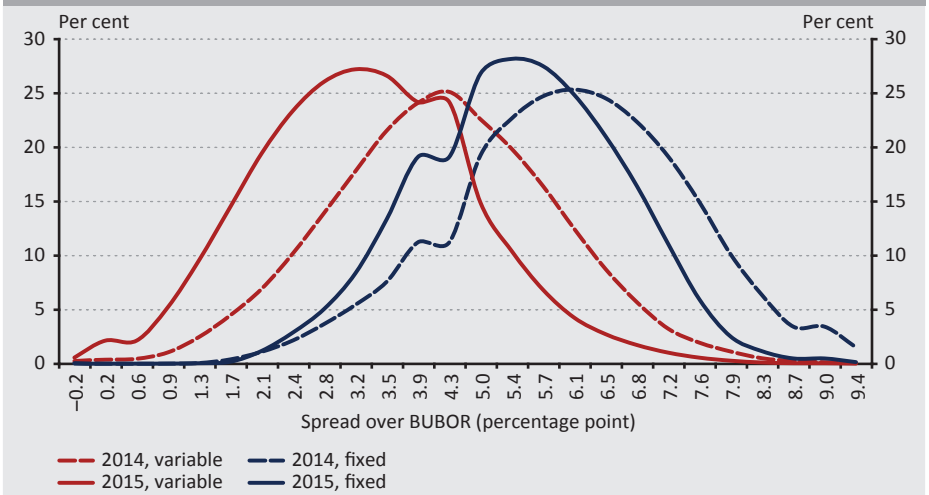
[7] In addition to the foregoing, there is methodological bias stemming from the fact that the spreads published by the MNB are based on the APR, and are thus sensitive to average loan contract maturity. The difference between the annual percentage rate and the interest rate is also shaped by other costs besides interest (generally disbursement and loan assessment charges, handling charges), which increase APR expressed as a percentage to greater extent if the maturity is shorter. The average maturity in Hungary in 2013 was 15 years, the shortest among EU countries. Within the region, Romania and Poland exhibit average maturities of 25-26 years (*ESRB 2015*). A maturity of 10 years shorter results in an approximately 0.1 percentage point increase in the APR characteristic of Hungary. A similar effect prevails when other costs are higher relative to the loan amount taken out (such as nominally fixed fees and lower average loan amounts), however there is no available international information on this.

Figure 4
Spreads above the 3-month interbank interest rate on housing loans extended in domestic currency with interest rate fixation of 1-5 years



Note: Spread above the 3-month interbank interest rate, interest rate based. This scheme does not exist in Poland. For loans with initial rate fixation of over one year, the 3-month interbank interest rate may diverge substantially from the actual cost of funding, so the spread presented by us may be partially shaped by higher funding costs. Newly extended loans.
Source: MNB, national central banks.

Figure 5
Distribution of spreads above the 3-month interbank rate by interest rate type and year of contract



Note: Interest rate based. Exclusive of building societies. Newly extended loans.
Source: MNB.

Despite the relative widespread nature of products with initial rate fixation of over one year, a significant improvement has been observed in recent years in the pricing of housing loans, as is also reflected in the distribution of spreads above the BUBOR: In 2015, the distribution of both floating rate products and products with an initial rate fixation of over one year shifted towards lower spreads relative to 2014 (*Figure 5*).

3. Identification of supply effects using micro-level data

3.1. Database and methodology

Since early 2014, the MNB has compiled interest rate and other information on new contracts on a transactional basis. We therefore have a micro-level database (with over 60,000 observations after cleaning the data[8]),[9] which contains the date of contract, the contracted amount, the maturity of the contract, the lending rate, the type of the interest rate, the contracting bank, the loan's subsidisation status and any associated collateral for all new housing loan contracts from 1 January 2014 onwards.

We were also able to associate bank attributes to individual contracts since we have information on the creditor financial institution. In light of this, we can on the one hand examine the impact of loan-level characteristics on the spread while controlling for the attributes of the creditor bank, and also analyse the partial effect of bank attributes on spreads. It is important to stress that although we can control for various loan contract attributes using variables of loan-level characteristics, the database does not include information on several important traits (such as income,[10] collateral value, payment-to-income ratio).

In order to identify partial effects, we use linear regression (OLS) where the dependent variable is the spread above the 3-month BUBOR. During the estimation of the first model, contract level characteristics are given the main focus among explanatory variables, and we control for the creditor bank using dummy variables. In the second model, we use variables describing the bank's operation instead of bank dummies in order to identify the partial effect of the latter. *Santos* (*2013*) follows a similar methodology to examine the interest rates on loans to Portuguese non-financial corporations. It is important to note that because the database only

[8] When cleaning the data, loans extended by building societies were also filtered out along with apparent data errors on account of the special nature of these institutions and the schemes offered by them. In addition, the model using bank variables does not include loans extended by cooperative credit institutions. This is because the integration process which cooperative banks underwent over the past two years makes it uncertain whether individual institutional attributes play a role in shaping spreads.

[9] The main characteristics of the database are presented in the *Annex.*

[10] However, it is difficult to judge the customer's income from this perspective. The price setting of banks may differ in terms of whether customer income only plays a role in accepting or rejecting loan applications, or in the determination of the specific interest rate as well.

contains data for 2014–2015, the findings can primarily be applied to these two years. Because of the special nature of this period in various regards, we use longer averages instead of the specific quarterly value for some of the bank variables:

- *Net credit losses*: banks set aside provisions according to their expected losses. However, the Settlement of household loans decreased the gross value of loans in 2015 H1, which also lowered the amount of expected loss, as the collateral backing the loans retained its earlier value. The Settlement thus decreased the net value below the collateral value for a portion of loans, and as a consequence writing back provisions was economically justifiable in some cases. Several institutions took advantage of this opportunity, but this development temporarily concealed actual credit risk costs and losses in their profit and loss accounts. We therefore use the average between 2008 and 2014 in the model.
- *Ratio of net income from fees and commissions*: the transaction fee introduced in 2013 emerged as an "other expense" for banks, but due to the charge being passed on to customers, its revenue side shows up among fee and commission income. Consequently, the ratio of net income from fees and commissions increased artificially relative to interest income. In view of this, we use the average value for the period between 2008 and 2012.

In light of the above, we estimate the following regression model that also includes bank dummy variables:

$$SPREAD_i = \beta_0 + \beta_1 CONTRACT_i + \beta_2 BANKdummy_i + \beta_3 TIMEdummy_i + \varepsilon_i \qquad (1)$$

where $SPREAD_i$ is the spread above the 3-month BUBOR for contract *i*, i.e. the difference between the contractual lending rate and the average 3-month interbank interest rate for the specific month. *CONTRACT* is the vector containing contract attributes, and we include two dummy variables: one for the creditor bank and one for controlling for time (quarter) of contracting. β_0 is constant, β_1, β_2 and β_3 refer to the vectors of the coefficients associated with different groups of variables, the element number of which corresponds to the number of variables constituting the group of variables. The contractual variables used in the model are the following:

- *Maturity*: the original duration of maturity as specified in the contract, expressed in months. The model also includes the square of the variable in order to identify non-linear effects.
- *Contracted amount*: the contractual loan amount expressed in HUF millions, logarithmised. Similarly to maturity, we also included the square value.
- *Collateral dummy*: if there is any collateral (generally real estate) associated with the contract.

- *Fixed rate dummy*: if the interest period defined in the contract is longer than 12 months, the dummy is 1; otherwise it is 0.
- *Amount of state subsidy:* estimated value of the interest rate subsidy based on the rules defined in the state interest subsidy decree effective in 2014-2015.[11]

The estimated equation of the model containing bank variables is:

$$SPREAD_i = \beta_0 + \beta_1 CONTRACT_i + \beta_2 BANK\_CHARACTERISTIC_i + \beta_3 TIMEdummy_i + \varepsilon_i \quad (2)$$

In the second model, besides the above variables, we also include the following bank variables (instead of bank dummy variables) (*BANK_CHARACTERISTIC* vector):

- *Proportion of liquid assets:* the proportion of liquid assets (cash, settlement accounts, central bank bonds and deposits, government securities) relative to the balance sheet total. We also include the square of the variable in the model.
- *Size of the capital buffer:* the difference between the consolidated capital adequacy ratio (also factoring in Pillar II requirements) and the minimal regulatory requirement. We also include the square of the variable in the model.
- *Operating cost to assets:* the proportion of operating costs (personnel costs, other administrative costs, depreciation) relative to the balance sheet total.
- *Loan loss provisioning to assets*: the average annual amount of the lending losses relative to assets between 2008 and 2014.
- *Ratio of branch offices:* the ratio of network units of a bank/banking group relative to the aggregate banking system branch office network.
- *Ratio of net income from fees and commissions*: the ratio of net income from fees and commissions relative to total of net income from interests, fees and commissions. The average of values measured between 2008 and 2012.

3.2. Findings

The first model using bank dummies gives an indication of the impact of contract attributes on spreads. Based on the results of the model (*Table 1*, model (1)), the higher the contract amount and the longer the maturity, the smaller the spread above the BUBOR. However, this effect only applies until a certain level, as shown by the positive sign of the squared variables. The significance of the loan amount

[11] The subsidy is differentiated depending whether the loan's purpose is to purchase used or new property. In the latter case, the number of children in the household also influences the subsidy. However, these two pieces of information are not available, so we assumed that every loan was contracted to purchase a used home. Based on aggregate statistics, this assumption will not lead to any significant errors, in view of the fact that only a small fraction of newly extended loans were used to purchase new homes in 2014-2015 (*MNB 2016*).

is presumably explained partly by the impact of income as an unobserved variable: wealthier borrowers, representing a lower risk tend to purchase larger properties which calls for higher loan amounts. Economies of scale considerations may also have an impact: every loan contract comes with certain fixed costs (such as communicating with the customer, handling payment difficulties), which requires a higher spread on smaller credit amounts. However, above a certain level, potential loss rises and this is reflected in the spread. For maturity, the negative coefficient may capture the effect of shrinking credit risks through the decreasing payment-to-income ratio. This effect however is offset by growing liquidity risks for loans with very long maturities, so as the maturity grows longer, a higher spread is warranted.

As suggested by intuition, the collateralized nature of a loan decreases the spread, while interest rate fixation of over one year increases the spread above the interbank rate. Based on the estimate, the state subsidy also has a relevant impact. In the database, we were able to observe the total interest rate received by the bank, which incorporates state subsidies received as well. We are able to estimate the approximate size of the subsidy based on the rules of the *Home Creation Scheme* being in effect in 2014–2015, and thus are also able to observe whether the bank prices subsidised loans differently depending on the amount of subsidy. Our findings show that for 1 percentage point of state subsidy, banks apply interest rates that are over 0.3 percentage points higher on average, *ceteris paribus.* The customer still fares well, getting the loan at a spread that is 0.6 to 0.7 percentage point smaller than the market rate in case of a 1 percentage point subsidy, while the bank "keeps" 30–40 per cent of the subsidy. This finding may also give an indication of the level of competition.[12]

Based on the coefficients identified above, changes in the general contract characteristic of newly extended loans over the past two years have pointed towards a reduction in spreads above the BUBOR. Since 2014, both the average of the contracted amount and the average maturity have increased, while the proportion of subsidised loans and the amount of state subsidy have continuously decreased, due to the characteristics of the pertaining regulation,[13] falling to minimal levels by 2015 (from February 2015, the average market interest rate was below the 6 per cent corresponding to the lower threshold of the state subsidy). These three

[12] Besides a low level of competition, it may of course reflects the impact of unobserved variables characterising various bank portfolios, that has been left out from the model. For example, if a bank specifically targets risky, lower-income customers with its state subsidised schemes, the higher spreads are indeed warranted. However, the fact that borrowers are aware of state subsidy options and may specifically seek them out irrespective of their income status decreases the probability of this distortion. However, the restrictions of subsidisation pertaining to property value increase the risk of bias.

[13] According to the rules of the Home Purchase interest subsidy, the interest rate payable by the customer must be no less than 6 per cent, so the subsidy can only lower the interest rate to this threshold. Given that market interest rates approached and even dipped below this level, the state subsidy lost much of its relevance compared to earlier, reflected in the shrinking ratio of subsidised loans.

characteristics have all fostered a reduction in transactional interest rates, and thus spreads.

For the model supplemented with bank variables, the signs of the coefficients discussed so far do not change, and they retain similar orders of magnitude (Table *1*, models (2)-(7)). For bank variables, the credit losses of recent years and higher operating costs were generally associated with larger spreads, which is in line with our preliminary expectations and the findings of the international literature. The ratio of net income from fees and commissions within net income of interest, fees and commissions has a negative coefficient, which suggests that banks which generate income through other channels — for instance by selling other services alongside loans — may take this into account by decreasing spreads. The ratio of liquid assets relative to total assets had a negative impact on spreads in the two years under review, which may capture the price-reducing effect of growing credit supply, while the positive coefficient of the capital buffer coefficient may reflect the impact of higher cost of capital. The latter variable, however, loses its significance in the broadest specification. For both variables, the square values mostly have an opposite sign (with the exception of the capital buffer, where the sign is the same in the broadest specification, albeit the value of the coefficient is particularly low), so these effects also only apply up to a certain level. The ratio of branch offices within the banking system branch office network has a positive coefficient, which may capture market power: banks with relatively more branch offices may have nearly exclusive presence on a greater amount of local markets, which they may then enforce in their pricing. We address this effect in depth in the section on the model examining demand patterns (*Chapter 5*).

Table 1
Results of the estimated linear regressions
(target variable: spread above the 3-month BUBOR)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
contracted_ amount_ln	–1.655*** (0.0171)	–2.131*** (0.0675)	–2.101*** (0.0680)	–2.030*** (0.0713)	–2.008*** (0.0716)	–1.977*** (0.0724)	–1.993*** (0.0727)
contracted_ amount_ln_sq	0.335*** (0.00512)	0.421*** (0.0188)	0.422*** (0.0191)	0.410*** (0.0196)	0.406*** (0.0197)	0.411*** (0.0198)	0.416*** (0.0198)
maturity_month	–0.00265*** (0.000278)	–0.00608*** (0.000376)	–0.00588*** (0.000371)	–0.00282*** (0.000359)	–0.00271*** (0.000358)	–0.00344*** (0.000355)	–0.00339*** (0.000354)
maturity_month_sq	8.57e-06*** (6.79e-07)	1.71e-05*** (8.92e-07)	1.63e-05*** (8.82e-07)	1.00e-05*** (8.50e-07)	9.81e-06*** (8.49e-07)	1.11e-05*** (8.42e-07)	1.09e-05*** (8.39e-07)
d_collateral	–0.777*** (0.0200)	–1.409*** (0.0358)	–1.498*** (0.0356)	–0.899*** (0.0287)	–0.928*** (0.0286)	–1.007*** (0.0285)	–0.994*** (0.0287)
subsidy	0.436*** (0.00930)	0.423*** (0.0101)	0.372*** (0.0100)	0.414*** (0.00932)	0.381*** (0.00944)	0.327*** (0.0100)	0.345*** (0.00999)
d_fixation	1.085*** (0.0127)	1.343*** (0.0132)	1.341*** (0.0132)	1.483*** (0.0139)	1.504*** (0.0139)	1.515*** (0.0137)	1.485*** (0.0136)
liquid		–0.304*** (0.0121)	–0.286*** (0.0126)	–0.162*** (0.00849)	–0.137*** (0.0101)	–0.124*** (0.0101)	–0.0697*** (0.0109)
liquid_sq		0.00405*** (0.000209)	0.00396*** (0.000221)	0.00157*** (0.000141)	0.00145*** (0.000180)	0.00112*** (0.000180)	0.000379** (0.000193)
capital buffer			0.137*** (0.00480)	0.142*** (0.00442)	0.147*** (0.00449)	0.0238*** (0.00545)	-0.000334 (0.00561)
capital buffer__sq			–0.00505*** (0.000379)	–0.00597*** (0.000339)	–0.00713*** (0.000357)	0.000494 (0.000374)	0.00205*** (0.000396)
cost to asset				0.678*** (0.0171)	0.550*** (0.0173)	0.675*** (0.0182)	0.636*** (0.0176)
prov_avg					0.327*** (0.0100)	0.281*** (0.00976)	0.370*** (0.0108)
branch						0.0303*** (0.000762)	0.0375*** (0.000862)
comm_fee							–0.0350*** (0.00178)
TIME dummy	YES	YES	YES	YES	YES	YES	YES
BANK dummy	YES						
Constant	6.426*** (0.0421)	12.62*** (0.173)	11.68*** (0.177)	7.748*** (0.129)	7.091*** (0.141)	6.877*** (0.141)	6.822*** (0.147)
N	64,904	62,848	62,848	62,814	62,280	62,280	62,280
R^2	0.671	0.562	0.572	0.621	0.630	0.638	0.641

Note: Robust standard errors in parentheses. Refers to a 10 per cent, ** to a 5 per cent, and *** to a 1 per cent significance level. The variables: spread above the 3-month BUBOR expressed in percentage points (BUBOR_SPREAD), contract amount in HUF million, logarithmised (contracted amount_ln), maturity in months (maturity_month), loan collateral dummy (d_collateral), estimated amount of state subsidy (subsidy), interest rate fixation over one year dummy (d_fixation), liquid assets/balance sheet total (liquid), consolidated capital buffer based on SREP (capital buffer), operating costs to assets (cost to asset), average loan loss provisioning between 2008 and 2014 (prov_avg), ratio of branch offices within the branch office network (branch), net income from fees and commissions within net income of interest, fees and commissions, 2008–2012 average (comm_fee), TIME dummies and institution dummies (BANK dummy). Variables ending in _sq refer to squared variables.*
Source: own calculations.

4. Identifying supply effects using the panel model

4.1. Database and methodology

We also used a panel database for our analysis, compiled from Hungarian banking system data that includes data on the major banks involved in housing lending in Hungary between 2004 Q1 and 2014 Q4 (OTP Bank, MKB Bank, Budapest Bank, FHB Bank, Cetelem Bank, Erste Bank, Raiffeisen Bank, CIB Bank, Unicredit Bank and K&H Bank).[14] Our approach was to use a regression model expressed for the differences of the dependent variable and that of the explanatory variables (3). We estimated a model using fixed effects broadly employed in the literature[15], and a dynamic model also containing the dependent variable's lag, used more rarely (e.g. *Valverde – Fernández 2007*).[16]

Because the presence of unit root processes could not be ruled out for level time series and because error terms exhibited autocorrelation when applying the fixed effect model, we instead chose to use a static model containing the first differential of the variables:

$$\Delta y_{it} = \Delta X'_{it}\beta + e_{it} \qquad (3)$$

$$e_{it} = \delta_t + \omega_{it} \qquad (4)$$

$$\omega_{it} \sim I.I.D., \qquad (5)$$

Where Δy_{it} is the annual change in housing loan margins, ΔX_{it} is the annual change in explanatory variables and δ_t is the time fixed effect . Because our panel is balanced, the calculation of differences did not cause any significant data loss. In the following section, we present the findings of the model estimates, which proved relatively robust for several specifications.

4.2. Findings

The database allows the examination of bank-specific factors shaping banks' pricing decisions such as operating and funding costs, economies of scale and bank strategy. Because similarly to the previous database, the sample only includes Hungarian

[14] The housing loans offered by one bank are special in that they are tipically unsecured transactions concluded for "other" loan purposes, and as such, can be regarded as consumption rather than housing loans. For this reason, we also made the estimate with the omission of this bank and our results proved to be stable.

[15] Based on the tests performed using the fixed effect model, we cannot exclude the presence of unit root processes for certain variables, so we rejected this approach due to potential spurious regression bias.

[16] Including the dependent variable lag may be motivated by the rationale that when determining bank lending spreads, earlier periods may serve as an anchor, and additionally, banks are not really capable of reacting flexibly when pricing loans due to market circumstances. Another advantage of this approach is its capacity to address the endogeneity stemming from reverse causality, which in our case may emerge in the variables related to bank portfolio structure or in the NPL ratio. But because the Blundell-Bond and Arellano-Bond type methods available for short time series can be applied effectively mainly with large cross section element numbers, in our case, estimating too many instruments created issues. Although we tried out different dynamic models, we encountered troubles with model diagnostics every time.

data, there is still no way to conduct a direct international comparison. However, the 10-year horizon allows us to control for country-level cyclical macroeconomic developments. In order to capture macroeconomic developments, we included annual GDP in the model and also included time fixed effects in an alternative specification (*Model 2*). Among the variables used, the ones capturing credit losses, such as the ratio of non-performing loans, the loan-to-value ratio and loan loss provisioning, can be considered as cyclical as well. We also included indicators representing market power for the sake of capturing structural effects: the size of bank branch networks and bank market share within household lending.

The findings of the estimated model have limited reliability. The sign of key variables is generally identical to the ones dictated by economic theory, but significance levels are not stable across the different specifications. Because banks are often unable to adapt on a quarterly horizon, we consider the findings of the model expressed for annual variables as the most convincing, so the following section addresses these in detail (*Table 2*). Overall, from our findings indicative conclusions can be drawn on the factors that shape housing loan spreads in the Hungarian banking system.

Table 2
Results of the Hungarian bank panel model
(target variable: spread above the 3-month BUBOR)

VARIABLES	(1)	(2)
Operating cost	0.994 (0.779)	0.489 (1.086)
Other income/interest revenue	–0.00831 (0.00604)	–0.00346 (0.00632)
Liquidity	0.0470*** (0.0174)	0.0508*** (0.0183)
CAR	0.0376** (0.0165)	0.0995*** (0.0350)
Ratio of fixed-rate loans × slope of the yield curve	2.774*** (0.699)	3.469*** (1.105)
External liabilities	0.0206 (0.0267)	0.00873 (0.0283)
GDP (YoY)	–0.188*** (0.0633)	–
LTV	0.0128* (0.00706)	0.00851 (0.00775)
NPL	0.120*** (0.0364)	0.0882** (0.0393)
Provisions	0.389*** (0.124)	0.209** (0.101)
Proportion of branches	0.141* (0.0786)	0.124* (0.0683)
Market share	32.44 (19.84)	35.80 (21.84)
Constant	0.0636 (0.211)	1.427* (0.849)
Time fixed effect	–	YES
Number of observations	317	317
R-squared	0.22	0.34
Number of banks	10	10

Note: robust standard errors in parantheses. Refers to a 10 per cent, ** to a 5 per cent, and *** to a 1 per cent significance level.*

Variables: operating cost to balance sheet total, non-interest income/interest income, liquid assets/balance sheet total, capital adequacy ratio expressed as a percentage, the share of fixed loans multiplied by the slope of the yield curve (5-year government security yield – 3-month BUBOR) taken into account after 2010, the share of external liabilities within the sum of deposits (households and corporate) and external liabilities, GDP growth expressed in percentage points, loan value to the property pledged as collateral expressed as a percentage, share of non-performing loans in proportion to household and corporate loans, loan loss provisioning in the given period in proportion to the balance sheet total expressed as a percentage, market share within the stock of outstanding household loans. We included the annual change of each factor into the model. Because it takes different amount of time for the changes of various factors to become incorporated into spreads, we applied an annual lag for operating costs and a quarterly lag for the capital adequacy ratio, the non-performing loan ratio and the provision.
Source: own calculations.

The individual bank factors capture, among others, the difference between banks' business models. The coefficient of the share of operating costs to balance sheet total is not significant, so in this model, we are unable to reliably confirm the intuition that banks compensate higher operating costs with setting higher prices.[17] However, this result can also be distorted by the change in the ratio's denominator (e.g. as a result of deleveraging after the crisis). The ratio of other income to interest income is also not significant at the usual significance levels. We featured this variable in the model to be able to control for bank strategies that place greater emphasis on net income from fees and commissions, allowing the bank to offer more attractive lending rates. The positive sign of the share of liquid assets to the balance sheet total and the capital adequacy ratio suggest that banks incur additional costs to maintain excess liquidity and excess capital which they compensate with higher prices.[18] We examined the ratio of fixed rate loans on variable interest rate loans for the post-crisis period in interaction with the slope of the yield curve. Based on our expectations, at those banks where the ratio of fixed interest rate loans is higher, the aggregated spread is sensitive to the slope of the yield curve which captures the higher cost of funding and/or the interest rate risk. This impact was significantly identified during the panel estimate on Hungarian banks. We included the variable of the share of external liabilities to corporate and household deposits in the regression in order to control for the difference in business models among banks which are relying on and those which are not relying on external funds. This variable is not significant, that is, the results of the regression do not suggest that banks would price differently as a result of their reliance on external funds.

Among cyclical variables, we go into detail about the impact of both the macro variables and that of the individual bank variables related to the cyclical position. The negative coefficient estimated for GDP capturing the economic performance suggests the pro-cyclical nature of spreads. In the case of an economic contraction, spreads increase in line with high risks as a sign of decreasing credit supply, which further aggravates the contraction of the economy, while during a boom period, banks lend with more moderate spreads, thereby further strengthening growth. The LTV ratio entered in the regression with a positive sign. The higher LTV ratio reflects higher risk, since in the case of default the bank may mitigate or avoid credit loss by selling the collateral. It should be noted that banks can compete not only in price,

[17] What makes the identification of the impact of operating costs more difficult is that prior to the crisis several banks gained market share through agent sales, the cost of which — as opposed to operating their own branch network — did not appear among their operating costs. Considering that following the onset of the crisis, agent sales decreased significantly, this may also be the reason why operating costs still appear as a significant factor in the case of a micro-level database only building on data from 2014-2015.

[18] In the case of liquidity, this result contradicts the result of the estimation conducted on the micro-database. However, t the latter database covers only a two-year period while the panel database processes the data of one decade, which means a difference. On the other hand, the impact of capital adequacy is in line with the results of the micro-database.

but also in lending conditions, which may cause endogeneity for the LTV variable, that is, in this case, the underestimation of the coefficient, especially if we examine newly issued loans. The non-performing loan ratio within the loan portfolio of the private sector *(NPL)* also correlates with the economic cycle: during the period of an economic boom the share of the NPL portfolio is generally low, while during recession, this ratio increases. The high NPL captures both already written-off and potentially expected lending loss; accordingly, the sign of the variable is positive in the estimated model. Similarly to the non-performance ratio, provisioning also reflects the risks, but this indicator only includes the loss already written off by the bank. The sign of the impairment is also positive in the model.

Because the development of economic growth in other countries was similar to the Hungarian trend, the cyclical variables probably only explain some of the difference between spreads in the region. In our view, some structural reasons are also causing the high spreads. We attempted to capture these factors by the share of the number of bank branches and the banks' market share on the household credit market. The share of the number of bank branches in comparison to the number of branches of the banks included in the model not only takes into account the bank's own branch network, but also the size of that branch network compared to that of the competitors. This variable is significant and it is featured in the model with a positive sign which suggests that banks operating a large branch network are able to use their dominant position on the market when defining the spreads on mortgage loans. In our view, the role of the branch network is indeed relevant because the majority of the population can select only from a limited number of banks located near their place of residence, which decreases competition between banks. The market share variable is not significant, so this simple control variable does not confirm our impression that banks strive to use their dominant position on the market in their pricing.[19]

It may be a question whether the levy on banks increased margins after it was introduced. We are unable to analyse this impact on the micro data due to the short time period available, but we have included it in the panel model as an explanatory variable. Based on our results, the impact of the bank levy is not apparent among new loans, which also confirms the findings of the literature according to which banks have averted this extra cost by modifying the interest rate of their existing loan portfolios (*Capelle-Blancard – Havrylchyk 2013*).

[19] We can see in the correlation matrix included in the annex that there is high correlation between the share of branches and the market share variable. For this reason, we decided to apply the model without this latter variable, and the significance level and the coefficient of the branch-proportion variable did not change significantly either.

5. Identification of demand effects using micro-level data[20]

5.1. Database and methodology[21]

Along with supply factors, it is important to examine whether the demand side supports the existence of a competitive market or whether there are any frictions that could result in less competition. As part of this investigation, we developed a model which belongs to the family of discrete choice models. This allows us to examine the factors that influence consumers in bank selection. During the modelling, we relied on the Central Credit Register database which contains detailed loan analytics for new disbursements, including customer characteristics, from 2015 onwards. The final model contains the data of seven major banks, covering more than two thirds of the mortgage loan market. In the following, we present the intuition behind the model and the main steps of the estimation (estimating interest rates and restricting the choice set) and we summarise the results of the estimation.

We applied a multinomial regression model for the analysis, placing consumers' individual choices into the focus of the investigation. Factors influencing the decisions of consumers can be classified into three groups. First, the conditions of the selected loan product and the characteristics of the selected bank play a key role. Beside the interest rate, we can mention the factors that capture the quality of bank services and that a past relationship with a given bank may also be an important aspect. Second, the customer's taste also matter as the popularity of the banks may differ in the various segments of the society. Third, the customer-specific factors which are not observable by the researcher show up in the error term of the estimate. Based on the above, following Train's demonstration (2002), the utility of the customer by choosing a given bank can be written as:

$$U_{ij} = V_{ij}\left(x_{ij}, s_i\right) + \varepsilon_{ij}, \tag{6}$$

Where U_{ij} is the utility of consumer i if he chooses bank j, x_{ij} is the vector containing variables which are customer- and also bank-specific (e.g. transactional interest rate). s_i is the vector that contains solely customer characteristics (e.g. age, income) while ε_{ij} is the model's error term, which follows an i.i.d. extreme value distribution by assumption. The model's starting point is that customers strive to maximise their utility, that is, they opt for the offer promising the highest level of utility compared to other offers.

$$U_{ij} > U_{ik}, \ \forall j \neq k \tag{7}$$

[20] This chapter provides a brief summary of the study, which was presented on the conference entitled „5th EBA Policy Research Workshop: Competition in Banking: implications for financial regulation and supervision" (*Aczél 2016*).

[21] The above study presents in detail the steps of database cleaning and the descriptive statistics of the data used.

Approaching the observable part of the utility function with a linear relationship, we have:

$$V_{ij} = x_{ij}^{'}\beta + D_j^{'}\gamma s_i, \tag{8}$$

where β is the parameter vector belonging to the characteristics of the various alternatives, D_j is a vector containing binary variables denoting individual banks, γ is the matrix containing the parameters belonging to the customer characteristics differing by bank. Using all of the above and assuming that the error term follows an i.i.d. extreme value distribution, the likelihood that customer i selects bank j can be written as:

$$P_{ij} = \frac{e^{x_{ij}^{'}\beta + D_j^{'}\gamma s_i}}{\sum_k e^{x_{ik}^{'}\beta + D_j^{'}\gamma s_i}} \tag{9}$$

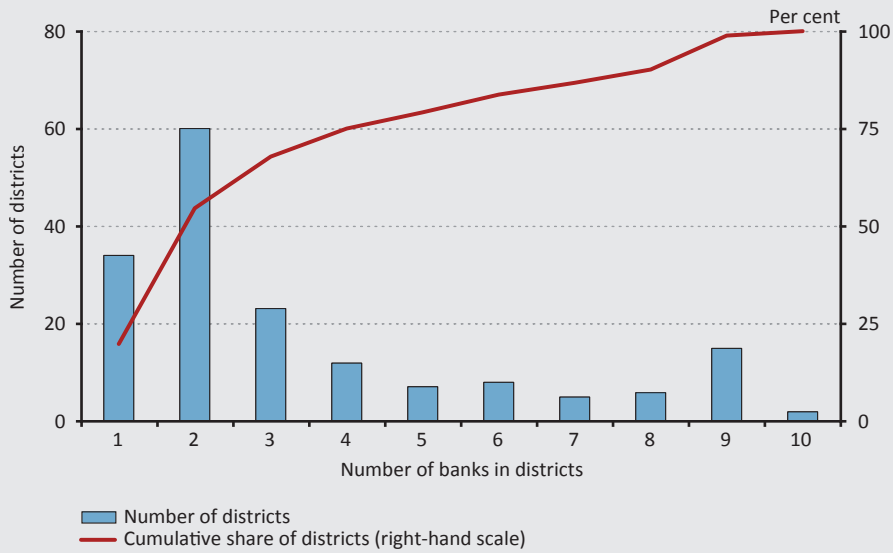
To estimate the model, we also need theoretical interest rate data that show the interest rate at which the customer would have received a loan had he chosen another bank instead of the observed choice. We estimated these theoretical interest rates using linear regression, so that we created a unique model for every bank where the dependent variable is the interest rate and the explanatory variables can be classified into two groups. First, we included in the models the characteristics of customers who actually borrowed from the specific bank (age, location, income) and second, we also controlled for the transaction attributes (value of the mortgage, maturity, loan type). The explanatory powers of the models are high (R^2 around 0.9) and their standard error is low (around 0.3 percentage points).[22] Despite the good model statistics, the fact that this estimation may be biased is an issue. The potential bias stems from the fact that the estimation sample is not random, because banks may be chosen by customers with strongly diverging characteristics (self-selection bias). However, it is important to stress that this estimation procedure is similar to the procedure applied by banks, because banks themselves define their pricing models based on relationships estimated with regard to their own clientele. In our view, our estimated models feature acceptable accuracy and estimate for a sample similar to banks' samples, so these estimates provide a good approximation of the theoretical interest rate that banks have offered to prospective borrowers.

After estimating theoretical interest rates, we also examined whether the assumption that households can choose from the offerings of all banks is well-founded. We found that households faced both geographic and financial constraints, so it is likely that they can only choose from a narrow range of banks when making mortgage loan decisions. The geographic constraints are reflected in the fact that

[22] R^2 (0.32) is low for a single bank interest rate model, however this model also yielded an estimate with a low error (RMSE 0.33).

no more than two of the eleven major banks are present in half, and no more than four are present in three-fourths of Hungary's districts (*Figure 6*).[23]

Figure 6
Distribution of the number of banks present in various districts

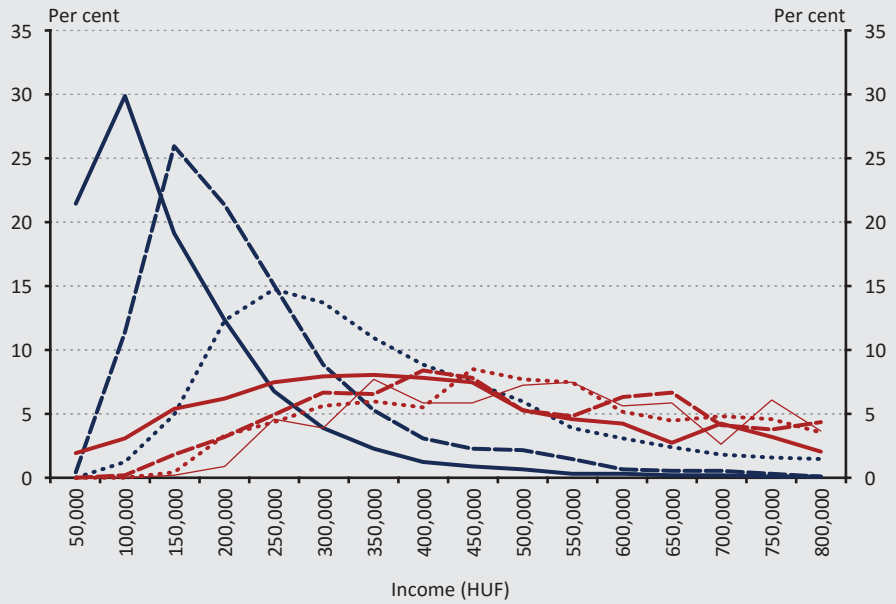


Source: MNB.

Figure 7 captures the differences in banks' business strategies through the distribution of customer income associated with the loans extended in 2015. The figure clearly shows that the banks marked by black mainly serve low-income customers, while those marked by red mainly target higher-income customers and barely lend to lower-income segments, or not do not lend to these segments at all. The distribution of loan size or the value of the property to be purchased shows a similar picture. We used these findings within the models to restrict the group of banks that customers may choose from.

[23] The distribution of bank presence as a function of the population would be an interesting addition. More than a quarter of the Hungarian population lives in a district where there are no more than two banks, and nearly 40 per cent lives in a district where there are no more than four banks present from among the eleven major banks. Only half of the population has access to at least six major banks in their region.

Figure 7
Distribution of incomes behind the loans extended by the seven major banks



Note: The various lines indicate the banks included in the analysis.
Source: MNB.

5.2. Findings

We run the final model in eight specifications; the results are listed in *Table 3.* In the first specification, we neither controlled for choice sets nor included demographic variables (A1). The findings of this estimate are not in line with expectations, because for example the interest rate coefficient is positive, which is difficult to interpret, as it suggests that consumers like high interest rates. This finding also suggests that endogeneity distorts estimates, which may be because the impact of demand and supply is not adequately distinguished in this specification.

For the sake of ruling out endogeneity, we implemented three changes in the model. First, we incorporated demographic variables and bank dummies (A2, A4, B2, B4), second, we restricted the choice sets (B1-B4), and third, we incorporated a variable that captures previous relationship with banks (A3, A4, B3, B4). We obtained intuitive results in each case, and the sign of the interest rate is negative, which is in line with a negatively sloping demand curve.

In the models that included demographic variables and bank dummies (A2, A4, B2, B4), the issue of endogeneity was significantly reduced. The procedure applied addresses the typical problem of a bank taking advantage of its strong brand and

lending at high interest rates in response to strong demand. Another key finding is that by including demographic variables, clearly outlined taste patterns can be identified. A good example of such pattern is that based on the estimated coefficients, older age groups tend to prefer banks that have an established presence on the Hungarian market, while younger age groups prefer newer market entrants.

The models estimated by narrowing the choice set (B1-B4) may yield a more realistic picture because banks that are not potential choices for customers are left out of the calculations. Thus for instance, in the case of a low-income customer, obtaining a loan from a bank that exclusively targets an affluent clientele and offers low interest rates is not a realistic option. If we leave out this bank from the customer's potential options, it would lead to the false conclusion that although the customer could borrow at a low interest rate, he instead chose to borrow at a higher rate. This effect may be present in specification A1, where we did not control for the choice sets. A key finding is that narrowing the options alone results in the estimation of a demand curve with a negative slope (B1).

We also included a variable in the models that shows whether the customer has borrowed from a specific bank (in the past eight years). This variable is significant and positive in every specification (A3, A4, B3, B4), which suggests that customers prefer banks that they are familiar with in their borrowing decisions.

In every model, we included a variable among explanatory variables that shows the number of branch offices that the bank has in the region where the customer resides. This variable is also significant and positive in almost every specification, meaning that an expansive branch network is valued by customers.

Overall, the estimation results suggest that the Hungarian population tends to choose from a specific and narrow range of banks when making borrowing decisions. This is partly due to the geographic distribution of banks' branch networks and partly to the taste patterns prevailing within society; banks' business models are also relevant. These limitations and patterns allow banks to price their products according to oligopolistic competition. These findings confirm the outcomes of the bank panel model investigating supply effects, i.e. that the distribution of branches plays a key role in determining spreads. Finally, these estimates demonstrate that structural factors play an important role on the Hungarian mortgage market.

Table 3
Results of the demand model estimate

		Total choice set				Restricted choice set			
		No taste (A1)	Taste (A2)	No taste (A3)	Taste (A4)	No taste (B1)	Taste (B2)	No taste (B3)	Taste (B4)
	Interest	0.171***	–1.262***	–0.0176	–1.182***	–0.862***	–1.640***	–1.042***	–1.539***
	Number of branches	0.0221***	0.000881	0.0136***	0.00213**	0.0181***	0.00762***	0.00843***	0.00971***
	History			3.037***	2.750***			2.502***	2.750***
Bank A	Age		0.00311		0.00563		0.00956		0.0167**
	Income		1.142***		1.213***		0.401***		0.430***
	Constant		–6.447***		–6.015***		–2.614***		–1.945***
Bank B	Age		–0.0266***		–0.0115**		–0.0153		–0.00750
	Income		1.326***		1.332***		0.428***		0.425***
	Constant		–10.22***		–9.233***		–3.936***		–2.947***
Bank C	Age		–0.0155***		–0.00626**		–0.0149***		0.00206
	Income		0.979***		1.032***		0.439***		0.441***
	Constant		–3.337***		–2.895***		–1.705***		–1.195***
Bank D	Age		–0.0623***		–0.0511***		–0.0747***		–0.0632***
	Income		1.270***		1.289***		0.523***		0.515***
	Constant		–5.198***		–4.584***		–0.590*		0.283
Bank E	Age		–0.0165***		–0.00558*		–0.0180***		–0.00227
	Income		0.480***		0.540***		0.0768**		0.146***
	Constant		–2.626***		–2.676***		–1.362***		–1.509***
Bank G	Age		0.00544		0.0136***		0.00448		0.0129*
	Income		1.245***		1.275***		0.504***		0.502***
	Constant		–7.052***		–6.388***		–2.897***		–1.948***

*Note: * Refers to a 10 per cent, ** to a 5 per cent, and *** to a 1 per cent significance level.*
Source: own edit.

6. Why are the spreads so high?

In previous sections we listed a number of characteristics that may potentially explain the high Hungarian spreads. In line with our research strategy, in the first step we attempted to explain the heterogeneity of *Hungarian banks'* price setting behaviour by using bank-level and customer-level variables. The next step is to examine the performance of the Hungarian banking sector compared to international examples with respect to the significant variables identified in the models estimated on the Hungarian sample.

Our main findings, as presented in previous sections, were the following:

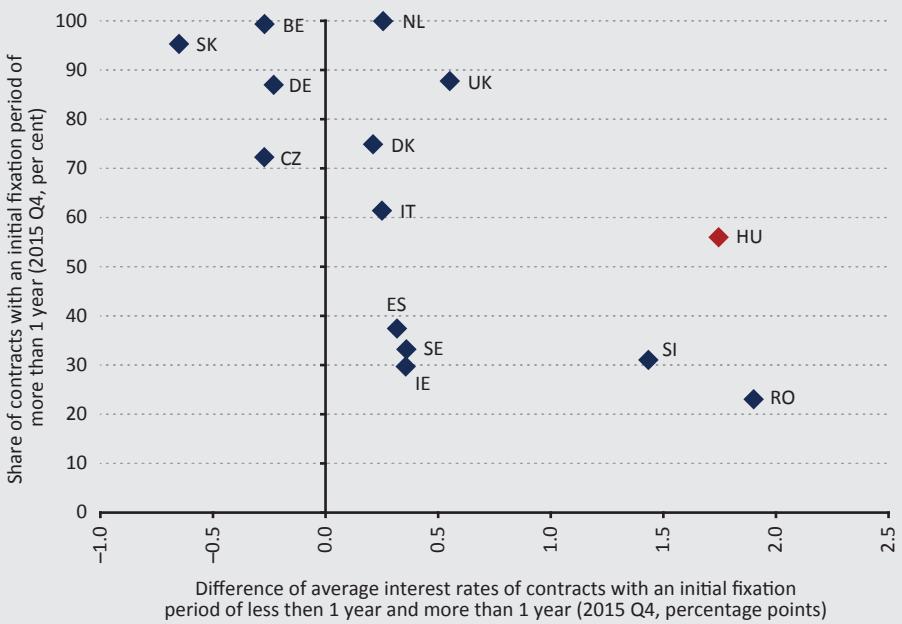
- Through a composition effect, the higher share of contracts with an initial interest rate fixation of over 1 year may account for the higher level of Hungarian spreads. The slope of the yield curve may also contribute to the relatively high cost of fixed-interest loans.
- An increase in GDP typically reduces spreads, while recession raises them.
- Credit losses and the higher share of nonperforming loans may influence the spreads through higher risk costs, partly as a result of banks' propensity to build on historical credit experiences involving past – poor quality – loans.
- Higher operating costs have been coupled with higher spreads in recent years.
- The lower share of profits from fees and commissions may induce relatively higher spreads.
- Similarly, banks' capital adequacy (capital requirement) may also exert upward pressure on spreads.
- There is a positive correlation between the average loan-to-value ratio of the loans disbursed and the spread imposed.
- Banks representing a higher share in the branch network of the banking sector applied, *ceteris paribus,* higher spreads.
- The lack of a sufficient number of market participants in certain regions and debtors' taste patterns may lead to the emergence of an oligopolistic market.

Unfortunately, owing to the limited availability of data, only some of these items can be analysed in international comparison. In the following, we focus our research on items that – in light of the international literature and/or our estimated models – appear to be especially important, and for which relevant international data are also available. The latter may pose a problem mainly in relation to the results of the demand model; indeed, there is practically no information available at the international level on debtors' income status, their taste and on the distribution of branches. We will not go into detail about the topic of liquid assets and the loan-to-value ratio because – although we found some evidence that these indicators and the size of the spreads are positively correlated – international literature does not provide clear guidance on the impact of such attributes on spreads.

6.1 Ratio of loans with an initial interest rate fixation of over 1 year

As pointed out above, the outstandingly high Hungarian spreads observed at the end of 2015 and in early 2016 can be primarily attributed to the higher spread on loans with an initial interest rate fixation of over 1 year. The spread between these lending rates and the interbank rate is partly determined by the yield curve; indeed, in the case of a steeper (and upward sloping) yield curve, the creditor bank will also face increased costs of funds when borrowing funds with a long-term initial rate fixation and consequently, this premium will be priced into the bank's lending rate. If the bank relies on short-term and/or floating rate funds to finance loans extended with a long-term rate fixation, the interest rate risk thus incurred by the bank justifies an increase in the spread. Based on Eurostat data, the yield curve is relatively steep in Hungary compared to other EU countries. At the end of 2015, the spread between the ten-year government bond yield and the three-month interbank interest rate took the fifth highest value in Hungary.

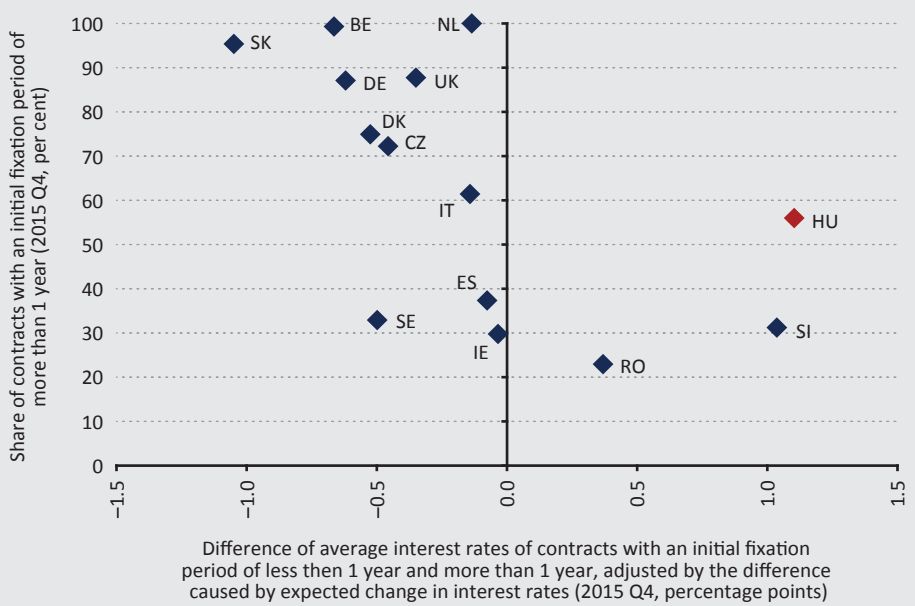
Figure 8
Share of housing loan contracts with an initial interest rate fixation of over 1 year in new disbursements vs. the interest spread between contracts with long-term and short-term interest rate fixation



Note: In the case of loans with an initial interest rate fixation of over 1 year, the most widespread scheme – the 1Y–5Y initial rate fixation – was considered.
Source: European Mortgage Federation, national central banks.

As at end-2015, data reveal that in Hungary, the share of products with a rate fixation of over 1 year was high even though Hungary recorded one of the highest interest spreads between fixed and variable rate products (*Figure 8*). It should be noted that, if the interest rate spread between two product types reflects the expected interest rate path, in theory, choosing between the two products would not make any difference for a rational consumer, provided that his interest expectations coincide with market expectations. Experience, however, shows that instead of looking at the interest rate path as a whole, consumers are far more concerned about the interest rate spread prevailing at the time of the loan disbursement and during the short period that follows (*Johansson et al. 2011*; *Badarinza et al. 2014*; *Holmberg et al. 2015*). It should also be remembered that, as noted in the introduction, it is often the given country's lending "traditions" or institutional background that determine consumers' decisions as they select from the product types available. Having said that, since the surge in household lending at the beginning of the 2000s, it has only been observed in recent years

Figure 9
Share of housing loan contracts with an initial interest rate fixation of over 1 year in new disbursements vs. the adjusted interest spread between contracts with long-term and short-term interest rate fixation
(2015 Q4)



Note: In the case of loans with an interest period of over 1 year, the most widespread scheme – the 5Y–10Y initial rate fixation – was considered. We deducted the difference between the 5-year IRS and the short-term interbank interest rate from the difference between the average interest rate on fixed-rate and variable-rate transactions.
Source: European Mortgage Federation, Datastream, national central banks.

that households are more likely to become indebted with fixed interest rates, on a market basis (without any state subsidy).

We also analysed the figure above after adjusting the interest spread by the differential between the 5-year interest swap relevant to the given currency and the short-term interbank interest rate. Our goal was to exclude, as far as possible, the effect of interest rate path expectations from the premium shown in the figure, in order to obtain a better approximation of the "pure" differential concerning the rational consumer.[24] Based on the values thus received, in Hungary the premium on fixed-interest loans is higher than would be warranted by the difference between funding costs; consequently, we still cannot consider the increase in the share of fixed-rate loans as being trivial (*Figure 9*).

We believe that the substantial share of fixed-rate products suggests that the Hungarian population is more risk averse than borrowers in other countries; indeed, Hungarian customers are willing to pay a much higher premium for a fixed interest rate. This, in itself, does not imply that this premium (or at least a part of it) is not justified; it is an interesting development, however, that Hungarian household debtors are apparently more likely to pay a considerably larger sum in exchange for a smaller deviation in monthly payments. In our opinion, this may also reflect households' negative experiences with foreign currency loans and the extremely volatile instalment amounts associated with them. *Banai and Vágó* (*2016*) also confirm that foreign currency lending gave rise to precautionary motives among households: based on data derived from the Austrian central bank's Euro Money Survey, the authors provided evidence that the negative experiences associated with foreign currency lending clearly set back credit demand. It is also conceivable that the "demand" problems presented in Section 5 can be perceived more strongly – possibly because of the limited number of active market participants – in the market of fixed-interest loans. The picture appears somewhat more complex once we consider that the high ratio of fixed-interest products has partly resulted from the activity of building societies issuing fixed-interest loans. Nevertheless, it is also true for these institutions that the interest rate they impose exceeds the interest level of variable-rate products; in other words, the customers of building societies will also pay the premium between the fixed rate and the variable rate in exchange for a predictable interest rate.

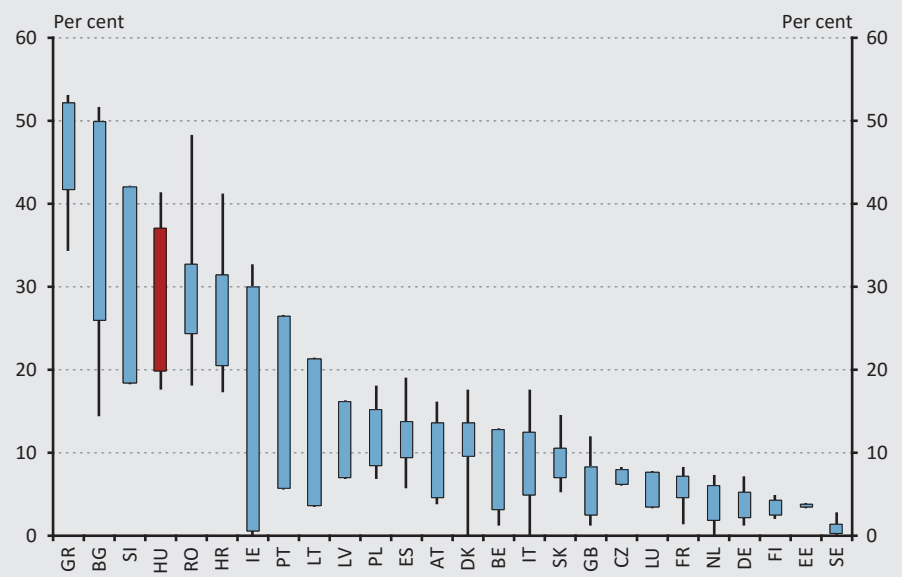
[24] However, this method should be viewed as an approximation only; indeed, the differential between the average interest rate on actually disbursed fixed-rate loans and the interest rate on variable-rate loans can also be influenced by composition effects, especially when a particular product has gained dominance in the given country. Various sub-markets may be dominated by different creditors and borrowers and the different characteristics of these market participants may also be reflected in aggregate interest rates. Consequently, the "pure premium" could not be presented even on the second figure.

6.2. The role of credit losses

Model estimates have demonstrated that the ratio of credit losses and non-performing loans play a prominent role in credit spread developments. In calculating their rate of return, banks should consider the probability of a borrower's falling into delinquency during the term of the loan, and calculate the expected recovery rate on the collateral in case of the borrower's delinquency. The calculation of expected losses is based on historical data; consequently, a substantial non-performing portfolio may have a long-term impact on price-setting. Based on the distribution of NPL ratios, Hungarian banks are among the more affected institutions of the region, which may have contributed to the emergence of higher spreads (*Figure 10*).

Collateral recovery and the efficiency of enforcement proceedings play a key role in credit loss developments. Hungarian legislation has significantly hampered banks in the acquisition and sale of real estate property in recent years. Moreover, the legal environment protecting debtors motivated even performing debtors to suspend their monthly payments, generating even more credit losses for banks (*Dancsik et al. 2015*).

Figure 10
Distribution of banks by the ratio of non-performing loans in certain countries
(2014)



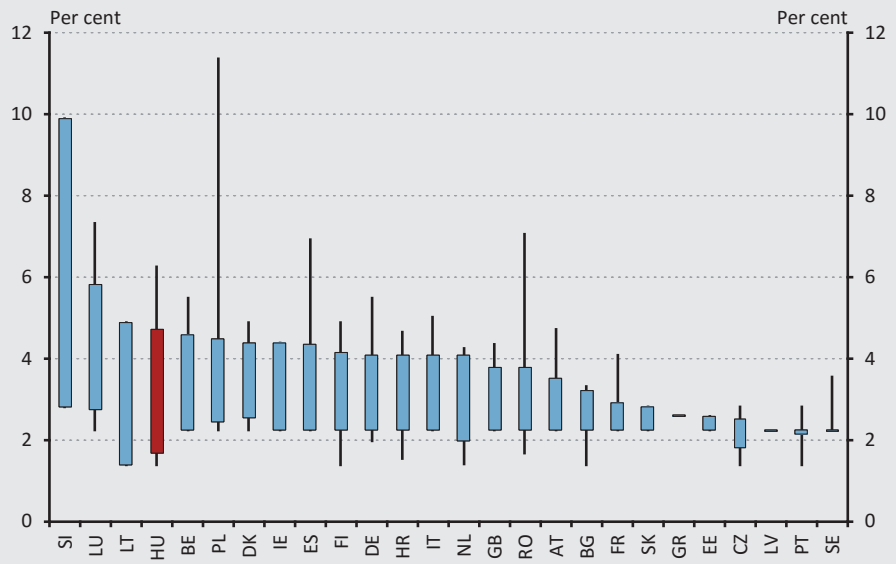
Note: Columns indicate the 25–75th percentiles of the ratios of individual banking systems, while lines show the 10–90th percentiles. Countries are ranked in descending order based on the 75th percentile.
Source: SNL Financial.

6.3. The role of operating costs

Operating costs have an intuitive role in the evolution of spreads, as banks need to set a price that allows them to achieve profits. Banks' lower efficiency and higher costs may also call for higher spreads. We demonstrated this effect successfully in the model featuring microdata; however, we did not receive significant results in the panel model. This may be partly attributed to the costs of agent sales preceding the outbreak of the crisis, as they were not part of banks' operating costs.

Based on the international data available, the Hungarian banking sector is among the less cost-efficient banking systems (*Figure 11*). Obviously, the magnitude of operating costs cannot be fully separated from non-performing loans; indeed several items related to the management of the NPL portfolio raise the costs incurred by banks. Such costs include, for example, the need for personal treatment in the case of a bad loan, or the continuous safeguarding and potential upkeep of already recovered collateral.

Figure 11
Distribution of banks by the ratio of operating costs to risk-weighted assets in certain countries
(2014)

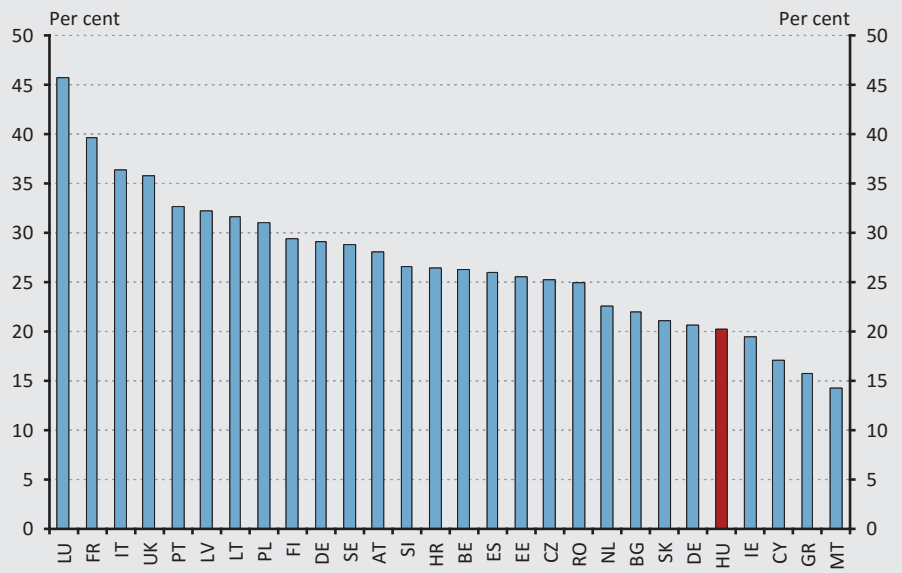


Note: Columns indicate the 25–75th percentiles of the ratios of individual banking systems, while lines show the 10–90th percentiles. Countries are ranked in descending order based on the 75th percentile. Data may be biased due to the fact that the value of risk-weighted assets is sensitive to the methodology applied by the bank (standard or IRB method), but for lack of internationally available data, we are unable to assess the magnitude of this effect. In certain countries, there were few banks for which information was available and the distribution might only reflect the data of a single institution or an extremely limited number of institutions.
Source: SNL Financial.

6.4. The role of net income from fees and commissions

According to the findings of the international literature, banks are more prone to set lower interest rates if they also collect income from services other than loan contracts. Although this was confirmed by the estimates we performed on microdata, it was not a significant variable according to the results of the panel model. In Hungary, the ratio of net income from fees and commissions is relatively small compared to other European countries (*Figure 12*), which may also contribute to higher spreads.

Figure 12
Ratio of net income from fees and commissions to net income from interests, fees and commissions
(2008-2013, mean)

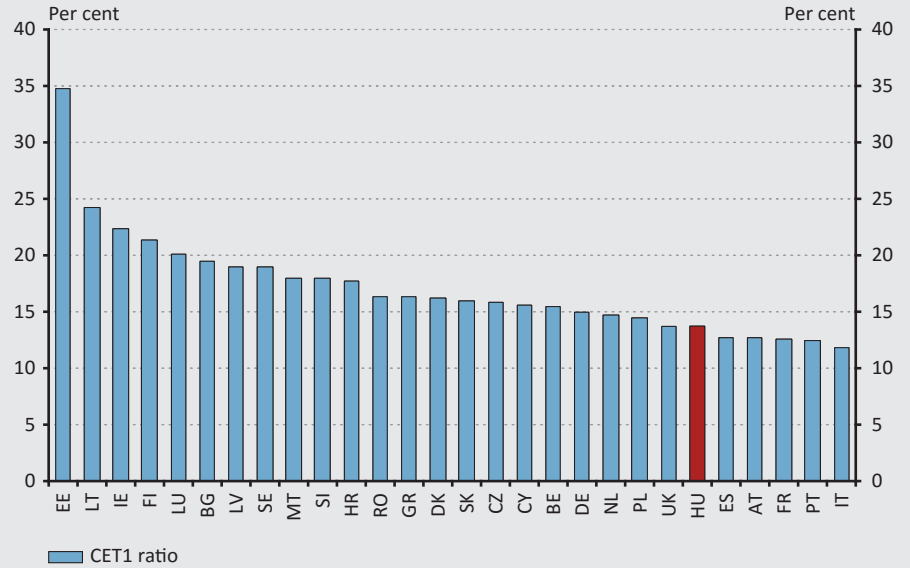


Source: ECB Consolidated Banking Data.

6.5. The role of capital adequacy

Our models demonstrated that a higher stock of capital is generally associated with higher spreads. This effect has been identified in the international literature as well. Based on the CET1 (Common Equity Tier 1) ratio – which is composed of the best capital elements – Hungarian banks cannot be deemed overcapitalised by European standards (*Figure 13*). It hinders data comparability – especially in the case of CEE countries – that the capital position of a bank largely depends on the capital allocation strategy pursued by the non-resident parent bank, i.e. in which country the bank holds the buffer set aside on top of its consolidated capital requirement.

Figure 13
CET1 capital adequacy ratio in international comparison
(at end-2015)



Source: ECB Consolidated Banking Data.

It is not only the size of the capital buffer that is relevant to a bank's capital position, but also the expected minimum statutory adjustment to its level. In parallel to the development of macroprudential strategy, regulatory authorities have gained access to several new discretionary instruments in recent years that exert an impact on banks' capital position (systemic risk buffer, countercyclical capital buffer, capital buffer applicable to systemically important institutions). In Hungary, the level of the countercyclical capital buffer has remained at zero per cent since its introduction, but the other two instruments have higher levels. In our opinion, however, these rules cannot be a significant factor in the deviation of Hungarian spreads from the international average; first, because they are also used in other countries (*ESRB 2016:52*) and second, because banks are only required to comply with these two rules, for the first time, from 2017, which means that their effect must have been rather muted during our review period (2014–2015 and 2005–2014).

7. Conclusions

Hungarian banks apply a higher spread on housing loans than most of their European counterparts. This paper investigated the reasons for the high spread using econometric tools, along with simple statistical examinations. In the absence of a reliable, adequately detailed international database that covers a sufficiently

long time horizon, we attempted to identify the determinants of the spreads on the basis of Hungarian bank and transaction-level data. In the last step, we examined the Hungarian banking system's sectoral performance relative to other European regions with respect to the main determinants identified.

Our results showed that the spreads diverging from those of the region are primarily caused by the higher spreads applied for loans extended with an initial interest rate fixation of over 1 year, while the spread on loans with short-term variable rates has already approached the regional average. Although the difference between the interest rates on variable and fixed-rate loans is relatively high in Hungary (partly as a result of the steeper yield curve), the share of loans with an interest rate fixation of over 1 year within newly disbursed loans is over 50 per cent. This means that borrowers are willing to pay a high premium in exchange for a fixed interest rate, even when adjusted for the higher costs associated with fixed-interest funds. Households' negative experiences during the period of foreign currency lending may have been an important contributor to this risk aversion.

The ratio of non-performing loans, which is also high by international standards, may have been another factor in the emergence of high spreads. Banks set their spreads in consideration of the credit losses incurred, and higher credit risks are typically coupled with higher spreads. Through collateral recovery rates, the efficiency of the legal enforcement system may also play a role in the evolution of the spreads.

According to our estimates, the high share of operating costs may also induce higher spreads. Banks' expected rate of return will warrant higher spreads if their cost-efficiency is inadequate. The relatively small impact of other net income items may also play a role: banks are more prone to set higher interest rates if they do not collect income from any other services. We could only demonstrate these last two effects in our estimates performed on microdata. Even in terms of these variables, the performance of the Hungarian banking sector is worse than the international average.

Our analysis also suggested that, owing to customers' limited price flexibility and the geographical distribution of branches, competition is inadequate in the field of housing loans. Our demand model showed that, on the one hand, customers face geographical limitations: only a strictly limited group of banks has presence in many Hungarian administrative districts and customers tend to choose the easily accessible banks. On the other hand, banks' business models also reduce the number of institutions that are perceived by consumers as potential opportunities; indeed, the banks which target affluent customers do not make efforts to serve low-income customers.

Thirdly, certain taste patterns suggest that customers rely on an extremely limited, preferred group of banks in making their borrowing decisions, and are only willing

to compare the offers of these chosen banks. These factors, overall, enable banks to set their prices in the context of oligopolistic competition. It is also a sign of weak competition that banks do not pass on to customers the full subsidy in the case of subsidised loans as they – according to our estimates – overprice these loans by about 30–35 per cent of the subsidy.

References

Aczél, Á. (2016): *Who is interested? Estimation of demand on the Hungarian mortgage loan market in a discrete choice framework.* 5th EBA Policy Research Workshop, under publication.

Badarinza, C. – Campbell, J.Y. – Ramarodai, T. (2014): What calls to ARMs? International evidence on interest rates and the choice of adjustable-rate mortgages. *NBER Working paper,* No. 20408, National Bureau of Economic Research.

Banai, Á. – Vágó, N. (2016): *Drivers of household credit demand before and during the crisis.* Manuscript. Magyar Nemzeti Bank.

Button, R. – Pezzini, S. – Rossiter, N. (2010): Understanding the price of new lending to households. *Bank of England Quarterly Bulletin,* 2010 Q3, pp. 172–182.

Capelle-Blancard, G. – Havrylchyk, O. (2013): Incidence of bank levy and bank market power. *CEPII Working Paper,* No. 2013–21. Centre d'études prospectives et d'informations internationales.

Carlehed, M. – Petrov, A. (2012): A methodology for point-in-time – through-the-cycle probability of default decomposition in risk classification systems. *Journal of Risk Model Validation,* Volume 6. No. 3. Fall, pp. 3–25.

Dancsik, B. – Fábián, G. – Fellner, Z. – Horváth, G. – Lang, P. – Nagy, G. – Oláh, Zs. – Winkler, S. (2015): Comprehensive analysis of the non-performing household mortgage portfolio using micro-level data. *MNB Occasional Papers,* Special Issue. Magyar Nemzeti Bank.

Demirguc-Kunt, A. – Huizinga, H. (1999): Determinants of commercial bank interest margins and profitability: Some international evidence. *World Bank Economic Review,* Vol. 13, pp. 379–408.

Demirguc-Kunt, A. – Laeven, L. – Levine, R. (2003): The impact of bank regulations, concentration and institutions on bank margins. *World Bank Policy Research Working Paper,* No. 3030. World Bank.

ECB (2009): Housing finance the Euro Area. *Occasional Paper,* No. 101. European Central Bank.

EMF (2012): *Study on mortgage interest rates in the EU.* European Mortgage Federation.

EMF (2016): *European Mortgage Federation Quarterly Review*, 2016 Q1, European Mortgage Federation.

ESRB (2015): *Report on residential real estate and financial stability in the EU.* European Systemic Risk Board.

ESRB (2016): *A Review of Macroprudential Policy in the EU in 2015.* European Systemic Risk Board.

Gambacorta, L. (2014): How do banks set interest rates? *NBER Working Paper,* No. 10295. National Bureau of Economic Research.

Ho, T.S.Y. – Saunders, A. (1981): The Determinants of Bank Interest Margins: Theory and Empirical Evidence. *The Journal of Financial and Quantitative Analysis,* Vol 16, No. 4. Proceedings of the 16th Annual Conference of the Western Finance Association, pp. 581–600.

Holmberg, U. – Janzén, H. – Oscarius, L. – Van Santen, P. – Spector, E. (2015): An analysis of the fixation period for Swedish mortgages. *Economic Commentaries,* No. 7, pp. 1–19.

Johansson, J. – Lagerwall, B. – Lundvall, H. (2011): *Larger share of variable mortgages – how does this affect the impact of monetary policy?* In: Sveriges Riksbank: The Riksbank's inquiry into the risks in the Swedish housing market. Sveriges Riksbank, pp. 97–108.

Laeven, L. – Majnoni, G. (2005): Does judicial efficiency lower the cost of credit? *Journal of Banking & Finance* 29, pp. 1791–1812.

MNB (2016): *Housing Market Report.* May. Magyar Nemzeti Bank.

Maudos, J. – De Guevara, F. (2004): Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking & Finance,* No. 28, pp. 2259–2281.

Santos, C. (2013): *Bank interest rates on new loans to non-financial corporations – one first look at a new set of micro data*. In: Financial Stability Report 2013, Bank of Portugal, pp 127–134.

Saunders, A. – Schumacher, L. (2000): The determinants of bank interest rate margins: an international study. *Journal of International Money and Finance,* No. 19, pp. 813–832.

Train, K.E. (2002): *Discrete Choice Methods with Simulation.* Cambridge University Press. Cambridge.

Valverde, S.C. – Fernández, F.R. (2007): The determinants of bank margins in European Banking. *Journal of Banking & Finance,* No. 31, pp. 2043–2063.

Annex 1: Main descriptive statistics of transaction-based interest statistics

Distribution of the sample by interest type		
	Number of contracts	**Distribution of contracts**
Variable rate or initial fixation of up to 1 year	33,705	51.93
Interest rate with a fixation of over 1 year	31,199	48.07
Total	64,904	100

Source: MNB.

Distribution of the sample by state subsidy		
	Number of contracts	Distribution of contracts
Market based	45,854	70.65
Subsidised	19,050	29.35
Total	64,904	100

Source: MNB.

Descriptive statistics for interest rates and the spread over the three-month BUBOR								
	Interest rate (%)				**Spread over BUBOR (percentage points)**			
	Mean	**Median**	**10th percentile**	**90th percentile**	**Mean**	**Median**	**10th percentile**	**90th percentile**
2014 Q1	7.9	7.7	5.7	9.7	5.1	4.9	3.0	6.9
2014 Q2	7.7	7.4	5.4	9.7	5.2	4.8	3.0	7.2
2014 Q3	6.8	6.6	4.7	8.5	4.6	4.4	2.5	6.3
2014 Q4	6.5	6.4	4.6	8.0	4.4	4.3	2.5	5.9
2015 Q1	6.3	6.2	4.6	7.7	4.3	4.2	2.5	5.6
2015 Q2	6.1	5.9	4.1	7.4	4.5	4.3	2.5	5.8
2015 Q3	5.7	5.3	3.6	7.2	4.4	3.9	2.2	5.9
2015 Q4	5.7	5.5	3.7	7.2	4.3	4.2	2.4	5.9
Total	6.4	6.3	4.2	8.5	4.5	4.4	2.5	6.3

Source: MNB.

Descriptive statistics for the contracted amount and maturity by contracting quarter

	Contract amount (HUF millions)				Maturity (months)			
	Mean	Median	10th percentile	90th percentile	Mean	Median	10th percentile	90. percentilis
2014 Q1	5.4	4.3	1.5	10.0	173.2	180.2	72.2	241.0
2014 Q2	5.8	4.5	1.5	10.0	172.1	180.2	72.4	241.0
2014 Q3	6.1	5.0	1.7	11.0	175.6	180.3	72.6	241.1
2014 Q4	6.1	5.0	1.9	11.5	180.2	180.4	72.9	241.7
2015 Q1	6.4	5.0	2.0	11.8	179.9	180.3	72.5	264.1
2015 Q2	6.5	5.0	1.6	12.5	175.3	180.2	71.0	265.2
2015 Q3	7.2	5.8	2.0	13.7	174.3	180.0	72.6	252.7
2015 Q4	7.2	5.7	2.0	13.7	180.1	180.4	72.8	299.3
Total	6.5	5.0	1.8	12.0	176.4	180.3	72.5	241.4

Source: MNB.

Correlation matrix of the variables included in the model

	BUBOR_spread	contracted amount_ln	maturity_month	d_collateral	subsidy	d_fixation	liquid	capital buffer	cta	prov_avg	branch	fcomm_fee
BUBOR_spread	1.00											
contracted amount_ln	–0.43	1.00										
maturity_month	–0.19	0.43	1.00									
d_collateral	–0.34	0.08	0.12	1.00								
subsidy	0.28	–0.06	0.04	0.07	1.00							
d_fixation	0.45	–0.11	–0.04	–0.06	0.36	1.00						
liquid	–0.46	0.19	0.07	0.16	–0.28	–0.29	1.00					
capital buffer	0.27	–0.16	–0.03	0.06	0.29	0.10	–0.41	1.00				
cta	0.32	–0.12	–0.17	–0.38	–0.14	–0.15	0.03	–0.02	1.00			
prov_avg	0.45	–0.19	–0.14	–0.24	0.07	0.09	–0.45	0.22	0.47	1.00		
branch	0.14	–0.13	0.08	0.24	0.24	0.18	–0.16	0.38	–0.37	0.00	1.00	
fcomm_fee	–0.22	0.05	0.08	0.24	0.09	–0.12	0.28	–0.01	–0.27	0.00	0.33	1.00

Source: own calculations.

Annex 2: Descriptive statistics of individual bank-level data

	Mean	Median	10th percentile	90th percentile
Spread	0.00	0.03	–4.56	4.55
Operating costs	–0.01	0.01	–0.38	0.36
Other revenue/ interest revenue	25.16	24.21	13.48	37.89
Liquidity	14.74	13.45	3.43	27.06
CAR	12.06	10.70	8.70	16.45
GDP (YoY)	1.76	2.32	–2.17	4.58
NPL	6.68	3.62	0.83	17.12
LTV	55.13	56.10	27.10	80.95
External liabilities	39.48	38.74	14.34	60.02
Provisions	0.22	0.11	0.56	0.01
Market share	0.09	0.05	0.02	0.19
Proportion of branches	10.73	8.59	1.45	26.66
Ratio of fixed-interest loans × steepness of the yield curve	0.71	0.73	0.19	1.10

Source: MNB.

Correlation matrix of the variables included in the model

	Spread	Operating costs	Other revenue/ interest revenue	Liquidity	CAR	GDP (YoY)	NPL	LTV	External liabilities	Provisions	Market share	Proportion of branches	Ratio of fixed-interest loans × steepness of the yield curve
Spread	1.00												
Operating costs	0.01	1.00											
Other revenue/ interest revenue	–0.03	0.00	1.00										
Liquidity	0.01	0.01	0.59	1.00									
CAR	–0.01	–0.04	0.15	0.21	1.00								
GDP (YoY)	0.02	–0.01	0.33	0.12	0.13	1.00							
NPL	0.00	0.01	0.20	0.48	0.27	0.13	1.00						
LTV	0.02	–0.05	0.13	0.09	–0.27	–0.24	–0.14	1.00					
External liabilities	0.00	0.00	–0.49	–0.54	–0.14	–0.15	0.03	–0.27	1.00				
Provisions	–0.08	0.02	0.18	0.19	0.06	0.13	–0.27	–0.01	–0.38	1.00			
Market share	0.00	0.00	0.38	0.01	0.10	0.00	–0.21	0.26	–0.20	0.16	1.00		
Proportion of branches	0.00	–0.01	0.54	0.13	0.02	0.00	–0.26	0.28	–0.34	0.21	0.93	1.00	
Ratio of fixed-interest loans × steepness of the yield curve	–0.02	0.01	0.16	0.22	0.48	0.34	0.50	–0.22	–0.01	–0.17	–0.08	–0.11	1.00

Source: own calculations.

The International Practice of Statistical Property Valuation Methods and the Possibilities of Introducing Automated Valuation Models in Hungary

Áron Horváth – Blanka Imre – Zoltán Sápi

In the wake of regulatory, information technology and methodological changes, statistical property valuation has gained traction in Hungary. This paper looks at the available methods of appraisal based on the literature. We provide an overview of the advantages and drawbacks of the currently known methods. Based on these, automated valuation models (*AVMs*) *can be readily introduced alongside the estimated median value based methods used so far. For real estate industry-specific reasons, the introduction of parametric hedonic estimates supplemented with spatial correlations can be expected for the time being. The better performance of statistical models would need improved quality of duties office data.*

Journal of Economic Literature (JEL) codes: C15, C45, G21

Keywords: mortgage, collateral valuation, automated valuation model, statistical valuation

1. Introduction: The new regulation of statistical valuation

The Minister of Finance Decree on real property valuation[1] was amended in the summer of 2016, introducing statistical valuation alongside the three previous methods as a means of determining the market value of a property. For one, this change was a reaction to the prevailing practice in Hungary where the majority of financial organisations had already been using statistical evaluation based on the analysis of comparative data. In addition, the change was also in line with

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We would like to thank the proofreaders for their valuable comments; any remaining errors are our own. The authors would like to thank for the support of OTKA K 112198 and the MTA Lendület (Momentum) VSVK projects.

The manuscript was received on 2 October 2016.

[1] Decree 25/1997 (VIII. 1.) of the Minister of Finance on the methodological principles for determining the mortgage lending value of property not qualifying as arable land

the international trend characterised by the spread of approaches referred to as automated valuation models.

This paper presents the background, methods and possibilities of statistical valuation. The second section presents the main concepts used in statistical valuation, based on the literature. The third section summarises the methodological approaches related to statistical valuation. The fourth presents why it is difficult to make general statements about the performance of various methods. We then present the possibilities in Hungary, in light of the data sources available to modellers. The last section presents the conclusions.

2. Definitions and sources of information

The European Mortgage Federation (EMF) and the European AVM Alliance (EAA) classify valuation methods into the groups shown in Figure 1 (*EMF – EEA 2016*). The group of statistical valuations are presented separately from individual expert appraisal. The difference between the two methods is that statistical valuation uses far more data for appraisal and generates the property's value from the data in a reproducible manner. There are also methods that are situated between statistical and individual expert appraisal, referred to under the umbrella term of hybrid valuation.[2]

Within statistical valuation, Automated Valuation Models (AVMs), which are used increasingly in recent years, are specified as a sub-group of statistical valuation models. No historical price information is needed for AVMs, in contrast to the methods based on indexation that estimate changes in value. They are able to appraise property based on a large quantity of data without an individual human decision, and are more complex than the estimates using average unit prices or average prices, meaning that they build strongly on managing the impacts of value-modifying factors.

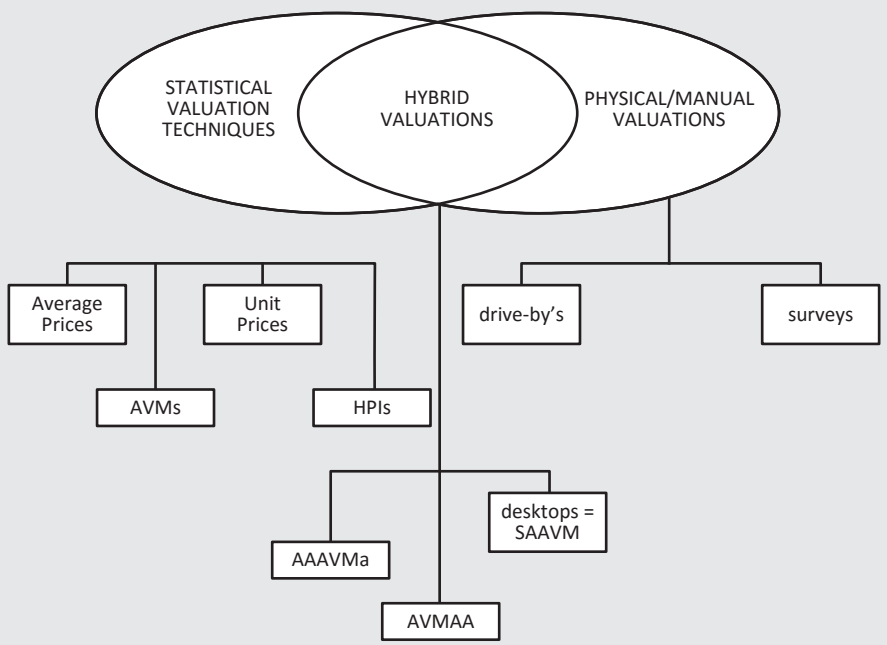
So far, the average unit price and indexation methods have been adopted by financial entities in Hungary. The development in methods can be seen as a kind of evolution, as at the time being only the aforementioned, less complex techniques are used in Hungary. There are several reasons why the more complex methods have not spread so far: in part, the FHB Index was a pioneer in indexation, the first to

[2] We only mention hybrid valuation methods in this paper as part of a list. The EMF and the EAA distinguish three categories:
- Analyst Assisted AVM (AAAVM): Relies on the experience and judgment of a professional, but not necessarily a qualified surveyor, to validate and supplement the output of an AVM.
- Surveyor Assisted AVM (SAAVM): Relies on the experience and judgment of a qualified surveyor, to validate and supplement the output of an AVM.
- AVM Assisted Appraisal (AVMAA): Relies on the experience and judgment of a qualified surveyor, to translate the output of an AVM into a legally compliant valuation, obtained without conducting a physical inspection of the subject property (*EMF – EEA 2016*).

calculate sub-indexes derived from national indexes. In addition, the spread of more complex methods is hindered by data limitations, as financial entities can only use the National Tax and Customs Administration's duties office transaction database, which does not contain detailed property attributes and thus cannot be used for more sophisticated methodologies. Third, the financial supervisory body has so far accepted the use of average unit prices and indexation for statistical revaluation, so agents were not compelled to develop their own methods.

Meanwhile, Hungarian financial market agents have recently contemplated whether more complex methods can yield more than the ones currently used. In Western Europe, several tools are used for statistical evaluation, including the techniques that have been adopted in Hungary, so these are not obsolete. At the same time, these may well become obsolete in the wake of possible methodological development in the future. The Hungarian subsidiaries of banks in foreign ownership have considered the possibility of adopting more complex methods in Hungary. This paper therefore focuses on AVMs, which are expected to appear as a novelty in Hungary. As the above definition suggests, the unit value and average price level based valuation can be seen as a special, simple form of AVM.

Figure 1
Types of property valuation



Source: EMF-EEA (2016:5).

Various patents filed in the United States define the general principles of automated valuation methods. These patents do not provide detailed guidance on valuation methodology, but merely a description of the processes used, without specific model specifications. However, they disclose the reasons for developing automated valuation methods and the requirements that must be met in terms of reliability. Most patents provide assistance for processing loans using the automated valuation of property (*US5361201, US6115694, US20040153330*).[3] The exception is *Rossbach and Conway's* (*2003*) patent which calculates the warranty of the value generated by the AVM, protecting the parties from the consequences of a potentially inaccurate appraisal (*US20030149658*). *Sennot's* (*2004*) patent tests a property pending appraisal in several stages to determine whether the available data quantity is sufficient for applying an AVM (*US20040019517*). *Graboske et al*. (2005) developed a decision-making mechanism that selects the most suitable AVM to maximise AVM utilisation compared to standard valuation methods depending on the guidance of the financial entity providing the mortgage and the specified accuracy (*US20050288942*).

To better understand the chances for the local adoption of statistical valuation procedures using more advanced methods and their adopted forms, it is worth looking at the international methodological practice along with the principles and processes involved. However, when assessing this, the firms typically offering and using the service as private entities do not share any details. Even the aforementioned EAA members do not share any relevant information on their websites. Besides general references, they only emphasise the use of automated evaluation based on large quantities of data. Even less information is available from clients, as financial institutions and asset managers do not publish the valuation methods that they use. The reason for this observed lack of information is that AVMs are almost always unique and tailored to the client. The more closely adjusted to the user's needs and opportunities, the better these methods work. Different parametrisation and systems will be optimal for a bank aiming to define the mortgage lending value of a collateral portfolio or for a mutual fund managing a portfolio of new homes. This paper therefore presents, based on the literature, the methodological foundations that can allow the adoption of systems suited to the applicants operating in the circumstances prevailing in Hungary.

3. Statistical valuation methods

In this section, we review the theoretical background of the known statistical valuations. We provide details on the methods that are not part of the economic academic curriculum, so we will not cover the indexation method taught in statistical

[3] The table summarising patents is included in *Annex 1.*

courses. According to *Pagourtzi et al*. (*2003*) automated valuations can be classified into four groups. First, they mention traditional *hedonic regressions*, according to which the value of the property can be defined by pricing its various attributes. *Spatial analysis*, is an approach that treats the dependence of the price of a given property on the characteristics of neighbouring units. The authors differentiate *models based on artificial neural networks,* belonging to the nonparametric family, where the model is developed with the help of learning algorithm sequentially applied to the available data. Finally, the authors define *models based on fuzzy logic as* the fourth group, where every observation belongs to one specific group and the extent of similarity is defined by a membership function taking on a value between 0 and 1.

We follow this classification in our paper.

3.1. Hedonic pricing

The hedonic pricing model used for property appraisal is the most frequently applied technique for pricing heterogeneous goods. Its core principle is the statistical valuation of the correlation between the price and the characteristics of the good. This method has been used since the 1960s for statistical analyses, and has become the most widespread analytical tool of empirical pricing problems since *Rosen's* (*1974*) development of the theoretical foundation of the method. Since there are no two properties that are identical, the hedonic method became a canonical property pricing technique. The application of the hedonic regression method for residential properties started from the pioneering work of *Ridker and Henning* (*1967*) *and Nourse* (*1963*). The first more widely known hedonic analysis conducted on a database of individual properties is the seminal paper of *Kain and Quigley* (*1970*). *Coulson* (*2008*) summarised the hedonic methods in his monography. The model can be described as follows in a multiplicative form:

$$\ln(p) = \beta_0 + \beta_1 \ln(x_1) + \beta_2 \ln(x_2) + \cdots + v \qquad (1),$$

where *p* is the price of the property, *x* are the various attributes of the property and *v* is the error term.

The advantage of this method is that the results immediately show the marginal impact of the various value influencing factors which eases the comparison of the property appraisal by the model with professional appraisers' valuation. A great number of papers address these value modifying factors, starting from the impact of green areas through landmark protection all the way to the value related to the existence of an elevator. According to this research, information available on the property increases the accuracy of the model, but one factor stands out; the most important value modifying factor, as generally viewed in the industry, is the location of the property. In line with early research, the basic models form

disjoint spatial units for the location. Due to the availability of the data, this often meant and still means a public administration grouping (e.g. according to postal code). In this case, the location of the property will be entered into the model as a category variable. In such cases, for example, the associated coefficient in the hedonic model shows how much more expensive a property located in the 6th district of Budapest is compared with ones located in another district used as the reference group, for properties that are otherwise identical. Handling spatial categories in such a way often corresponds with the knowledge held by the real estate profession, e.g. a housing project represents a completely different unit than the set of condominium buildings located on the other side of the road; however, spatial correlations are often more complicated than this. This is one the reasons why research has mainly developed in that direction, as we explain in the next sub-section.

3.2. Spatial econometrics

According to the early definition of the spatial econometrics (*Anselin 1988*), this discipline addresses the spatial attributes of the data, due to which the canonical[4] econometric methods cannot be applied. According to *Anselin* (*1988*), spatial impacts can be of two types: spatial dependence and spatial heterogeneity. Spatial dependence is a spatial cross-sectional correlation, where the correlation structure of the various spatial units cannot be handled by standard econometric tools. Spatial heterogeneity is such an observed or non-observed heterogeneity, where the spatial structure may carry information, but in terms of methodology, it does not necessarily require spatial analysis tools. The two impacts often cannot be differentiated from one another when using cross-sectional data; namely, in this case, the clusters and the patterns may be identified, but the processes causing them might not (*Anselin 1988*). In the short description of the models that form part of spatial analysis, we follow the summary of *Anselin* (*2010*) *and Elhorst* (*2010*) and we rely on the text books by *LeSage and Pace* (*2008*) and *Fotheringham and Rogerson* (*2009*).

According to *Anselin* (*2010*), the main criterion of spatial econometrics is the application of *spatial lag variables*. These are basically the weighted averages of observations that are the ''neighbours'' of the given variable. As to what we exactly mean by neighbour, is a key component of the definition, which is provided by the spatial weights matrix. A spatial lag may be included in the dependent variable (these are the spatial lag models), in the explanatory variable (spatial cross-regressive model), or in the error term (spatial error models) or possibly in all of them (*Anselin 2010*).

[4] As we mentioned earlier, we regard the current master level university curriculum to be canonical and publicly known.

Spatial heterogeneity may be discrete or continuous; in the first case, the parameters of the model are different for the preliminary indicated units differing from one another (these are the spatial regime models, see e.g. *Anselin 1990*), while in a continuous case, it is part of the model specification as to how the parameters change in space. This can be described by a pre-defined function (*Cassetti 1997:* spatial expansion method) or by a function estimated locally from the data (Fotheringham et al. 2002 geographically weighted regression (GWR). According to another approach, the spatial heterogeneity is a spatial case of the random coefficient variation (*Gelfand et al. 2003*).

Elhorst (*2010*) briefly reviews the topics addressed in the textbook of *LeSage and Pace*, along with extensions, and describes the preferred model specification process illustrated by *Figure 2*. *Elhorst* (*2010*) regards the most general specification known as the Manski model to be his starting point. *Manski* (*1993*) mentions three interactions due to which an observation made at a given location may depend on observations made at other locations:

1) endogenous interaction effect which specifies how the behaviour of one spatial unit depends on that of other units,

2) exogenous interaction effect, whereby the behaviour of the spatial unit depends on independent variable(s) explaining the behaviour of another spatial unit, and

3) correlated effect where similar non-observed attributes result in similar behaviour.

The Manski model is given by two equations:

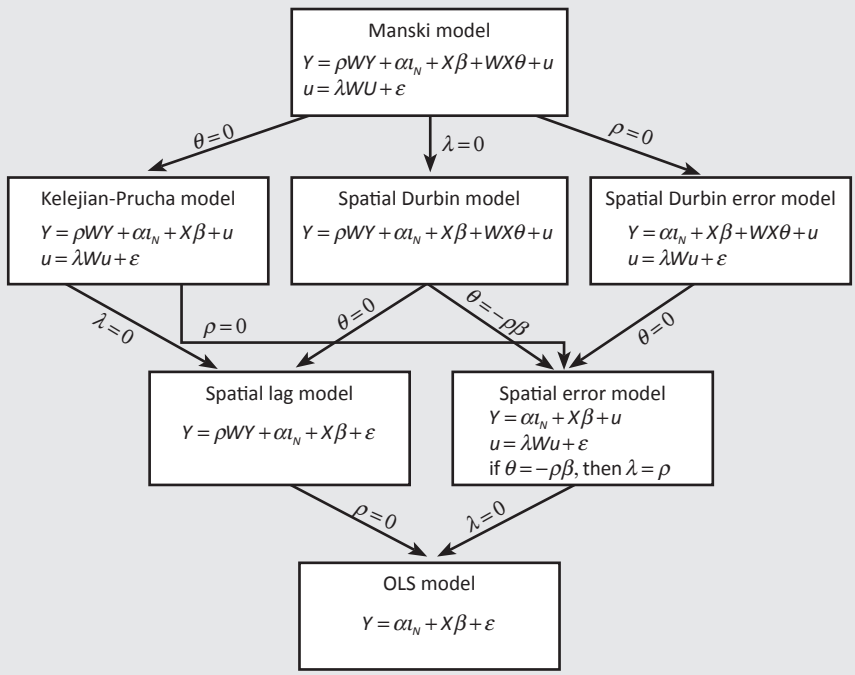
$$Y = \rho WY + \alpha \iota_N + X\beta + WX\theta + u \qquad (2)$$

$$u = \lambda Wu + \varepsilon \qquad (3)$$

where Y is a vector of Nx1 components, which contains an observation for every unit in the sample ι_N is an Nx1 unit vector, X is an NxK dimension matrix of the explanatory variables, u is an Nx1 vector of the error terms, $\varepsilon=(\varepsilon_1,\varepsilon_2,\ldots,\varepsilon_N)$, which is a variable with IID distribution, with mean 0 and σ^2 variance. WY denotes the endogenous interaction among the dependent variables of the various spatial units, WX is the exogenous interaction among the independent variables, and Wu is the interaction among the error terms. ρ denotes the spatial auto-regression coefficient, λ the spatial auto-correlation coefficient while β and θ are the fixed, but unknown parameters. The following technical conditions must be fulfilled for the W matrix: its components are non-negative known constants with zeros in the main diagonal, and the $I_N - \rho W$, and $I_N - \lambda W$ matrixes should be invertible. In addition to this, at least one of the K+2 interaction impacts should be excluded so that the parameters can be identified (*Manski 1993*). Making various parameter restrictions, from the

Manski model one can arrive at other spatial models, and then finally at the simple linear regression as shown in *Figure 2*.

Figure 2
Spatial models



Source: Elhorst (2010:13).

Although it can be estimated, the Manski model is difficult to use because the endogenous and exogenous interaction effects cannot be disentangled, and therefore the estimated parameters cannot be interpreted (*Manski 1993*). Therefore, instead of the Manski model, *Elhorst* (*2010*) recommends the spatial Durbin model for two reasons. First, not taking into consideration the spatial dependence of the error terms only decreases the precision of the estimation, while ignoring the spatial dependence of the dependent or independent variables leads to endogeneity problems. Second, however, the Durbin model correctly estimates the standard errors of the parameters if the real data generating process is a spatial lag or a spatial error model, as these are special cases of the Durbin model, therefore, the Durbin model's covariance matrix properly takes into account the spatial dependence of the error term.

The weakness of spatial econometrics models is that the W spatial weights matrix is given on an ad-hoc basis. Because there are no generally accepted rules for the specification of W, econometricians rely on robustness checks carried out by Monte Carlo simulations. The valuation of this gives room for the non-parametric methods as well.

We next briefly review another important branch of the relevant econometric research, semi-parametric and non-parametric methods. In this, we rely on chapter 14 of the textbook by *Fotheringham and Rogerson* (*2009*). Semi-parametric methods are a compromise between fully parametric specification and the non-parametric approach, where the data fully define the parameters alongside a minimal prior structure. One instance of the application of non-parametric methods is necessitated by the weakening of the assumptions regarding the spatial weight matrix in the spatial lag model. *Pinkse, Slade and Brett* (*2002*) use the following model:

$$y_i = \sum_{j \neq i} g\left(d_{ij}\right) y_j + x_i \beta + \varepsilon_i \qquad (4)$$

Instead of the weight matrix, dependent variables of the neighbouring units are weighted by a coefficient depending on the distance of two units, where they approach the appropriate function with a polynomial series.

In *Gress's* (*2004*) approach, the spatial weight matrix is as in the spatial lag model, but the dependence from the other variables in modelled in a nonparametric way:

$$y = \rho W y + g(X) + \varepsilon \qquad (5)$$

Henderson and Ullah (*2005*) use a semi-parametric spatial error term model as a special application of the local linear weighted least squares (local WLS) method. Finally, *Gibbons and Machin* (*2003*) use a spatial filtering approach which consists of performing a non-parametric modelling of spatial spillover effects, referred to as the smooth spatial effects (SSE) model:

$$y_i = x_i \beta + g(c_i) + \varepsilon_i \qquad (6)$$

The SSE estimating function is essentially an OLS applied to a transformed equation, where the transformation replaces the dependent variable and explanatory variables with the deviation from their conditional expected value.However, advances in information technology now enable non-parametric approaches as well, one of which is addressed in the following section.

3.3. Neural networks

Nowadays, quantitative, multiple-variable regression-based methodology are considered the orthodox procedural technique of AVMs. The past decades have seen the development of novel procedures, which differ from the most widespread methods of mass automated valuation on a theoretical basis. The use of model-free

estimation methods such as neural networks or fuzzy logic in property appraisal calculations provide flexibility without sacrificing mathematical rigor, thus creating a more powerful method compared to "inflexible" regression (*Kauko – d'Amato 2008b*).

Increasing computation capacity has also paved the way for the application of non-parametric models on the housing market. The book edited by *Kauko and d'Amato* (*2008a*) provides a thorough presentation of the possibilities that these models offer. This section highlights the key basic assumptions based on two papers that compare artificial neural network (ANN) based models with more traditional linear hedonic regression and the spatial lag model.

Mimis et al. (*2013*) compare a spatial autocorrelation (SAR) and the ANN model on a database containing the observation-based attributes (including geographic location) and price of 3,150 properties located in Athens. The ANN model is made up of neurons (or nodes) linked by synapses. The assigned weight refers to the strength of a synaptic connection. The neurons are structured in layers, which are either input layers, hidden layers, or output layers. The data enter through the input layer and are then transmitted to the neurons of the hidden layer through the synapses. Here, the data is exposed to weighted summarising functions and the transformation function, and the result then exits the network through the output layer. *Mimis et al.* (*2013*) use the multilayer perceptron (MLP), a feedforward supervised ANN, which means that the network structure is a controlled, fully interconnected graph that is taught using a supervised backpropagation algorithm.[5] The explanatory variables used describe property structure, the neighbourhood's characteristics (within a 1 km radius) and access to the property (in this case: distance from the subway). The database was randomly broken down in a ratio of 60–20–20 per cent into training, validation and test data. *Mimis et al.* (*2013*) used numerous metrics to compare the models: the forecasting error and its deviation, mean absolute error (MAE), mean absolute percentage error (MAPE), root mean squared error (RMSE), actual and estimated value correlation and R^2 for the model fit. With the exception of the mean error, the MLP exhibited better values than SAR in every case. The authors interpret this result as meaning that the ANN is better suited for describing the nonlinear relationship between price and explanatory variables.

Peterson and Flanagan (*2009*) applied an ANN and a linear hedonic regression to a residential property sales database containing 46,467 pieces of observation-based data for Wake County (North Carolina, USA) for the period 1999–2005. The authors used 10–90, 25–75, 50–50, and 75–25 per cent of the data for the model's

[5] During the backpropagation learning algorithm, the ANN calculates output for specific inputs using weights. It then compares this to actual values, adjust the weights by minimising squared errors until the estimation precision reaches a desired threshold.

estimation and testing for each year, and then drew a 100-element random sample of observations for each year. The OLS and ANN were estimated using the training sample, then the absolute errors calculated per observation were summarised for the partial samples; this yields the average absolute pricing error differential. According to the null hypothesis, there is no significant difference between the OLS and the ANN. *Peterson and Flanagan* (*2009*) also provide the RMSE and MAPE values for the two models alongside t-statistics. All three statistics favoured the ANN; the authors also stress that the errors increased over time (property price volatility increased in Wake County during the period under consideration), and a larger training database brought about larger errors. The weaker performance of the OLS might have resulted from neglected nonlinearity, which *Peterson and Flanagan* (*2009*) tested for using the RESET misspecification test. According to this, the null hypothesis which states that there is no ignored nonlinearity, can be rejected so the ANN provides a better fit.

3.4. Fuzzy logic

Fuzzy logic essentially differs from probability in that it addresses the inaccuracy prevailing in the present, while probability pertains to future uncertainty. Fuzzy logic allows for the truth values of a statement to be any real number between 0 and 1, as opposed to Boolean logic, where a statement is either true (taking a truth value of 1) or false (truth value of 0). According to the theory of fuzzy logic, the relation between a set and its elements can be described using what is referred to as a membership function, which allows for various degrees of membership compared to the usual 0 and 1 (*d'Amato – Siniak 2008*). These degrees can also be used for property appraisal. According to *Lee et al.* (*2003*), the fuzzy quantification theory help manage the subjectivity stemming from appraisal and also allows for the more accurate calibration of the factors shaping value. *Sui* (*1992*) highlights that standard regression methods – characterised by sharp sets – lead to loss of information in the presence of equivocality or inaccuracy.

Actual data may be inaccurate for various reasons, which impede the creation of mass revaluation models. Amongst other things, errors arising from flawed model specification may increase, as well as simultaneous correlations between explanatory variable and murky transitions among submarkets. A prime example of the latter is the difficulty in classifying municipalities in the case of consecutive market regions (e.g. where does an agglomeration end?). The segmentation of data or the grouping of the database into subsamples renders modelling quite complicated. Alongside traditional methods, more flexible and complex models such as fuzzy systems have emerged. However, these systems are unable to learn market attributes independently, so they are generally developed in combination with other methods such as artificial neural networks or genetic algorithms. The

hybrid systems thus created are capable of addressing the uncertainties of the housing market (*González 2008*).

Lughofer et al. (*2011*) examined the relative performance of linear regression, ANN, SVM and fuzzy logic-based models (SparseFIS and FLEXFIS) using the data of 50,000 housing properties sold between 1998 and 2008. The authors found that fuzzy models offer the best forecasting performance based on average squared and average absolute error and cross validation error.

4. Assessment of the performance of statistical valuation

In the previous section of this paper, we presented several different models used for statistical valuation. This diversity stems from the varying needs of users. Accordingly, the rating criteria of models are also varied. The models are generally used to support the work of experts, but they are also used in the context of labour- and cost-effective mass appraisal. In the former case, it is important that the models yield the most accurate result possible, thereby supporting the work of experts, while apparent errors can be easily identified and overwritten based on real estate industry experience. This requirement has induced users to rely on hedonic models. In the course of mass appraisal, avoiding major errors may be an even more important criterion, i.e. keeping substantial misappraisals to a minimum even when working with large data sets of thousands of properties. This places emphasis on model fits tested according to statistical criteria, even to the detriment of the interpretability of partial impacts. For this reason, the models can only be qualified as better or worse very conditionally. Of course, as a general result of the nature of statistical indicators, the results of investigations on different databases or different sources of information cannot be compared. As a result, in every case, the statistical valuation model must be tailored to the user's objectives and opportunities. The following section therefore provides an overview of studies that offer valuable insight into the use of valuation criteria and testing.

Bourassa et al. (*2003*) use data on the residential properties sold in 1996 in Auckland (New Zealand) to estimate hedonic regressions by comparing local appraisers' market segmentation with a statistics-based segmentation[6]. *Bourassa et al.* (*2003*) test the models' forecasting performance by retaining 20 per cent of the data for testing. The authors measure forecasting performance of different specifications using the absolute value of the forecast error: the forecasting error is less than 10

[6] The authors selected the orthogonal factors from among the property's physical attributes, distance from the business district and the neighbourhood's demographic and socioeconomic attributes using main component analysis, and then rotated them using the VARIMAX method to obtain uncorrelated factors and the associated factor scores. They then defined homogenous submarkets using cluster analysis (which are not necessarily related in spatial terms, but are used by surveyors). Using *MacQueen's* (*1967*) method, the authors obtain 14–18 submarkets depending on the sample (all properties; only single-family houses; single-family houses for which an appraisal is available).

per cent of the price for 40–50 per cent of estimated values. Their findings imply that the model using submarket definition based on statistical methods performed worse than the one that used the local appraisers' submarket definition. The authors conclude that using sophisticated statistical tools to define submarkets is not worthwhile. However, incorporating spatial analysis into any of the models allows for a slight improvement in forecasting accuracy.

Goodman and Thibodeau (*2003*) use data for approximately 30,000 single-family home transactions for the submarkets of Dallas County defined using four different methods to examine the accuracy of hedonic estimates: with no spatial segmentation, based on postal codes, based on census districts, and taking into account the hierarchical structure of the submarkets (certain areas are located in school districts, administrative districts and city districts). The authors tested a total of eight models: a narrower (with three explanatory variables) and a broader (with all available explanatory variables) hedonic regression alongside the four submarket definitions. Submarket validity was examined using three tests: the structure associated with the smallest squared error was retained, an F-test performed (this, however, only works for embedded alternatives) and a Davidson – MacKinnon F-test.[7] The authors retained 10 per cent of the data to test the model in terms of its forecasting performance which was measured using various statistics of forecasting error value, its absolute value and the proportionate value (error/price). According to the F-tests and J-tests, neither model predominates in terms of forecasting accuracy. The most accurate results were obtained by combined estimates (that have the lowest average squared forecasting error). The authors conclude that the estimate should be performed for smaller markets, as any model based on submarkets provided a more accurate forecast than those run on county-level data, and that the combined estimate stood out in precision.

Clapp and O'Connor (*2008*) conduct an experiment where they applied three models created by academics specialising in the field of property economics and a simple OLS, alongside six expert-created models to the same database, retaining a portion of the data, and subsequently evaluating the models based on the precision of out-of-sample forecasting. The authors used a database containing over 50,000 observations of property sales in Fairfax County, Virginia between 1967 Q1 in 1991 Q4, supplemented by the properties' longitude and latitude coordinates. Only the models featuring an average absolute forecasting error of less than 20 per cent were retained for further comparison. The best performing models were the OLS, a multiplicative specification where the trend variable depended on the census district and a hedonic regression that included a residual of the closest neighbours. The authors defined two conditions for well-performing models: geographic location must be modelled using at least neighbourhood dummies and closest neighbour

[7] *Davidson – MacKinnon* (*1981*)

residuals; and the models must be specified ensuring that the defined districts are not too small.

Rossini and Kershaw (*2005*) apply various AVMs to on a data set of 2,000 observations on properties sold in Adelaide (Australia) for the period 1998–1999. The authors estimated linear, log-linear (multiplicative) and hybrid models, using the geographic location of the properties (longitude and latitude coordinates). Finally, they estimated six models modelling geographic location effect in two different ways. The spatial effects are captured in one case by a location variable estimated based on location value response surface calculated from the basic models residuals and coordinates, which describes the main location attributes, but ignores local neighbourhood effects, while in the other case, the authors calculated smoothed residuals from the response surface using kriging[8] subsequently defining a variable that incorporates neighbourhood effects. The authors used absolute percentage forecasting error (average and under 10 per cent) and the statistics describing estimated value/actual selling price (average, deviation) to evaluate the models. Based on this, hybrid models performed the best for residential properties: 60 per cent of the predicted values featured an absolute percentage error of less than 10 per cent.

While respecting the considerations outlined at the beginning of this section, prudent conclusions may be drawn from these results. No matter what goal the user has in the course of modelling, it is important to examine the results of alternative models using several indicators. An important and general lesson is that the data used for the estimation (calibration) and testing of the models should be distinguished (in other words, a portion of the data set should be retained for testing) to prevent the model from being excessively sample-specific.

In terms of model specification, spatial analysis in parametric form is useful regarding estimation results, for example by addressing neighbourhood effects. The other interesting point is that it is difficult to do better than models with market segmentation defined by experts using statistical methods; in other words, models relying on the definition of urban areas defined based on real estate expert experience cannot be outperformed by automated methods.

5. Possibilities in Hungary

Based on a summary of the well-known methods at present, this section addresses the possibilities of application in Hungary. Currently, Hungarian financial institutions use statistical property valuation methods, but these are indexation and the average

[8] Kriging is an interpolation technique where the interpolated values are described by an earlier (associated with the previous steps) covariance-led normal distribution process. If the conditions defined for prior covariances are met, the best undistorted linear estimate is achieved.

value methods that differ from AVMs. In order to see a rise in the use of AVM models, more complete data sets are needed in addition to user incentives. Data on property sales with the broadest current coverage can be obtained from the National Tax and Customs Administration. This data set is based on actual property sales transactions and county duties offices record transactions entered into the unified National Tax and Customs Administration system. All records must contain the following property data:

- Property address
- Ownership share sold
- Time of contract signed
- Selling price specified in the contract[9]
- Property area
- Property type: single-family house or semi-detached house, condominium, housing project

Two significant uncertainties arise regarding the contents of the database. One of them is varying content of the variable "area". In most cases, the total area of the property itself is listed in the NAV records, but in case of single-family housesit is the area of the plot that is often listed. The two types of areas cannot be clearly distinguished from the recorded data, and as a result, the total area of the house is not even present in the database. The other uncertainty is the property type classification. In many cases, properties registered as apartments often appear in exclusively single-family detached home neighbourhoods, and housing project dwellings are often not identified as such. Exacerbating the issues with the database, access to it also limits the opportunities of using the data for statistical purposes. Referring to data protection policies, only 50–60 per cent of total data can be accessed by third parties, and among the variables addresses are truncated to the street level and dates are only available with quarterly accuracy. Based on user experience, due to these shortcomings, using the database for statistical purposes requires intense filtering and backcasting procedures. *Békés et al.* (*2016*) show that only an R^2 of roughly 50 per cent can be achieved by using this database for national-level estimates.

This fit can be increased by incorporating additional property attributes. The HCSO (Hungarian Central Statistical Office) housing survey analysis, based on own samples and property appraisal contains a regression using 30 explanatory variables. These variables (which include several category variables) yield an R^2 of 84 per cent of explanatory power of housing prices, illustrating the role of detailed information

[9] The basis of the duty paid is the purchased property's current value rather than the selling price negotiated by the parties. Therefore, if the National Tax and Customs Administration deems that the selling price falls short of the current value, it will determine the property's current value in the context of an on-site inspection. In these cases, the value determined by the tax authority is available as the property price.

on properties. Financial and real estate sector players could benefit from this opportunity by accessing a more detailed, publicly available land registry. Another solution would be to combine the results of several databases, such as the NAV's observations supplemented by estimates on advertising data.

Relying on the data available in Hungary, a better fit could be achieved using AVM methods. This objective could be approached by using spatial analysis methods. Still, without knowing the detailed attributes of properties, the estimation error will be substantial in the case of properties with unique attributes, which may result in a high frequency of large estimation errors. As long as users wish to apply more precise statistical models, the NAV database should be improved and access to it expanded in addition to methodological developments. Once this is achieved, the approaches presented in this paper could also be examined based on quantified criteria.

6. Summary

In the wake of regulatory, IT and methodological changes, statistical property valuation has gained traction in Hungary. In our paper, we looked at the what methods could possibly be applied to achieve this goal based on the literature. The fit of estimates based on classic hedonic models could be improved by using spatial analysis tools more intensively; however, nonparametric methods, such as neural networks, are able to yield an even better fit (smaller error). Nonetheless, regression methods are most suitable to contrast with real estate industry views, since experts, in line with the relevant legislation, present the partial effect of value-influencing factors on prices as part of the appraisal process.

Our review of methods that could possibly be applied shows that in Hungary everything is available to introduce automated valuation models (AVMs) besides the estimated mean-value based methods used so far. According to the results of related estimations performed in Hungary, statistical methods are able to provide useful information even outside the municipal boundaries defined by the current regulations. None of the statistical methods are able to approach individual expert knowledge for the time being, partly due to the size of the set of information that is difficult to quantify, and because of the degree of experience-based processing. However, statistical valuations, which are far less costly, will not crowd out but rather support the work of appraisers. For the aforementioned real estate industry specific reasons, in an effort to combine the benefits of automated and expert estimation, the introduction of parametric hedonic estimates augmented with spatial dependence can be expected.

References

Anselin, L. (1988): *Spatial Econometrics: Methods and Models.* Kluwer Academic Publishers, Dordrecht, 284 p.

Anselin, L. (1990): Spatial dependence and spatial structural instability in applied regression analysis. *Journal of Regional Science,* Vol. 30, May, pp. 185–207.

Anselin, L. (2009): Spatial Regression. In: A.S. Fotheringham – P.A. Rogerson (Eds.). *The SAGE Handbook of Spatial Analysis.* SAGE Publications Ltd., London, pp. 255–276.

Anselin, L. (2010): Thirty years of spatial econometrics. *Papers in Regional Science,* Vol. 89, March, pp. 3–25.

Békés, G. – Horváth, Á. – Sápi, Z. (2016): Housing prices and municipality-based differences (Lakóingatlan-árak és települési különbségek). *MT-DP* – 2016/21, Institute of Economics, Centre for Economic and Regional Studies of the Hungarian Academy of Sciences, Budapest, p. 39

Bourassa, S.C. – Hoesli, M. – Peng, V.S. (2003): Do housing submarkets really matter? *Journal of Housing Economics,* Vol. 12, March, pp. 12–28.

Cassetti, E. (1997): The expansion method, mathematical modeling, and spatial econometrics. *International Regional Science Review,* Vol. 20, April, pp. 9–33.

Clapp, J.M. – O'Connor, P.M. (2008): *Best practice automated valuation models of time and space.* https://www.researchgate.net/publication/253052334_Best_Practice_Automated_Valuation_Models_of_Time_and_Space. Downloaded: 2 October 2016

Coulson, E. (2008): *Hedonic methods and housing markets*. Unpublished manuscript, Penn State University, Pennsylvania.

d'Amato, M. – Siniak, N. (2008): Using Fuzzy Numbers in Mass Appraisal: The Case of the Belarusian Property Market. In: T. Kauko – M. d'Amato (Eds.): *Mass Appraisal Methods: An International Perspective for Property Valuers,* Wiley-Blackwell, Oxford, pp. 91–107.

Davidson, R. – MacKinnon, J.G. (1981): Several tests for model specification in the presence of alternative hypotheses. *Econometrica,* Vol.49., May, pp. 781–793.

Elhorst, J.P. (2010): Applied spatial econometrics: Raising the bar. *Spatial Economic Analysis,* Vol. 5, March, pp. 9–28.

EMF – EAA (2016): *Joint Paper on the use of automated valuation models in Europe.* http://hb.betterregulation.com/external/EMF_EAA%20Joint%20Paper%20on%20Automated%20Valuation%20Models%20(AVMs)%20in%20Europe%2009%20May%2016.pdf. Downloaded: 2 October 2016

Fotheringham, A.S. – Rogerson, P.A. (2009): *The SAGE Handbook of Spatial Analysis*. SAGE Publications Ltd., London, 511 p.

Fotheringham, A.S. – Brunsdon, C. – Charlton, M. (2002): *Geographically Weighted Regression: the analysis of spatially varying relationships.* John Wiley & Sons Ltd., Chichester, 269 p.

Gelfand, A. – Kim, H.-J. – Sirmans, C.F – Banerjee, S. (2003): Spatial modeling with spatially varying coefficient processes. *Journal of the American Statistical Association,* Vol. 98, June, pp. 387–396.

Gibbons, S. – Machin, S. (2003): Valuing English primary schools. *Journal of Urban Economics,* Vol. 53, March, pp. 197–219.

González, M.A.S. (2008): Developing Mass Appraisal Models with Fuzzy Systems. In: T. Kauko – M. d'Amato (Eds.): *Mass Appraisal Methods: An International Perspective for Property Valuers,* Wiley-Blackwell, Oxford, pp. 183–202.

Goodman, A. – Thibodeau, T. (2003): Housing market segmentation and hedonic prediction accuracy. *Journal of Housing Economics,* Vol. 12., September, pp. 181–201.

Gress, B. (2004): *Semi-Parametric Spatial Autocovariance Models*. PhD thesis. CA: University of California, Riverside.

Henderson, D.J. – Ullah, A. (2005): A nonparametric random effects estimator. *Economic Letters,* Vol.88., September, pp. 403–407.

Kain, J.F. – Quigley, J.M. (1970): Measuring the value of housing quality. *Journal of the American Statistical Association,* Vol. 65, June, pp. 532–548.

Kauko, T. – d'Amato, M. (2008a): *Mass Appraisal Methods: An International Perspective for Property Valuers*, Wiley-Blackwell, Oxford, 324 p.

Kauko, T. – d'Amato, M. (2008b): Introduction: Suitability Issues in Mass Appraisal Methodology. In: T. Kauko – M. d'Amato (Eds.): *Mass Appraisal Methods: An International Perspective for Property Valuers,* Wiley-Blackwell, Oxford, pp. 1–24.

Lee, Y.-L. – Jung, C. – Kuang, Y.Y. (2003): *Fair Evaluation of real Estate Value in Urban Area via Fuzzy Theory*. 10th ERES Conference, Helsinki, Finland, 10-13. June

LeSage, J. – Pace, R.K. (2009): *Introduction to Spatial Econometrics*. Taylor & Francis, Boca Raton, 374 p.

Lughofer, E. – Trawiński, B. – Trawiński, K. – Kempa, O. – Lasota, T. (2011): On employing fuzzy modeling algorithms for the valuation of residential premises. *Information Sciences,* Vol.181., December, pp. 5123–5142.

MacQueen, J. (1967): Some methods for classification and analysis of multivariate observations. In: L.M. Le Cam – J. Neyman (Eds.): *Proceedings of the Fifth Berkeley Symposium on Mathematical Statistics and Probability. Volume I: Theory of Statistics,* University of California Press, Berkeley and Los Angeles, pp. 281–297.

Manski, C.F. (1993): Identification of endogenous social effects: the reflection problem. *Review of Economic Studies,* Vol. 60, July, pp. 531–542.

Mimis, A. – Rovolis, A. – Stamou, M. (2013): Property valuation with artificial neural network: The case of Athens. *Journal of Property Research,* Vol. 30, June, pp. 128–143.

Nourse, H. (1963): The effect of public housing on property values in St Louis. *Land Economics,* Vol. 39, November, pp. 433-441.

Pagourtzi, E. – Assimakopoulos, V. – Hatzichristos, T. – French, N. (2003): Real estate appraisal: A review of valuation methods. *Journal of Property Investment & Finance,* 21 (4), pp. 383–401.

Peterson, S. – Flanagan, A. (2009): Neural network hedonic pricing models in mass real estate appraisal. *Journal of Real Estate Research,* 31(2), pp. 147–164.

Pinkse, J. – Slade, M.E. – Brett, C. (2002): Spatial price competition: A semiparametric approach. *Econometrica,* Vol. 70, May, pp. 1111–1153.

Ridker, R.G. – Henning, J.A. (1967): *T*he determinants of residential property values with special reference to air pollution. *Review of Economics and Statistics,* Vol. 49, May, pp.246–257.

Rosen, S. (1974): Hedonic prices and implicit markets: Product differentiation in pure competition. *Journal of Political Economics,* Vol.82., January-February, pp. 34–55.

Rossini, P. – Kershaw, P. (2005): *Using a hybrid automated valuation model to estimate capital and site values.* Eleventh Annual Pacific-Rim Real Estate Society Conference, Melbourne Australia, January 23rd – 27th January, 2005.

Sui, D.Z. (1992): A Fuzzy GIS Modeling Approach for Urban Land Evaluation. *Computer Environment and Urban Systems,* 16(2), pp. 101–115.

Annex 1

Patent number	Year	Authors	Note
US5361201	1994	Jost–Nelson–Gopinathan–Smith	An AVM using neural networks that calculates property value based on learned relationships first between individual property characteristics, followed by property and surface area characteristics.
US6115694	2000	Cheetham–Bonissone	A computer-implemented method for validating specified prices on real property.
US6609109	2003	Bradley–Gordon–McManus	An AVM combining the results of predictive models.
US6609118	2003	Khedkar–Bonissone–Golibersuch	Calculates property value by combining three processes: the first is based on location and living area, the second is based on a fuzzy neural network model, and the third uses a case based reasoning process.
US20010039506	2001	Robbins	An AVM that uses a comparative sales method.
US20030149658	2003	Rossbach–Conway	This system defines property value and its warranty for appraisal, protecting the party from the consequences of an inaccurate AVM appraisal.
US20040019517	2004	Sennott	The method determines whether there is sufficient information about a property to run an AVM.
US20040153330	2004	Miller–Hansen–Sennott–Sklarz	A process for evaluating default and foreclosure loss risk, which uses an AVM estimate as one of the first steps.
US20050288942	2005	Graboske–Walker–Helbert	Chooses the most accurate AVM calculation among those available to maximize AVM utilisation.
US20060085234	2006	Cagan	Calculates the deviation of AVM appraisals.

Impact of the Funding for Growth Scheme on the Hungarian economy

András László

In this paper, I examine the efficiency of the Funding for Growth Scheme (hereinafter FGS or Scheme), based on the loans disbursed until the end of 2015. The FGS is an unconventional instrument of the Magyar Nemzeti Bank, launched in 2013, the purpose of which is to provide micro, small- and medium-sized enterprises (SME) sector with loans on favourable terms. The efficiency of the Scheme means, on the one hand, to what extent the problem addressed by the Scheme was relevant, and on the other hand, the type of solution provided by it, and whether it did not involve excessive cost and risk compared to the anticipated results. I regard these as the two main pillars based on which its efficiency can be judged. I also present the Scheme's descriptive data and practical implementation. According to the conclusions, the Scheme offered an adequate solution for a problem of national economy significance, it has set lending to SMEs on a growth path and also contributed to economic growth, with relatively low costs and risks compared to the achievements.

Journal of Economic Literature (JEL) codes: E43, E50, E52, E59, H58

Key words: Funding for Growth Scheme, unconventional monetary policy, credit crunch

1. Introduction

In the public opinion, credit is a negative phenomenon for many, associated with the notions of dependency and vulnerability. On the other hand, in the absence of credit, economic agents can only rely on their present wealth, which is usually too small to maximise their future revenues with the utilisation thereof. Economists agree that in the absence of an equilibrium level of debt of adequate size, the performance of an economy will be lower. In Hungary – and in the overwhelming part of the developed world – during the post-crisis period outstanding borrowing gradually moved away from the equilibrium level, which was felt in the real sector.

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The author owes György Pulai thanks for his considerable assistance, and also András Kollarik, Kristóf Lehmann and Ádám Plajner for their cooperation in the accomplishment of this paper.

The manuscript was received on 3 October 2016.

Central banks applied a number of unconventional instruments to address this, with varying success. In accordance with the decision of the Monetary Council, the Magyar Nemzeti Bank announced the Funding for Growth Scheme in April 2013, the first phase of which commenced in June of the same year, with a view to mitigating the persistent market strains experienced in lending to the SME sector, and through this to fostering economic growth, strengthening financial stability and reducing the external vulnerability of Hungary. This paper analyses the background of the Scheme based on the sources available. After discussing the considerations underlying the launch of the Scheme, I also present its individual phases and achievements in detail. By presenting its effects, I provide a view of its impacts exerted on the real economy, its costs and risks, with a view to providing an overall picture of the Scheme and answering as many as possible questions and criticism – which arose not only in scientific circles – related to the FGS.

2. The need for the FGS

In the next section, I present the post-crisis persistent decline in corporate lending, which was addressed by the FGS. Lending is broken down into demand and supply factors, to identify the impacts that influenced the decisions of the actors in a way which gave rise to a decline in lending. I examine the credit market from the outbreak of the crisis until the announcement of the FGS; hereinafter I refer to this time interval as the period under review. I also look for correlations in the region, as in the beginning of the period under review corporate lending declined in all countries of the region, but the decline either turned around or stopped gradually, while this was not the case in Hungary (*Figure 1*). Summarising these, I come to a final conclusion about the disturbances to corporate lending. According to my assumption, the decline in SMEs' outstanding borrowing was the result of several impacts that reinforced each other, but the most important factors were the high funding costs of loans and the decline in the willingness to lend.

2.1. Situation of the Hungarian SME sector

First of all, I examine why it is (was) an important objective to support the SME sector. A well-functioning SME sector fosters enterprising spirit, new companies may appear on the scene or existing ones may expand their capacities, thereby employing more people and serving consumers' need with their products. In Hungary, this sector provided a living for 73 per cent of all employees, i.e. almost 2 million people, while its contribution to GDP in 2012 was merely 33.6 per cent. In addition, there is high concentration within the SMEs as well: micro enterprises, employing 1 million people in total, realised roughly the same sales revenues as medium-sized companies, which employ a little fewer than half-million people. This disproportion is natural to some extent, as with the increase in the employees'

headcount the corporations' production per capita rises to a much higher degree all over the world. On the other hand, of the countries listed in Table 1, this sector has the lowest output compared to the employees, in Hungary. Based on these facts, we can state that productivity in the Hungarian SME sector is quite low, which alone is a sufficient reason to support the convergence of SMEs.

The picture worsens further when broken down by regions. There is a major concentration in Central Hungary: the per capita gross value added of each SME is three times higher than in each of Hungary's other regions, and the per capita investment values in certain eastern regions are hardly half of that measured in Central Hungary (*cf. HCSO 2014*).

Table 1
International comparison of SME sectors
(per cent)

Country	Share of SMEs in all enterprises'			
	Number	Sales revenue	Gross value added	Number of employees
European Union total (EU28)	99.8	55.1	57.9	67.2
Of this:				
Hungary	99.9	57.0	53.7	71.3
Austria	99.7	65.8	61.1	68.0
Croatia	99.7	59.5	54.5	68.3
Romania	99.6	58.0	–	66.5
Slovakia	99.9	55.3	62.7	71.2
Slovenia	99.8	67.6	63.0	72.3
Estonia	99.7	76.9	73.7	78.0
United Kingdom	99.7	44.3	50.6	53.6

Source: HCSO (2014).

2.2. Supply and demand factors in corporate lending

Real economy developments impact lending from the demand side. The financial sector is destined to serve the real sector by facilitating financing, whereas during a crisis the capital assets, which would require financing, deteriorate. When there is a decline in the real sector, companies will produce less due to the lower demand, and thus their current assets needs will be also lower, resulting in low or no investment. On the other hand, the causal connection exists in the other way around as well: the phenomenon known as a creditless recovery has already been examined by numerous empirical researches, drawing the conclusion that in the case of a (corporate) credit crunch, long-term growth will be extremely fragile and much lower than possible (*Claessens–Kose–Terrones 2009*). Accordingly, the real

economy and lending exercise mutual influence in an endogenous manner, mutually reinforcing each other.

Hungary's activity situation was poor even by regional standards, as it outstripped only Romania, where growth was negligible even in 2011 (*Figure 2*). This should be compared with the figure comparing corporate lending at international level, where Romania already exceeded its 2008 level from 2012 Q2 and a year later it achieved the highest growth among the countries under review. The Czech Republic followed a similar growth path in 2011–2012 as Hungary, while its corporate credit portfolio increased in 2011 and stagnated in 2012, where it declined sharply in Hungary during the same period. There was also a robust increase in the outstanding borrowing of corporations in these two years in Poland and Slovakia, where activity was high already right after the crisis.[1] It follows from this that GDP growth fosters an increase in the corporate credit portfolio, but the expansion thereof may also be achieved without that.

The other credit demand factor is the interest rate. The interest rate on corporate loans is comprised of the cost of funds and the interest rate spread. A commercial bank may obtain funding (liquidity) from depositors, the interbank market, sales of its assets or from loans taken from the central bank. Apart from the sales of assets, all of these depend on the base rate in the longer run, following a similar path; accordingly, in order to compare the funding costs in the countries of the region by their magnitude, it is sufficient to examine the base rates.

Interest rate spreads are influenced mostly by two factors. One of them is the operating costs and cost of capital, while the other one, having a larger share, is the risk spread (*MNB 2013a*). Risk spreads are determined by the banks in such a way that they charge an interest rate spread to companies with a given probability of default that ensures that the non-defaulted ones cover the unrecovered parts of the loans.

Hungarian corporate interest rate spreads were absolutely in line with the regional average and also did not materially depart from the euro loan interest rate spreads (they were more or less above 2 per cent in the period under review), and thus I do not regard them as a factor relevant for the decline in lending. On the other hand, the funding costs are much more determinant, as is also reflected by Figure 3. After the onset of the crisis – as soon as the inflation outlooks and the financial stability considerations permitted it – the high base rates declined both in the region and in Hungary. In spite of this, the rate of decline in corporate lending did not decrease at all in Hungary, and in parallel with the additional interest rate

[1] The economy was able to grow even during the crisis in Poland.

cut in August 2012, outstanding borrowing by corporations continued to contract (*Bihari 2013*). In the credit market, the decrease in the price (interest rate) of the products (loans) does not necessarily entail higher sales volume. This is due to the fact that apart from the interest rates, another factor, i.e. non-price terms, also determines developments in the volume of credits. This is necessary, because the price is not always able to play a market clearing role. If the banks want to reduce their credit supply, after a certain they point their tighten the conditions rather than raise the interest rates. This is due to the fact that the higher credit costs (interest rate spread) paid by the corporation for its level of risk only makes its profitability even lower, thereby increasing the probability of bankruptcy, i.e. the defaulting on the loan (*Fábián–Hudecz–Szigel 2010*). This consideration – after a crisis that was caused by the underestimation of the probability of a systemic default – is rather important for the decision-makers of the banking system.

This is how it is possible that in the credit market – contrary to a normal market – on the basis of the changes in prices it cannot be established for sure whether the change is caused by the decline in supply or in demand. It is quite possible that 1) interest rates rise, while the non-price terms remain constant or become tighter, 2) it is also possible that the interest rates remain constant and only lending conditions are tightened (i.e. only better performing companies are eligible for credits),[2] but it may as well be that a fall in interest rates is accompanied by the tightening of conditions (*Fábián–Hudecz–Szigel 2010*). The lending conditions simultaneously reflect the banks' lending capacity (capital position, cost of finance, liquidity) and willingness to lend (changes in the real economy, competition between banks).

As regards lending capacity, following a fast recovery after 2008, lending capacity once again started to weaken from the end of 2011 (*Balogh et al. 2012*). From the capital side, the rise in credit losses and the early repayment of the household loans at preferential exchange rate represented an obstacle. From the financing side, the persistently high domestic funding costs experienced during the period, the rise in the price of external funding and the withdrawal thereof lowered lending capacity (*MNB 2012a*). It should be mentioned that the high base rate, as a hindering factor, appears in this respect as well. Since Hungary experienced a foreign currency loan crisis, the withdrawal of external funds was to some extent a natural consequence, while on the other hand, it was also attributable to the decrease in the willingness to lend. However, after a while the decline in corporate lending was the consequence rather than the cause of the withdrawal of funds. 20 per cent of the outflow can be regarded as a negative process (*MNB 2013b*). Liquidity was no longer a material constraint to lending already one year before the introduction of the FGS (*MNB 2012b*), and thus lending capacity hindered lending activity only to a minor extent, while willingness

[2] "Flight to quality" phenomenon, see *Bernanke et al.* (*1996*).

to lend was a much more determinant factor (*Balogh et. al. 2012; Sóvágó 2011*). According to some studies, liquidity at that time was illusory, as a major part thereof was held by foreign-owned banks due to the requirements, and from a lending point of view this is almost the same as a liquidity crisis (*Balog et. al. 2014*).

On the credit demand side, the real economy effect did not justify – apart from 2009 and 2012, i.e. the periods of recession – the dramatic fall in outstanding lending. By contrast, on the supply side this factor was deemed to have the greatest explanatory power; banks tightened their conditions most often and to the largest degree as a result of the anticipated downturn in real economy and the industry problems (*MNB 2012b*). These, on the one hand, were only the fears of the banks, as they did not ease the conditions despite the economic expansion in 2010 and 2011, and on the other hand, there were also country-specific factors in these years such as the increased uncertainties surrounding the macro and regulatory environment (Balogh et. al. 2012). As a result, the banks' excessive risk aversion made a major contribution to the decline in lending, particularly in the period of 2010–2011, when two thirds of the fall in outstanding lending was attributable to the supply component (*Hosszú et. al. 2013*). Thus, during the recession, the development in the real economy is a significant factor on the credit demand side, but on the supply side there are also other factors.

It should be mentioned that it is easy to underestimate credit demand, particularly in a post-crisis period, as there are companies that do not appear at the credit institutions with their credit applications, as they are convinced that they would be denied anyway. However, these surveys examine the credit applications submitted to the banks, rather than asking the companies directly (*Fábián–Hudecz–Szigel 2010*).

2.3. Impact of close-to-zero funding costs

If we continue with the regional comparisons, it becomes clear that from the start of the crisis until April 2010 the Czech Republic experienced a decline in corporate lending of the same degree and rate, but this trend turned around thereafter and lending embarked on a growth path. When we compare this with the changes in the base rates, we see that it was roughly at the time of the turnaround when an interest rate cutting cycle ended there, pushing the base rate down to 1–0.75 per cent. I believe that this played a major role in the corporate credit boom. On the one hand, this had a liquidity expanding effect, as banks could obtain domestic funds at lower price. On the other hand, as a result of the low base rates, more companies satisfy the tighter conditions, as the lower interest burden reduces the probability of default. In addition, if the loan funding cost is very low, i.e. close to zero, banks may apply higher risk spreads on the lending rates more daringly, to cover the defaulted parts of loans, as a result of which companies earlier rated as uncreditworthy may get access to loans. In addition to the supply side, there may be a strong effect on the demand side as well, since the interest rate on loans fall

due to the lower funding costs and companies can finance their investments and current assets at a lower price. This triple effect – the decline in the probability of default, the larger credit supply due to the higher interest rate spread and the stronger credit demand resulting from lower loan interest rates – may be powerful in sectors such as the SME sector.

2.4. Special features of lending to SMEs

The general picture outlined in the previous section on corporate lending is even worse in the case of SMEs. It is much more difficult for this sector to obtain funding at any time, as their indicators are worse (they are less profitable and represent higher risk) than those of the large corporations, and thus they are positioned higher up compared to the average loan interest rates, and upon the tightening of the non-price terms they tend to be squeezed out to a much greater degree. The external financing of Hungarian SMEs is practically monopolised by the banking sector: going public in the period under review was only a theoretical option,[3] primarily due to the high specific costs thereof; in addition, the possibility of raising private funds was also negligible (*Mikesy 2015*).

It may be generally stated that Hungarian-owned SMEs have always been underfunded. This is supported by the fact that the majority of the domestic SMEs are present in the less capital-intensive industries and generally pursue more narrow, easy-to-specify activity; they are not characterised by diversification, thus their operation represents higher risk. The greatest disadvantage is attributable to the fact that most of them produce for the domestic market only (Walter 2014). As a result, they strongly depend on domestic business cycles; during times of recession they are less inclined to invest, but even if they find it feasible, it is less probable that they would get a loan in recession than an exporter company. If they applied for foreign currency loan, they would also face – not only during the crisis – tighter credit terms, but even if their application is granted, in the absence of export revenues, they would bear the potential negative consequences of the exchange rate risk in full. In the case of forint loans, in addition to the high funding costs seen in the period under review, SMEs are required to pay much higher spread – i.e. 5–7 per cent – compared to the previously mentioned low spread of around 2 per cent, and thus additional SMEs were prevented from borrowing, or they did not even apply to credit institution, as under the high interest rates the investment was less likely to recover.

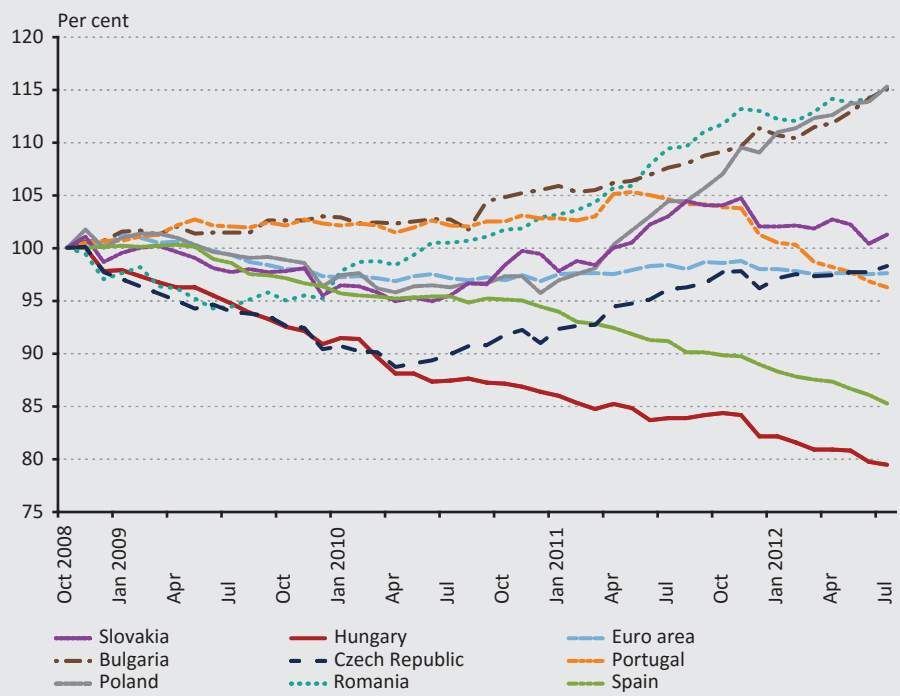
2.5. Summary

Many of negative impacts were felt much more strongly in lending to SMEs than in the entire corporate lending. One of these is that they produced only for the domestic market. In addition to the high funding costs, they also faced significantly

[3] In the strategy of the Budapest Stock Exchange, which commenced in 2016, the public offering of domestic SMEs is a priority objective, supporting the implementation thereof by various services and programmes (source: https://bet.hu/Rolunk/a-budapesti-ertektozsderol/A-BET-2016-2020-as-strategiajanak-fo-iranyai).

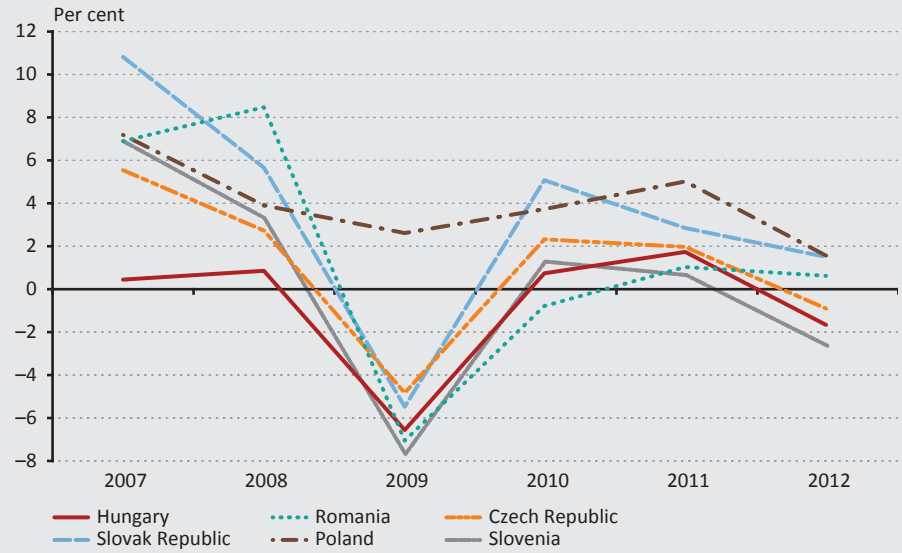
higher credit spreads than large corporations. Thus, in a poor cyclical situation they are burdened by extremely high credit costs. The supply side – i.e. the banks – faced capital and liquidity constraints from the start of the crisis until 2012; on the other hand, in 2012, when their creditworthiness recovered, they were less willing to lend, particularly to the SME sector, i.e. the sector most vulnerable to the domestic activity trends. Through these factors, the credit demand and supply both contributed to the contraction in SME loans, moreover in a self-reflective manner. Furthermore, SMEs were burdened by their previous loans, i.e. in the case of forint loans by the higher interest rates, while in the case of foreign currency loan by the increased loan amount. Consequently, the central bank deemed it justified to reinstate lending to the SME sector, and announced the Funding for Growth Scheme in April 2013. Of the problems listed in the foregoing, the Scheme reduced the high interest rate on loans, which extremely weakened the demand side and also improved the banks' profitability and willingness to lend.

Figure 1
Corporate lending in an international comparison
(October 2008 = 100 per cent)



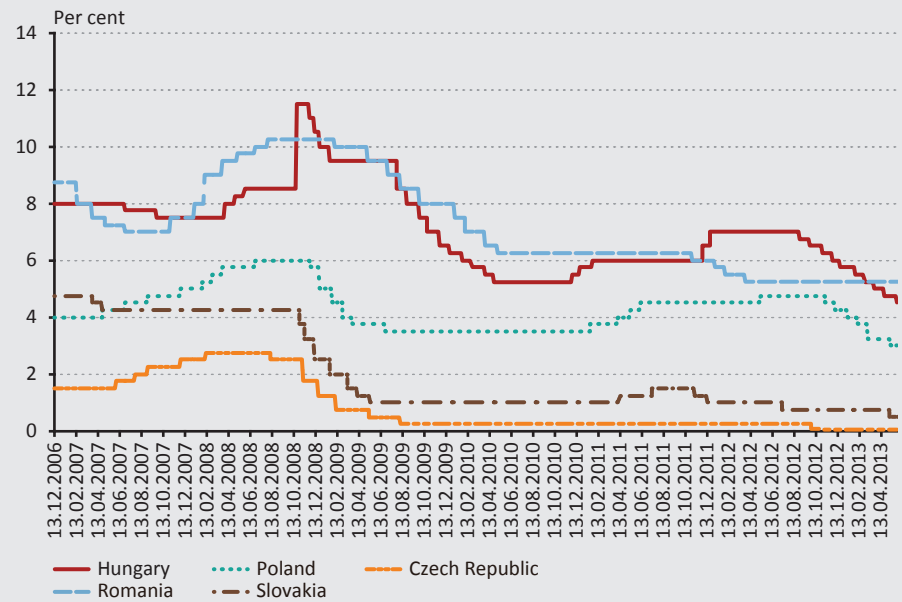
Source: Financial Stability Report MNB, November 2012.

Figure 2
GDP growth



Source: World Bank.

Figure 3
Base rates in the region



Source: Websites of the central banks of the reviewed countries.

3. Features and achievements of the individual phases of the Funding for Growth Scheme

Having discussed the reasons underlying the launch of the FGS, in this chapter I describe the Scheme in detail. The Scheme is divided into three phases, which I will present separately in order to highlight their specific features.

3.1. First phase

In Pillar 1 of the Scheme, the MNB granted refinancing loans to the credit institutions at 0 per cent interest for loans extended to SMEs for maximum 10 years with a fixed interest margin capped at 2.5 per cent. Enterprises could use these loans for working capital financing, for the own contribution and pre-financing of the EU grants, or for the refinancing of loans or financial leases, disbursed originally for such purposes in forint. SME clients could use the loans received under Pillar 2 to refinance foreign currency or foreign currency-denominated loans or financial leases from domestic credit institutions with forint loans. In both cases, the contract amount was specified as a minimum of HUF 3 million and a maximum of HUF 3 billion (*MNB 2013c*). That is, under the FGS, SMEs could borrow new forint loans or replace their existing foreign currency loan or forint loans bearing higher interest rate with forint loans with a capped, 2.5 per cent interest rate, with the result that their outstanding debt was in domestic currency, thus supporting financial stability, specified as one of the objectives, and reducing dependency on external funds. Foreign currency loans pose two additional threats: the exchange rate risk and the reference rate of loans, which change independently of Hungary's financial sector. In view of the keen interest in the FGS, the Monetary Council already raised the credit facility amount before launching the Scheme by 50 per cent to HUF 750 billion. Demand was indeed assessed correctly, as loan contracts were concluded for 93.5 per cent of the facility, i.e. HUF 701 billion, representing 10,000 contracts.

Meanwhile, Pillar 1 attracted even stronger interest, and accordingly the MNB permitted the reallocation of the still unutilised part of the facility allocated to Pillar 2 to Pillar 1. Consequently, 8,131 credit transactions, in the amount of HUF 472 billion, were concluded under Pillar 1, while 1,713 foreign currency loan loans were refinanced under Pillar 2 in the amount of HUF 229 billion. Loan contracts could be concluded until end of August; those concluded until that date had to be submitted and the first tranche disbursed by the end of September, while the remaining tranches had to be drawn down, in the case of investment loans, by the end of March 2014 (*MNB 2013c*). The first phase of the Scheme had an outstanding impact, as the amount drawn down in that phase alone was of almost the same magnitude as the amounts disbursed in the previous quarters. At the same time, it is also worth examining the type and structure of the FGS loans. In the first phase, the ratio of refinancing loans was extremely high: these loans accounted for all of Pillar

2 and 40 per cent of Pillar 1 (*MNB 2013c*), and thus the actual amount of new loans taken by SMEs was "only" HUF 210 billion. This explains the very high amount in 2013 Q3; the FGS did not have such a large impact on new loans, as shown by Figure 1, which illustrates developments in new corporate loans. However, the volume of new loans of HUF 210 billion, created by the Scheme, is still an extraordinary achievement, as in the few periods that preceded the FGS the volume of forint loans taken by the entire corporate sector hardly exceeded this value. In addition, as regards its structure, it is important to differentiate the short-term working capital loans from the longer-term investment loans. 61 per cent of the HUF 210 billion went to finance new investment loans in the amount of HUF 128 billion, which is also a robust figure compared to the earlier data.

3.2. Impacts of the first phase

The impacts and results of the first phase of the FGS can be deemed positive on the whole: the Scheme increased the funding of the SME sector to a large degree, helping to stabilise its financial situation. The FGS also reduced the interest burdens of the participating SMEs to a great degree. At the beginning of 2013, the two worst, but still creditworthy SME client groups had access to loans only at a much higher spread (475–700 basis points) than the market average, on top of the base rate, which was 4 per cent at the time of the first phase (*cf. MNB 2013c*). Thus, as a result of the interest rate spread cap of 2.5 per cent and zero funding cost in the FGS, interest rates on new loans fell by 6.25-8.5 percentage points.

The easing of corporate lending conditions also started during this period, in which the FGS played a significant role due to the zero funding cost. Competition among lenders appeared indirectly, due to the abundance of funds, which also contributed to the easing of conditions. Competition was further boosted under the FGS by the possibility of changing banks, which was used by 20 per cent of clients, as small and medium-sized banks received proportionately higher credit facility under the Scheme than the cooperative societies (*MNB 2013a*).

Irrespective of the foregoing, the non-price terms were still tight during this period, and no willingness to ease them could be observed. As a result of the large volume of refinancing, corporations removed their exchange rate exposure, and their interest burdens also decreased: in Pillar 1 interest rates on investment loans and working capital loans fell to 2.5 per cent from the average of 5.9 and 5.8 per cent, respectively. In Pillar 2, interest rates on investment loans and working capital loans fell from 3.7 per cent and 4 per cent, respectively, to 2.5 per cent. These factors greatly assist corporations in fulfilling the non-price terms during their future borrowing.

The tenor of the loans drawn down is relatively even (*MNB 2013c*), and thus there is no risk of concentrated credit demand in the future related to a specific period, which would jeopardise banks' liquidity.

The distribution of the loan types among the SMEs of various size can also be deemed efficient. 60 per cent of the loans taken under the Scheme by micro enterprises – which represent the highest risk on average, and thus meet the credit terms to the least extent – are new investment loans, amounting to HUF 66 billion.

The distribution of the credit size can be deemed particularly favourable. 70 per cent (in terms of quantity) of the loans remained below HUF 50 million, which is an optimal figure, as the size of these is not so small that they do not permit the implementation of larger investments, while on the other hand, this amount is not concentrated only at a few companies, which is a positive factor in the case of credit defaults. In addition, the FGS had a positive impact on the regional distribution of the outstanding borrowing of SMEs. The concentration in Central Hungary decreased under the Scheme, and more loans were disbursed particularly in the east and south-east regions (*MNB 2013c*).

4. Presentation and analysis of the second phase

In terms of its nature, the second phase of the Scheme is the continuation of the first phase, as the lending facilities and loan types are the same, and some of the results are also very similar. With this in mind, I have combined the description with the evaluation.

The second phase of the Scheme commenced right after the completion of the first phase, i.e. on 1 October 2013; the end of the drawdown period in Pillar 1 will be 31 December 2016 and in the case of Pillar 2 it was the end of 2015. Until the very end of 2015, i.e. for more than 2 years, almost 27,000 companies submitted loan contracts in the amount of HUF 1,402 billion, 95 per cent of which were new loans and 60 per cent of which financed investments (*MNB 2016a*).[4]

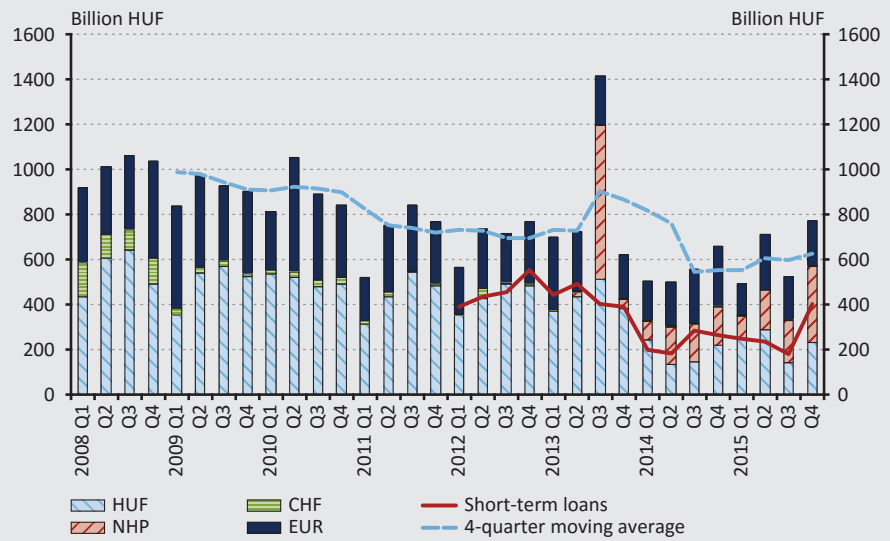
This means that during this period of just over two years, investments of HUF 89 billion per quarter could be implemented on average in the SME sector, only through the FGS, and thus the decline in credit demand in 2012 was only a temporary phenomenon. Moreover, the remaining demand was generally related to the financing of investments.

During the two-year term of the second phase, the drawdown of non-FGS forint loans (hereinafter: forint loans) fell drastically. The relatively high weight of the FGS within forint loans and the decline in forint loans (*Figure 4*) suggest that

[4] In this phase, refinancing accounted for roughly 10 per cent of the facility amount only.

a crowding-out effect occurred, meaning that a large part of the SMEs would have become borrowers even without the FGS. According to a questionnaire-based survey conducted at the end of October 2014, this was only true to a small degree. According to the responses, almost 30 per cent, i.e. HUF 220 billion, of the new loans taken in the first one and a half years would have materialised without the FGS, and the same proportion would have been realised only in part (*MNB 2014a*). This alone suggests that it is not correct to assume a crowding-out effect, but if we examine the distribution by the number of companies, we get an even brighter picture: significantly fewer companies would have been able to borrow in the absence of the FGS, i.e. many small-value loans would have not been concluded: 70 and 65 per cent of the respondent micro and small enterprises, respectively, would have been unable to borrow in the absence of the FGS.

Figure 4
New corporate loans in the credit institution sector as a whole



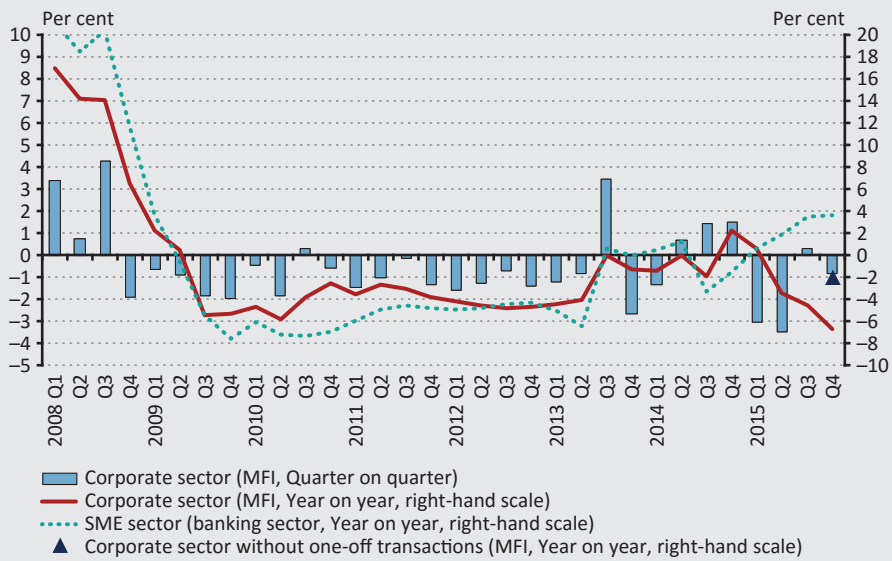
Source: MNB Trends in Lending, February 2016.

In addition, the second phase also deserves credit for the fact that micro enterprises, which have the greatest growth potential, concluded FGS loan contracts for HUF 501 billion, and 76 per cent of their loans were new investment loans. Small enterprises took FGS loans in the amount of HUF 468 billion, half of which were investment loans. About 30 per cent of all loans were concluded at small and medium-sized banks and cooperative banks, which is a much higher ratio than in the case of the forint loans (*MNB 2015a*). EU loans were shared equally between micro, small and medium-sized enterprises, which is important, as this helps them obtain additional funding and thereby achieve higher growth potentials.

The regional distribution of the second phase is less concentrated than the pre-FGS SME loan portfolio: before the FGS, 54 per cent of SME loans were taken in Central Hungary, while in the second phase this amounted to 34 per cent only, with the South Great Plain and South Transdanubian regions benefiting from the difference.

The greatest achievement of the second phase of the FGS was that whereas the outstanding borrowing of corporations, adjusted for individual transactions, decreased, the SME credit portfolio expanded (*Figure 5*). The negative change in SME loans recorded in 2014 Q3 was only attributable to the fact that growth is calculated in annual terms, and the outstanding first phase was launched in 2013 Q3. Based on this, it can be stated that the new loans of SMEs showed a continuous upward trend from the start of the FGS until the end of 2015, while the total outstanding borrowing of corporations steeply declined in 2015.

Figure 5
Growth rate of loans outstanding of the whole corporate sector and the SME sector



Note: Transaction-based; from 2015 Q4 on, data for the SME sector are based on new data supply.
Source: MNB.

5. Monetary policy effects of the FGS

Having looked at the practical implementation of the FGS, it should be clarified where the Scheme is positioned in the monetary policy framework. The FGS is part of the set of monetary policy instruments, and more particularly it is an unconventional instrument. The application of unconventional instruments may be justified in three cases. Obviously, if the conventional instrument – i.e. the base

rate – is no longer effective or it is close to zero, i.e. no further monetary easing can be performed through the short-term interest rates, the central bank needs to resort to unconventional instruments. On the other hand, the application of such instruments may also be justified even when the base rate is above zero, if there is such a financial market conflict, distrust or constraint that severely prejudices the transmission mechanism, and thus interest policy cannot be as effective as usual. In Hungary, the failure of the financial market was represented by the decline in corporate lending, discussed in Section 1, which cannot be managed only by the reduction of the base rate, as SME loan interest rates remained high.

"By the manner of interventions, three types can be differentiated: 1. instruments providing commercial banks with liquidity, 2. direct credit market interventions, 3. the purchase of government securities" (*Balogh et. al. 2012*).

"The liquidity providing instruments essentially include the loans and refinancing schemes provided to the financial intermediary system. In many cases, the central banks modified and expanded their own former, traditional liquidity providing instruments, operating with much larger volumes (often unlimited) and more favourable terms (tenor, interest rate spread, range of collaterals) than before. The objective of these instruments is to stabilise the key financial markets, to reinstate transmission and to strengthen the banks' lending capacity by mitigating their liquidity constraints. However, the degree to which the instrument reducing the funding costs of the financial intermediary system appears in the private sector's loan conditions, depends on the banks' attitude" (*Balogh et. al. 2012*). This means that if, in addition to the liquidity problems, the financial market in question is also confronted with other lending constraints – arising from capital adequacy, cyclicality or competition – the application of the instrument is not necessarily successful.

"As a result of the decrease in the excessive spreads which developed in the markets playing an important role in transmission – the interbank market and the government securities market – the liquidity providing instruments usually also reduce the difference between the key policy rate and the bank's funding cost, i.e. the refinancing costs" (*Bini Smaghi 2009*). This happens when the banking sector is provided with large volume of funds or even unlimited funds at the base rate. Right after the crisis, most of the developed countries used this instrument in this way and successfully (*Balogh et. al. 2012*).

In a sense, the FGS belongs to this group of liquidity providing instrument, as it increases the liquidity of the banking system, albeit it cannot be fit into any of the categories. However, in contrast to other central banks' instruments of this type, the MNB provides refinancing in a very targeted manner, i.e. related to certain SME loans, for longer term, even for 10 years, with a fixed 0 per cent interest rate, which is lower than the central bank base rate. The question is, whether there

were better alternatives to the Scheme, and whether the central bank could have achieved better effect or the same effect at lower costs – or better effects at lower costs – in the SME credit market.

The purchase of government securities takes place in a way that the central bank buys government bonds in the secondary securities market, as a result of which their prices go up and their yield drops, thereby making other instruments more attractive. If other instruments are purchased – bank or corporate bonds, or mortgage bonds – the same effect prevails with them as well, i.e. the funding costs decline both for households and corporations (*Bank of England 2010*).

Accordingly, it affects not only the corporate credit market, but also has broader impact, the objective of which is generally to ensure that the central bank channels cash into the economy and reduces long-term yields. This is less targeted than the FGS. Moreover, due to the prohibition of monetary financing of the budget deficit, the purchase of government securities is permitted only in specific cases, usually when there are disturbances in the government securities market.

"During the direct interventions in the credit market, the central banks purchase corporate securities and mortgage bonds, or – rarely – extend loans to corporations. By doing so, the central bank partially assumes the credit risk of the private sector. The purchase of instruments is essentially feasible where the economy has a developed securities market, which provides substantial securities-based corporate finance, and the companies finance their activity in large numbers (across several sectors) and to a large degree by bonds and bills" (*Balogh et al. 2012*). In terms of its goal, it is closer to the FGS than the purchase of government bonds; however, the feasibility thereof would have been rather questionable: in Hungary, the corporate sector raises only a few per cent of its funds from the bond market, while in the case of SMEs this is not typical at all.

In the broader sense, the FGS is a lending incentive instrument, which intends to remedy the post-crisis aversion to risk and the lengthy and expensive deleveraging across the whole economy (*MNB 2014a*). In the first phase of the FGS, the prevalence of refinancing meant the replacement of the former expensive debts by cheap ones. It was only after this that SMEs could afford new borrowing, but only at low and predictable interest rates, which they could repay. The interest rates were sufficiently low to revive credit demand.

The placement of an FGS loan in practice does not represent extra costs[5] for the bank, and thus it can increase willingness to lend, thereby also strengthening the supply side.

[5] The placement of loans has one-off costs, but in the case of longer terms it is recovered through the moderate spread.

Thus, a second central bank rate appeared in addition to the key policy rate, and the more funds the central bank channels to the economy using this rate, the larger the decrease in the actual interest rate (i.e. the average of the base rate and the funding rate). The larger the volume of preferential funds and the range of users, the more the base rate loses its significance (*Bihari 2013*). In the case of the FGS, there is no such threat, bearing in mind that within lending in general it influences only corporate SME loans.

6. Macroeconomic effects – revenues, costs and risks

The individual results of the various phases were outlined in the previous section; in this section I present the impact exerted by the Scheme on macroeconomic indicators (e.g. GDP, investment, employment). Knowing the theory of its functioning, we can examine the macroeconomic costs and risks of the FGS, as both negative factors derive from the effects thereof.

6.1. Real economy impact of the Scheme

The FGS primarily impacts GDP via growth in investments. On the one hand, it reduces corporations' borrowing costs, and thus they can take out higher loans for investment (as well). On the other hand, due to the lower instalments, the cash flow of corporations will also be higher, which improves their creditworthiness, and thus they can borrower more, or they can save the higher cash flow or use it for the financing of investments without saving. As a result of the latter impact, later on SMEs will be less dependent on external financing, and thus this effect reduces future borrowing (*MNB 2016a*). The higher cash flow exerts an impact not only through investments, but may also facilitate a potential wage increase. Investments raise GDP through the increase in aggregate demand. The rise in GDP results in wage increases and corporate profit, and the use of higher wages for consumption or the profit for investment or consumption, generates additional second-round demand effects.

The macroeconomic effect of the FGS can be estimated both from the demand and supply sides. On the supply side, we have the structural vector auto regressive (SVAR) model examining the real economy impacts of the credit supply shocks (*Tamási–Világi 2011*), which calculates GDP not only through the investment effect. In this model, we must choose which one of the shocks on risk assumption, interest rate spread and monetary policy may have been generated by the FGS. Since the FGS is an unconventional instrument and covers only part of outstanding borrowing, it causes no shock in monetary policy (*MNB 2016a*). Based on the estimate prepared among the borrowers of new FGS loans in 2014, borrowers participating in the FGS do not represent a higher risk than the creditworthy SME group, selected

as the benchmark,[6] and thus the Scheme also has no impact on the Bank's risk assumption (*MNB 2014b*). The interest rate spread generated a shock, and thus the real economy effect of the FGS is estimated on the basis of this (*MNB 2016a*).

According to the calculations of *Bauer* (*2016*), the GDP increasing effect of the FGS was 1.7 per cent in 2013–2015, which roughly amounts to HUF 550 billion. The effect in the coming years is expected to be more moderate, as the corporations immediately use the loans requested for specific purposes, and thus the investments and current asset purchases financed by the FGS have already materialised. However, the surplus output of the investments have a long-term effect in most industries, and thus the FGS will increase Hungarian GDP in the future as well.

The effects of the FGS on employment can be deduced from its effect on GDP, using a macroeconomic model (DELPHI). According to the results, the FGS increased employment by 17,000 persons in the period 2013–2015.

The model estimating investment based on micro data from the demand side was prepared on the basis of the financial statements of the corporations that borrowed new FGS loans. Thus, we can estimate how investment would have developed in the absence of the Scheme, and manage the opposite of this, i.e. those investments of companies that would have been implemented anyway, even in the absence of the Scheme. However, it is a disadvantage that the model can only manage changes in tangible assets, which may differ from the investment realised in macro-statistics (e.g. when second-hand assets are purchased).

Based on the calculations of Bauer (2016), the loans drawn down in the first and second phase of the FGS generated new investments in the amount of HUF 137 and 210 billion, respectively. One unit of loan generated 0.5 unit of additional new investment in both phases (*MNB 2016a*).

6.2. Costs and effect on the budget

The previous section made it clear that the FGS is a refinancing loan for the commercial banks, diverted downwards from the base rate. Commercial banks lend this amount on to the SMEs. If the SMEs received and used the amounts – for investments or current assets – sooner or later the funds will appear as money on the account of a commercial bank. From then on, no matter how that commercial bank decides to use this excess liquidity, in terms of the entirety of the banking system, it will be returned to the central bank, in the largest part through the main policy instrument, i.e. the three-month deposit[7] (*cf. Balogh 2009*). It follows from

[6] See more on this in the section on risks.
[7] It can be also channelled back to the central bank via the overnight deposits and the clearing accounts. In the first case, the funds may be channelled back to the central bank at a cost lower than the base rate, but as the ratio of overnights within the banks' liquid assets is negligible, for the sake of simplicity we disregard this option.

this that the central bank pays the base rate to the commercial banks on the three-month deposit, while it granted the FGS free of charge. Accordingly, the central bank's cost on the FGS will be the FGS portfolio outstanding at any time multiplied by the interest rate paid on the deposits.

In my calculations, I used the annual average outstanding borrowing and the weighted average base rate for the period of 2013–2016. Looking ahead, the recent quantitative restriction of the main policy instrument somewhat decreases the average sterilisation costs compared to the base rate, and therefore, for the post-2016 period I use the market expectations regarding BUBOR instead of the anticipated path of the base rate. When estimating the outstanding borrowing in the given year, I assumed that it peaks at HUF 1,500 billion in 2016 and due to the maximum 10-year tenor, it is repaid by 2026. I assumed fixed instalments during the 10 years.

Based on my estimations, the expected costs of the FGS between 2013 and 2026 is roughly HUF 200 billion. This amount is fully borne by the MNB, but the finances of the central bank form part of the budget, i.e. if it has no sufficient retained earnings and it makes a loss, it will have to resort to the state, and therefore the FGS can be regarded as a budget expenditure at the level of the consolidated general government.

Due to the costs of the FGS, it is important how much tax revenue is generated by the Scheme. It increased the tax base of most tax types through employment, consumption and investments. Bearing in mind its effect on GDP and the tax centralisation of the Hungarian economy, in the period of 2013–2015 budget revenues increased by roughly 0.68 per cent of GDP due to the FGS, which amounts to approximately HUF 220 billion. Accordingly, the budget revenues generated by the Scheme in 2013-2015 almost equal the costs that the central bank is likely to incur during the next 10 years. Moreover, although the degree to which GDP will exceed in the coming years the level that would have been realised in the absence of the Scheme cannot be determined precisely, almost 40 per cent of the surplus output compared to that appears annually as additional budget revenue as a result of the tax centralisation, and thus taking the 10 years together, the tax revenues realised at the general government are likely to be well above the costs incurred by the MNB.

6.3. Risks

One of the risks of the FGS, as in the case of all loans, is credit default. Due to the abrupt pick-up in demand and as a result of the competition, there is a chance that banks may act irresponsibly and place FGS loans with clients representing a much higher risk. Due to the fact that the commercial banks must repay the refinancing loan to the central bank, the prevention of credit default enjoys the

same priority as in the case of funds sourced from the market. This was confirmed by the estimation prepared by *Endrész et al.* (*2014*), which measured the average and median risk of the companies participating in the first phase between 2007 and 2011 compared to the SMEs that borrowed then or already had a loan. Based on the logit estimation thus prepared, in 2011 of the companies with future FGS loans, only the group of those that refinanced foreign currency loans represented higher risk by 1.5 per cent, while those with new FGS loans or refinancing forint loans represented roughly the same risk as the SMEs that already had loans then (4.5 per cent). It is a question to what extent their risk level has changed by 2013, i.e. by the time of the borrowing. Based on estimation prepared for this, the average and median risk of the companies participating in the FGS fell by 0.5–1 percentage point from 2011 to 2013 (*MNB 2014b*).

The critics of the Scheme were of the opinion that the FGS loans are not profitable for the commercial banks – or in the short run they may even generate losses – as the margin of 2.5 per cent appears to a great degree (or in full) as a risk spread, which is not a revenue for the banks. They explained this by saying that the high, 3–5 per cent pre-FGS risk spread surely has not dropped to such a low level that it would be more profitable to lend at a 2.5 per cent margin than without FGS. The only reason why banks join the FGS is scheme is competition, to ensure that later on the clients remain with them and they may lend to them at a profit after the phase-out of FGS. In order to confirm or refute this opinion I conducted a questionnaire-based survey among the banks with larger corporate exposures. All respondents noted that there was substantial competition, and thus their clientele hardly expanded at all, and it was more typical that the existing clients once again became borrowers or they took on larger loans. The profit realised on the margins show a mixed picture depending on the tenor and the change in the base rate, but on the whole, the FGS had a positive impact on banks' profitability due to the higher demand for loans.

Under the FGS – due to the mechanism presented before – the interest rate risk is borne by the MNB instead of the SMEs, and a future high base rate represents a higher burden for the general government. The question is which factors may increase the expected interest level, discussed in the section on costs, compared to the currently priced market expectations. In September 2016, according to one of the alternative scenarios, we may see larger wage increases compared to previous years, which – through the growth in household consumption – results in a higher consumption path than forecast. On the other hand, this has a positive impact on GDP as well, as a result of which the increase in the FGS interest expense would be accompanied by an increase in tax revenues. Other risks include the higher oil and commodity price path and the potential for financial market turbulences, but these are not considered as key risks (*MNB 2016b*).

Setting out from the fan chart of the Inflation Report of September 2016, if we use the extreme assumption that by the end of 2018 the interest level would increase to 5 per cent and remain persistently at that level, the total interest expense of FGS incurred by the MNB would amount to HUF 440 billion. This already considerably exceeds the tax revenues generated in recent years, but if we also consider the tax revenues generated over the full term – in relation to the surplus GDP realised as result of the Scheme – we can draw the conclusion that the fiscal revenues would possibly cover most of the central bank's interest expense even in this extreme situation.

7. Conclusions

The FGS may be deemed efficient from its launch in June 2013 until the end of 2015. It achieved its objective, as more than 28,000 SMEs were able to access preferential forint loans or replace their earlier foreign currency loans or expensive forint loans using the Scheme. A larger part of the SMEs, mostly micro and small enterprises, would have not become borrowers without the FGS. Its estimated effect on the economy may be deemed efficient and is much larger than the costs of the Scheme. As regards its risks, there are no major threats in the FGS, the probability of credit defaults is the same as in the case of market-based SME loans. Despite the sharp decline in corporate lending, which commenced in the beginning of 2015, loans to the SME segments are on the rise, which is an outstanding result of the Scheme.

References

Balog, A.– Matolcsy, Gy. – Nagy, M. – Vonnák, B. (2014): Credit crunch in Hungary between 2009 and 2013: is the creditless period over? *Hitelintézeti Szemle* (*Financial and Economic Review*) Volume 13, Issue 4, pp. 11–34.

Balogh, Cs. –Krekó, J. – Lehmann, K. – Mátrai, R. – Pulai, Gy. – Vonnák, B. (2012): International experiences and domestic opportunities of applying unconventional monetary policy tools. *MNB Occasional Papers* 100.

Balogh, Cs. (2009): The role of MNB bills in domestic financial markets. What is the connection between the large volume of MNB bills, bank lending and demand in the government securities markets? *MNB Bulletin,* October 2009 https://www.mnb.hu/letoltes/balogh-0910.pdf. Downloaded: 1 May 2016.

Bank of England (2010): *The United Kingdom's quantitative easing policy: design, operation and impact*. http://www.bankofengland.co.uk/publications/Documents/quarterlybulletin/qb110301.pdf. Downloaded: 26 April 2016.

Bauer, P. (2016): *Macroeconomic effects of the Funding for Growth Scheme in 2013–2015*. https://www.mnb.hu/letoltes/novekedesi-hitelprogram-a-magyar-nemzeti-bank-hitelosztonzo-eszkozenek-tapasztalatai.pdf. Downloaded: 30 September 2016.

Bernanke, B. – Gertler, M. – Gilchrist, S. (1996): The Financial Accelerator and the Flight to Quality. *Review of Economics and Statistics,* Vol. 78, Issue 1, pp. 1–15.

Bihari, P. (2013): Application of non-conventional central bank instruments in Hungary and abroad – some experiences. *Hitelintézeti Szemle* (*Financial and Economic Review*) Volume VIII, Issue 3, pp. 39–61.

Bini Smaghi, L. (2009): *Conventional and unconventional monetary policy. Keynote lecture at the International Centre for Monetary and Banking Studies*. ICMB, Genova.

Claessens, S. – Kose, M. – Terrones, M. (2009): *A recovery without credit: Possible, but…* http://voxeu.org/article/creditless-recoveries-what-do-we-know. Downloaded: 28 April 2016.

Endrész, M. – Harasztosi, P. – Lieli, R.P. (2012): The Impact of the Magyar Nemzeti Bank's Funding for Growth Scheme on Firm Level Investment. *MNB Working Papers 2,* 2015/4. https://www.mnb.hu/letoltes/ehl-wp-2015-final-1.pdf. Downloaded: 20 September 2016.

Fábián, G. – Hudecz, A. – Szigel, G. (2010): Decline in corporate lending in Hungary and across the Central and East European region during the crisis. *MNB Bulletin,* October 2010 https://www.mnb.hu/letoltes/fabian-hudecz-szigel-mnbszemle-1007.pdf. Downloaded: 28 March 2016.

Hosszú, Zs. – Körmendi, Gy. – Tamási, B. – Világi, B. (2013): Impact of the credit supply on the Hungarian economy *MNB Bulletin,* Special Issue, October 2013, https://www.mnb.hu/letoltes/hosszu-1.pdf. Downloaded: 15 November 2016.

HCSO (2014): *Characteristics of the small- and medium-sized enterprises – 2014* https://www.ksh.hu/docs/hun/xftp/idoszaki/regiok/gyorkkv12.pdf. Downloaded: 16 September 2016.

Mikesy, Á. (2015): Openness of the Hungarian micro, small- and medium-sized enterprises to external funding. *Köz-Gazdaság,* Volume X, Issue 1.

MNB (2012a): *Financial Stability Report – April 2012* https://www.mnb.hu/letoltes/jelentes-penzugyi-stabilitas-201204-hu.pdf. Downloaded: 3 April 2016.

MNB (2012b): *Financial Stability Report – November 2012* https://www.mnb.hu/letoltes/jelentes-penzugyi-stabilitas-201211-hu.pdf. Downloaded: 11 April 2016.

MNB (2013a): *Trends in Lending – May 2013* https://www.mnb.hu/letoltes/hitelezesi-folyamatok-201305-hu.pdf. Downloaded: 2 April 2016.

MNB (2013b*): Trends in Lending – November 2013* https://www.mnb.hu/letoltes/hitelezesi-folyamatok-2013-nov-hun.pdf. Downloaded: 6 April 2016.

MNB (2013c): *Utilisation of the first phase of the Funding for Growth Scheme*. https://www.mnb.hu/letoltes/nhp1-elemzes-v5-clean.pdf. Downloaded: 12 April 2016.

MNB (2014a): *Funding for Growth Scheme – the first 18 months.* https://www.mnb.hu/letoltes/novekedesihitelprogramazelso18honap.pdf. Downloaded: 22 April 2016.

MNB (2014b): *Analysis of the enterprises that participated in the first phase of the Funding for Growth Scheme: Based on descriptive statistics and micro data* April 2014 https://www.mnb.hu/letoltes/a-novekedesi-hitelprogram-elso-szakaszaban-resztvevo-vallalatok-elemzese.pdf. Downloaded: 12 April 2016.

MNB (2015a): *Press release on the loans granted in the second phase of the Funding for Growth Scheme* https://www.mnb.hu/letoltes/nhp2-kihasznaltsag-20150707.pdf. Downloaded: 14 April 2016.

MNB (2016a): *Funding for Growth Scheme – Experiences of the Magyar Nemzeti Bank's lending incentive instrument* https://www.mnb.hu/letoltes/novekedesi-hitelprogram-a-magyar-nemzeti-bank-hitelosztonzo-eszkozenek-tapasztalatai.pdf. Downloaded: 30 September 2016.

MNB (2016b): *Inflation Report – September 2016* https://www.mnb.hu/letoltes/hun-ir-digitalis-verzio-kpr-tol.pdf. Downloaded: 16 November 2016.

Sóvágó, S. (2011): Identifying supply and demand in the Hungarian corporate loan market. *MNB Occasional Papers* 94.

Tamási, B. – Világi, B. (2011): Identification of credit supply shocks in a Bayesian SVAR model of the Hungarian Economy. *MNB Working Papers,* 2011/7. https://www.mnb.hu/letoltes/wp-2011-07-1.pdf. Downloaded: 05 September 2016.

Walter, Gy. (2014): *Vállalatfinanszírozás a gyakorlatban (Corporate finance in practice).* Alinea könyvkiadó, Budapest.

The insurance sector at a milestone: positive initial experiences with the newly introduced Solvency II system

Zsuzsanna Bora – Norbert Holczinger – Koppány Nagy – Gabriella Merész

Indisputably, the most important event of the year on the European insurance market was the transition to the so-called Solvency II (S2) regime, which laid down the new risk-based own funds requirement. In our study, we assess the first Hungarian results based on the "Day 1" S2 submissions, the MNB's first S2-based risk assessment and the EIOPA[1] stress test examining the impact of the persistently low yield environment on capital adequacy. The first experiences of the new regime are positive. The sector-level 204 per cent capital adequacy is reassuring overall. Within this, the capitalisation of 20 out of the 28 insurers is above the 150 per cent stipulated in the MNB's recommendation on the volatility capital buffer. In 2016, the MNB introduced a new risk assessment approach based on S2 and business models, and according to that, the overall risk level of the sector is moderate, but the challenges include the low yield environment from the perspective of profitability, the level of digitalisation among operational risks as well as the adjustment to the MTPL and the life insurance market situation with regard to insurance risks. The moderate risk rating with respect to capital risk is borne out by the results of the EIOPA stress test: the persistently low yield environment has no substantial impact on capital adequacy at the sector level, however, when it is coupled with a market shock, some market participants may experience difficulties.

Journal of Economic Literature (JEL) codes: G22, G29, G32

Key words: Solvency II, stress test, capital adequacy, own funds, capital requirement, risk assessment

1. Introduction

The Solvency II (S2) insurance regulation introduced on 1 January 2016 brought about several qualitative and quantitative changes as compared to the previous Solvency I (S1) system, and was the most momentous event for the insurance

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The manuscript was received on 4 October 2016.

[1] European Insurance and Occupational Pensions Authority.

sector all across Europe. Within the quantitative elements, the key difference is the valuation of assets and liabilities on an economic basis, and the risk-based calculation of the capital requirement instead of the earlier, factor-based model using technical provisions, exposure, claim and the insurance premium. The introduction of S2 led to substantial changes not only for insurers but also from the perspective of regulatory and supervisory practice. On account of the special topicality of the issue, it is crucial to summarise the experiences in connection with the insurance sector's transition based on the "Day 1" S2 reports for 1 January 2016 received in May 2016 and the audit report verifying their accuracy, the Q1 submissions also received in May 2016 and the risk assessment based on those, as well as the results of the stress test carried out by the European Insurance and Occupational Pensions Authority (*EIOPA*) examining the impact of the persistently low yield environment and other market shocks.

The establishment of the new system was a long process: the European Commission launched a review of the insurance sector's regulation within the framework of the S2 project in April 2001. The aim of the initiative was to expand of the European Union's insurance market, give priority to the protection of clients' interests, boost the competitiveness of European insurers and standardise the supervision of the insurance sector. In addition to these goals, the harmonisation with the whole financial sector was also an important aspect during the development of the S2 system, and therefore the new regime was sought to be aligned with the rules applied in the field of banking. As a result, similar to the Basel II system, the S2 rests on three pillars: the calculation methodology of the own funds requirement and the technical provisions (*Pillar 1*), the quality requirements with respect to corporate governance practices and the capital add-on that may be imposed by the supervisory authority (*Pillar 2*), and supervisory reporting and disclosure (*Pillar 3*). Similar to banking practices, the S2 system is based on risk management, risk-based requirements and the relationship between risk exposure and solvency requirements.

The S2 Directive (*2009/138/EC*) was adopted by the European Parliament on 25 November 2009 and was to be implemented by the Member States by 1 January 2016. Transposition of the EU regulation affected the Hungarian regulation at several points (*Szedlák 2015*). After the approval of the directive, long negotiations were conducted between the panel of experts of the European Parliament, the European Council and the European Commission with respect to the S2 valuation of the technical provisions for insurance products containing long-term guarantees, and therefore adoption of the second-level regulation was postponed until 2014. The transitional period until the actual implementation of the S2 Directive provided an opportunity to insurers for preparing for the qualitative and quantitative requirements stipulated in the directive (*Haraszti 2015*) and to national authorities

for the modification of the regulatory practices. To facilitate the preparation and harmonisation of the individual Member States' regulatory work, EIOPA issued guidelines for the transitional period (2014 and 2015) in four topics.

In order to meet EIOPA's requirements, the Magyar Nemzeti Bank (*MNB*) implemented all four preparatory guidelines. The MNB transposed the guidelines on corporate governance, the pre-application of internal models and the forward-looking assessment of insurers' own risks in the form of recommendations, and it informed insurers regarding the submission of the information set forth in EIOPA's transitional measure "Guidelines on Submission of Information to National Competent Authorities" via several channels. The MNB held a market consultation in December 2014 and requested Hungarian insurance market participants in an executive letter to familiarise themselves in the preparatory period with the practices of reporting standardised at the European Union level and in force under S2 as well as with the information to be submitted.

In addition to the above, in the spirit of the proactive supervisory approach, the MNB prepared regular Quantitative Impact Studies (*QIS*) with the voluntary participation of the insurers, thereby assisting the Pillar 1 preparation. The primary objective of the impact studies was to assess the quantitative impact of the transition to Solvency II, i.e. the effect on technical provisions and the capital position, at the institutional and sector level, and at the same time it provided insurers an opportunity to gain a deeper insight into the S2 methodology. The latter was facilitated by the question–answer process during the QISs, where the MNB clarified the issues that were raised, as well as by the market notices containing the sector-level results of the impact studies. In the last two years, the MNB also published the results in the industry journal "*Biztosítás és Kockázat"* (Insurance and Risk). The preparatory guideline on the submission of the above-mentioned information enabled the most recent of the ten quantitative impact studies carried out since 2006, i.e. the one for the end of 2014, to be based on the new reporting tables in effect from 1 January 2016 (*Bora et al. 2015, 2016; PSZÁF 2011, 2012, 2013*).

Similar to the impact studies, Pillar 1 preparation was also supported by the fact that the MNB conducted pre-application surveys among the insurers that wished to use an internal model. In addition to the individual, institution-level surveys, the MNB also took part in group-level pre-application assessments and gained valuable information on the preparedness of the groups. The surveys involved several institutions, but in the end only one of them is expected to submit an application for an internal model in 2017.

In order to support Pillar 2 preparation, in addition to presenting its expectations at prudential discussions, the MNB prepared a qualitative impact study in 2014,

in which it assessed in a comprehensive questionnaire the measures insurers had taken in order to prepare for the corporate governance requirements of the S2 system. In addition to the survey, the MNB processed the results of the forward-looking assessment of Hungarian insurers' own risks (based on the ORSA principles) (hereinafter: FLAOR report) based on Annex 1 of MNB Recommendation 6/2014. The institutions were informed about the results and the identified shortcomings in an executive letter, and about the sector-level experiences at professional events. Moreover, based on the processed results, the MNB supplemented its relevant recommendation.[2]

Our study presents the lessons learnt from S2 effective from 1 January 2016, the period since then and the transition from the S1 system. The analyses cover the entire Hungarian insurance market, since all insurers supervised by the MNB are subject to S2, with the exception of small associations.[3] In Section 2, we present a detailed overview of the results of the "Day 1" S2 submissions for 1 January 2016 with respect to technical provisions, capital requirements and capitalisation. In Section 3, we present the experiences of the 2016 Q1 sector-level risk assessment, the first that was based on the S2 principles, and finally in Section 4 we discuss the results of the EIOPA stress test examining the impact of the low yield environment and market shocks.

2. Based on the first successful S2 reports, the capital adequacy of the insurance sector is reassuring

The "Day 1" S2 reporting obligation for 1 January 2016 regulated uniformly at the European Union level was fulfilled by all Hungarian institutions subject to S2 with the exception of one insurer by the 20 May 2016 deadline, in line with the legal obligation stipulated in Commission Delegated Regulation (*EU*) 2015/35. The reporting package for 2016 Q1 was received on 26 May 2016. The "Day 1" S2 submissions covered less than the annual submissions, as they focused on data on the balance sheet and capital requirements. Within the framework of the 2016 Q1 submissions, in addition to the S2 international reporting tables, the national reporting tables stipulated in *MNB Decree 48/2015* (*8 December*) amended in view of the S2 system were also submitted.

During the assessment of the submitted information with respect to data quality considerations, several issues were raised, mainly about stock data, technical provisions and the revaluation of balance sheet items for S2. After remedying the shortcomings which were detected, Hungarian insurers fulfilled their reporting

[2] Magyar Nemzeti Bank Recommendation 3/2016 (6 June) on the own risk and own funds assessment system
[3] The weight of small insurance associations is insignificant, they generated merely 0.04 per cent of the sector-level premium income in 2014, the most recent year for which data are available (*MNB 2016b*).

obligation to EIOPA, faring exceptionally well in European comparison, without major validation errors and with 100 per cent coverage.

In addition to the MNB's data quality control, another check was performed. This is because in view of the data quality risks inherent in the new S2 reporting system, the MNB requested insurers in an executive letter in December 2015 to perform an audit control of the S2 "Day 1" submissions. Based on the recommendations made by the auditor, several institutions submitted modified S2 "Day 1" information. The findings typically involved methodological shortcomings with regard to the valuation of balance sheet items and provisioning, application of the so-called look-through approach, documentation and control functions. In the case of several insurers, the methodological adjustments resulted in less own funds and higher solvency capital requirements, however, with the exception of one insurer, the capitalisation of the institutions did not drop below the statutory limit after the adjustments.

In S2 terms, the sector-level capitalisation for 1 January 2016 is 204 per cent, which is consistent with the 218 per cent in the most recent impact study concerning the end of 2014[4] (*Bora et al. 2016, p. 32*). Despite the high sector-level capitalisation, the capitalisation of individual institutions varies widely. In both instances, the S2 capital requirement doubled compared to the S1 value as a result of the risk-based assessment of the solvency capital requirement, and own funds increased by more than 100 per cent on account of the economic revaluation. Based on the results, *the transition to the new system was in line with expectations.*

2.1. Assets, liabilities

On 1 January 2016, the assets valued in line with S2 amounted to HUF 2,566 billion, which was 4 per cent more than the S1 asset value, due to the differences in the valuation principles and the items that can be included on the balance sheet. When comparing the S2 value for 1 January 2016 to the asset value for the end of 2014, we see a 2 per cent increase, which can be attributed to the growing portfolio, the rise in the value of government securities on account of the continued fall in yields, and the 2015 stock market rally. Thus, we can say that insurers' smooth transition to the S2 system was also assisted by the favourable economic and yield environment in early 2016.

On 1 January 2016, sector-level liabilities in the S2 system amounted to HUF 2,081 billion (*Table 1*), which was lower than the S1 value by almost 16 per cent, due, *inter alia*, to the inclusion of future profits and the discounting of non-life insurance technical provisions.

[4] The impact study at the end of 2014 was prepared based on the data from the 29 insurers subject to S2, and the present article discusses the data from the 28 institutions on 1 January 2016.

Table 1
Revaluation of the balance sheet in Solvency I and Solvency II
HUF million

	Solvency I		Solvency II	
	31 Dec. 2014	1 Jan. 2016	31 Dec. 2014	1 Jan. 2016
Assets	2,398,141	2,465,976	2,510,370	2,566,183
Liabilities	2,398,141	2,465,976	2,029,433	2,080,794

Source: MNB data reporting.

2.2. Technical provisions

On 1 January 2016, aggregate sector-level S2 technical provisions[5] were close to HUF 1,900 billion, which was 4 per cent higher than at the end of 2014 (*Table 2*). Technical provisions increased due to the combined effect of several factors, which are presented in detail below.

S2 technical provisions in the *life segment* were close to HUF 1,700 billion, more than half of which were made up of unit-linked life insurance technical provisions. Life insurance technical provisions linked to non-unit-linked and non-health insurance products have remained practically stable since late 2014 (–1 per cent), but the *technical provisions of health insurance that is pursued on a similar technical basis to that of life insurance business* (*SLT*)[6] have nosedived to HUF –2.6 billion, which was caused by the expected future profits of health insurances. The change in the (SLT) health insurance technical provisions is a result of the expansion of the health insurance portfolio and the increased accuracy of the models, since several insurers started to separate similar technical basis to life insurance, long-term supplementary health insurances with huge future profits from life insurance policies. Out of the 28 insurers, 10 institutions have (SLT) health insurance technical provisions, the largest of which amounts to HUF 580 million. Three insurers have an especially large profitable health insurance portfolio, and in their case the (SLT) health insurance technical provisions amount to HUF –4.7 billion overall. As under S2 the annuity stemming from liability insurance established in line with the life insurance principle and health insurance obligations have to be recorded among life insurance technical provisions, four non-life insurers reported life insurance obligations. Insurers calculate non-unit-linked life insurance technical provisions as the sum of the risk margin and the best estimate.

[5] Technical provisions equal the present value of the sum of future cash flows (incoming and outgoing) plus the risk margin.

[6] Pursuant to Article 55(*2*) of Commission Delegated Regulation (EU) 2015/35 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (*Solvency II*), the assignment of an insurance obligation to a line of business reflects the nature of the risks relating to the obligation. Pursuant to Article 55(*3*), obligations of health insurance pursued on a similar technical basis to that of life insurance should be assigned to the lines of business for life insurance and obligations of health insurance pursued on a similar technical basis to that of non-life insurance should be assigned to the lines of business for non-life insurance.

Table 2
Changes in technical provisions
HUF million

	Solvency I		Solvency II	
	31 Dec. 2014	1 Jan. 2016	31 Dec. 2014	1 Jan. 2016
Life insurance technical provisions (without UL)	603,434*	606,763*	664,621	657,109
(SLT) health insurance technical provisions	–	–	482	–2,640
Unit-linked technical provisions (UL)	1,023,815	1,073,362	941,044	996,105
Non-life insurance technical provisions	429,725	443,795	214,259	242,331
Non-life health insurance technical provisions	–	–	3,193	6,780
Total	2,112,829	2,178,475	1,823,599	1,899,686

**Mathematical reserve.*
Source: MNB data reporting.

The drop in SLT health insurance and non-unit-linked life insurance technical provisions was more than offset by the 6 per cent rise in *unit-linked technical provisions.* The increase is consistent with the 5 per cent expansion of unit-linked technical provisions as calculated in S1. Two insurers continued to calculate a portion of their unit-linked technical provisions using a replicating portfolio as a whole, which amounted to approximately 10 per cent of the sector-level unit-linked technical provisions.

The S2 value of *non-life insurance technical provisions* increased more than life insurance technical provisions (by 15 per cent compared to the end of 2014); therefore their volume exceeded HUF 249 billion on 1 January 2016. *The technical provisions of health insurances that is pursued on a similar technical basis to that of non-life insurance business (NSLT)* more than doubled, but they still represent a small share of all non-life insurance technical provisions. One-third of the NSLT health insurance technical provisions amounting to more than HUF 6.7 billion are held by one insurer, which can be attributed to the MTPL technical provisions. Due to the technical provisions maintained for income insurance risk, another 46 per cent of the NSLT health insurance technical provisions are kept by two insurers. Non-life insurance technical provisions other than health insurance technical provisions increased by 13 per cent as compared to the end of 2014.

In addition to the above-mentioned discounting and the inclusion of future profits, the other important reason behind the difference between the life and non-life insurance technical provisions as calculated in S1 and S2 is the assignment of

obligations to lines of business and the resulting realignment, since that has to reflect the underlying risks linked to obligations under the new regime.

2.3. Solvency c apital requirement and minimum capital requirement

The S2 sector-level capital requirement remained practically stable as compared to the end of 2014, increasing by merely HUF 1.7 billion by early 2016 (Table 3), but there is large dispersion between institutions as regards the difference. More than 10 per cent change in the solvency capital requirement can be observed in the case of 13 out of the 28 insurers. As a result of the risk-based capital requirement calculation in line with S2, the capital requirement for 1 January 2016 exceeds the S1 value by roughly 90 per cent.

Table 3
The distribution of the capital requirement among the individual risk modules
HUF million

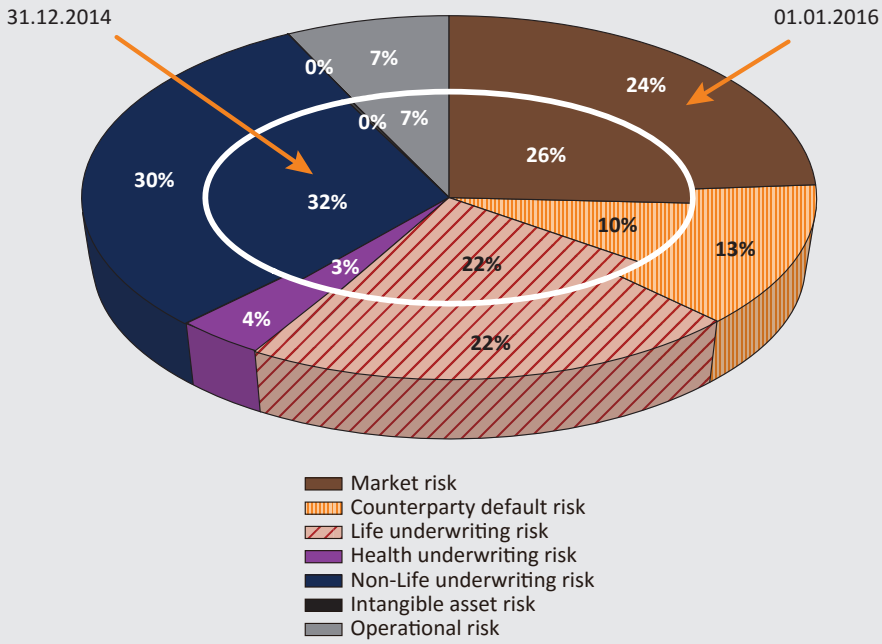
	31 Dec. 2014	1 Jan. 2016
Market risk	88,034	85,674
Counterparty default risk	35,416	47,742
Life insurance risk	76,188	78,163
Health insurance risk	11,064	15,029
Non-life insurance risk	111,391	106,433
Intangible asset risk	257	432
Operational risk	24,995	24,909
Diversification	–94,356	–96,876
Adjustments	–42,620	–49,343
Solvency capital requirement	212,860	214,507

Source: MNB data reporting.

The distribution of the solvency capital requirement between risks[7] in early 2016 did not change significantly as compared to the end of 2014 (it changed by over 3 per cent, see *Figure 1).* Based on the solvency capital requirement by risks, the most important are still the non-life insurance, market and life insurance risk modules. In the previous year, the proportion of the capital requirement of life and non-life insurance risks[8] decreased in favour of health insurance, which can be primarily attributed to the separation of supplementary insurances from the main insurance by underlying risks. The rise in the proportion of the capital requirement for counterparty default risk within the undiversified capital requirement by 1 January 2016 (13 per cent) is also worth noting. This increase is chiefly the result of the risk that emerged in the case of five insurers.

[7] The "Day 1" Solvency II information submitted for 1 January 2016 is less detailed than the future regular, annual submissions, and therefore the distribution of the solvency capital requirement is only known for the main risk modules.
[8] Compared to the undiversified capital requirement.

Figure 1
Distribution of the sector-level capital requirement



Source: MNB data reporting.

Two out of the 28 insurers have a *capital requirement for intangible asset risk* for 1 January 2016, while at the end of 2014 only one insurer reported this. Out of the adjustment factors, the *loss-absorbing capacity of technical provisions* increased by 2.5 times by 1 January 2016 as compared to the end of 2014, and 80 per cent of this change could be attributed to three insurers. The adjustment due to the loss-absorbing capacity of technical provisions was included in the calculations of 12 institutions in early 2016 as compared to 7 one year earlier. In Hungary, the adjustment due to the loss-absorbing capacity of technical provisions should be included in the calculations of insurers that offer with-profits policies; however, there is no standardised practice for the interpretation of the corresponding future discretionary profit-sharing, and thus there are still life or composite insurers that did not record such an adjustment. The loss-absorbing capacity of deferred taxes did not change materially (–2 per cent), *adjustments due to deferred taxes* were reported by 23 institutions, two more than at the end of 2014.

According to the information submitted for 1 January 2016, the capital requirement calculated with the standard formula was lower in the case of seven institutions than the minimum capital requirement calculated with the linear formula, and in their case the minimum capital requirement is determined by the legally stipulated

absolute lower limit. At the end of 2014, in addition to the above-mentioned seven insurers, one more institution's capital requirement was determined by the minimum capital requirement calculated with the linear formula, but its capital requirement calculated for 1 January 2016 with the standard formula exceeds the minimum capital requirement. The corresponding absolute lower limit in S1 was the minimum guarantee fund, which determined the capital requirement of 15 institutions according to the S1 values for the end of 2015.

Hungarian innovation – the MNB's recommendation on the volatility capital buffer

The S2 system differs from the earlier S1 regime in terms of both quality and quantity. Out of the quantitative elements, the key difference is the transition to the *risk-based calculation of the solvency capital requirement, and the introduction of the valuation based on economic principles* in the case of assets and liabilities. During economic valuation, the value of assets has to match the market price, while liabilities (in absence of a market price) have to match a modelled value, using information from the financial markets. The solvency capital requirement in S2 has to be determined as the economic capital of the insurer that guarantees that it can meet the obligations to policyholders and beneficiaries over the following 12 months with a 99.5 per cent probability (*Govt. Decree, Article 26*). The new system introduces the concept of minimum capital requirement, which sets a level under which policyholders and beneficiaries would be exposed to unacceptable levels of risk during the pursuit of insurance activities. The Hungarian regulation (*Insurance Act, Articles 99 and 101*), in line with European requirements, prescribes continuous compliance in the case of both the solvency capital requirement and the minimum capital requirement, i.e. insurers need to have the capital for meeting the capital requirements.

Since insurers must determine compliance with the solvency capital requirement annually, and the amount of own capital and compliance with the minimum capital requirement quarterly *(Govt. Decree, Articles 27 and 54*), in the interim period a capital shortfall may emerge. In order to ensure continuous compliance with the capital requirement, the expectation that insurers should hold capital in excess of the capital requirements is warranted.

The MNB first mentioned the necessity of holding capital in excess of the capital requirement at the November 2014 conference of the MABISZ (Association of Hungarian Insurance Companies): the MNB argued that insurers' capital position in the S2 was expected to be more volatile than before, which could be managed by holding a so-called *volatility capital buffer*. The volatility of insurers' capitalisation mentioned at the conference

was attested by the results of the quantitative impact studies (*Bora et al. 2015, 2016; Lencsés 2015; MNB 2016a*). In his study published in 2016, *Zoltán Zubor* (*2016*) presented a method for determining the size of the volatility capital buffer. In the article, the author derived the capital to be held in excess of the capital requirement from the solvency capital requirement. In his approach, when determining the volatility capital buffer, we have to find the quantile pertaining to the confidence level of the same probabilistic variable the 99.5 per cent quantile of which is the solvency capital requirement, therefore the size of the volatility capital buffer is proportionate to the solvency capital requirement. The amount of the capital held in excess of the capital requirement is influenced, *inter alia*, by the probability distribution of the unexpected losses and the given confidence level. The author determined the potential size of the volatility capital buffer by assuming well-known distributions. By assuming a normal distribution of unexpected losses, the proportion of the volatility capital buffer relative to the solvency capital requirement is 49.8 per cent with the 90 per cent quantile.

In its recommendation No. 6/2016 (14 June) on holding the volatility capital buffer ensuring continuous capital adequacy, the MNB requires insurers to determine the size of the volatility capital buffer in a way that it guarantees, with at least 90 per cent probability, that insurers' capital adequacy does not drop below 100 per cent over a one-year horizon. The MNB expects insurers to be able to prove that they meet the above-mentioned expectation when determining the capital to be held in excess of the statutory limit. If insurers are unable or unwilling to prove that they meet the above-mentioned expectation, the MNB recommends that the *size of the volatility capital* buffer held by the insurer be *50 per cent* of the last reported *solvency capital requirement*. During the drafting of the recommendation aimed at managing capital adequacy risk, which can be deemed ground-breaking at the European level, the MNB considered the above-mentioned mathematical approach, as well as the experiences of the quantitative impact studies, the values of the capital adequacy indicators targeted by the institutions and recorded in the FLAOR reports, and the comments received during the professional consultation.

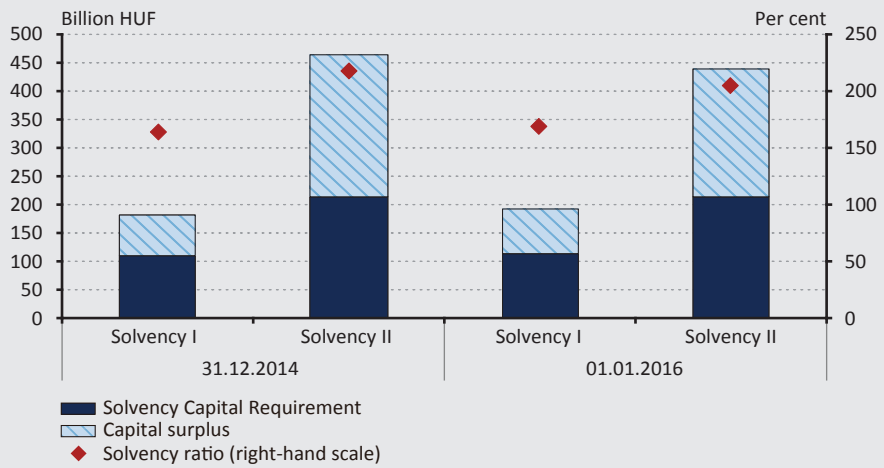
2.4. Capital adequacy

The *sector-level solvency ratio* in S2 for 1 January 2016 is *204 per cent*, which dropped from the 218 per cent at the end of 2014 on account of a 5.5 per cent decrease in own funds and the practically unchanged capital requirement. The proportion of institutions with capitalisation of above 150 per cent is basically the same in the impact studies for the end of 2013 and 2014 and in the "Day 1" S2 submissions for 1 January 2016 (70 per cent); however, the capital level of

the individual institutions fluctuates over the years. The change in own funds as compared to the end of 2014 varies widely in the sector, we can observe an 80 per cent drop as well as a rise of over 400 per cent.

As, due to the future expectations that are taken into consideration during the assessment of the economic environment and the liabilities, the valuation methodology in S2 entails the risk of larger short-term fluctuations in own funds and the capital requirement, the MNB issued its Recommendation No. 6/2016 (14 June) on stabilising the prudential level of capitalisation. *The 150 per cent capital level* required in the recommendation on holding the volatility capital buffer ensuring continuous capital adequacy *enables insurers' own funds to continuously exceed the capital requirement.*

Figure 2
Sector-level solvency ratio in Solvency I and II



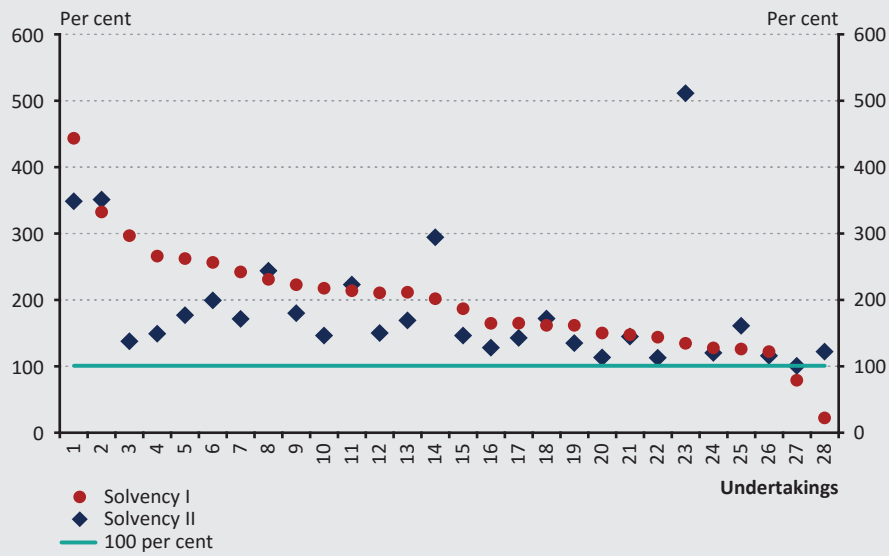
Source: MNB data reporting.

The solvency ratio of 20 out of the 28 institutions subject to S2 exceeds the 150 per cent value in the recommendation, and the solvency ratio of six insurers is between 120 per cent and 150 per cent. The solvency ratio of two institutions remains under 100 per cent: in both cases, the capital adequacy was already low in the S1 system, and it decreased further due to the expected losses, and in one case the capital requirement also rose drastically on account of the risk-based calculation.

If the capital level of the sector is compared in the two systems, the S1 sector-level capitalisation for the end of 2015 was 169 per cent (just as at the end of 2014), which is well below the 204 per cent in S2 (*Figure 2*). The difference is due to the rise in the capital requirement (89 per cent) and in own funds (129 per cent). The

S1 solvency ratio remains below the prudential level of 120 per cent in the case of four insurers, and one institution's capital level is 120 per cent. With respect to the solvency ratio, the standard deviation among institutions is huge in Solvency I as well, the largest value being 510 per cent[9] and the smallest being 101 per cent (*Figure 3*).

Figure 3
Solvency ratio by institutions in Solvency I and Solvency II on 1 January 2016



Source: MNB data reporting.

3. The MNB introduced a new risk assessment approach based on S2 and business models in 2016

In its 2014 supervisory strategy and at the MABISZ conference held that year, the MNB announced that it aimed to revise its risk-based methodology with an approach that focused on S2 and business models (*MNB 2014a; Lencsés 2015*), which was successfully introduced in 2016. The goal of business model analysis is to identify the factors that determine the sustainability of insurers' business models and to gain deeper insight into these factors, thereby creating a supervisory programme tailored to the unique features of the individual institutions (*Dénes et al. 2014*). The core of the new risk assessment methodology is the risk menu that contains all the identified risk categories and risk segments. In developing the

[9] On account of the S2 valuation, the insurer undertook a capital increase amounting to HUF 4 billion in 2015 Q4.

new risk menu, the MNB utilised the experiences in EIOPA's SRP[10] working group focusing on supervisory methodologies, as well as the EIOPA SRP handbook still in production that summarises good and desired practices.

The risk menu included a new category, the business model, which integrated previously existing risk groups (such as profitability or environmental risk), and was supplemented with new risk segments (such as the viability of the business model or vulnerabilities). Another vital innovation is that the classification in the category of financial and operational risks follows the structure of the risk modules of the standard formula for calculating the solvency capital requirement, thereby ensuring consistency between the methodology and the submissions. Within corporate governance, risk management, own risk and solvency assessment (ORSA) and the internal control system are separate risk groups, and the latter covers the assessment of the key functions (risk management, actuarial function, compliance, internal audit).

The first risk assessment with the new methodology was performed for 2016 Q1, and it was based on the "Day 1" S2 data submission for 1 January 2016 and the Q1 data submission. The reports for 2015 were received in parallel with the "Day 1" data submission, while during the Q1 data submission, market participants had to submit the S2 data tables as well as the so-called national tables. There is no uniform, EU-level regulation for filling out the latter, and therefore national supervisors (such as the MNB) may require the submission of these data in line with local market characteristics at their own discretion.

According to the quantitative and qualitative assessment performed based on the new methodology, the sector-level risks of insurers decline in the moderate and significant categories, typically with a stagnant or growing outlook. The sector-level risk map (*Table 4*) was also updated with respect to its content, in line with the new risk menu.

[10] Supervisory Review Process.

Table 4
Risk map of the insurance sector

Risk category	Risk groups	Risk rating	Outlook	Written assessment of risks
Business model	Environment Strategy, business plans Profitability			Overall, insurers' profitability is sound (quarterly ROE: 7.8 per cent). In the case of loss-making institutions, we can mainly identify problems with the business model and economies of scale. One of the vulnerabilities is the lopsided marketing mix (e.g. the absence or the exclusive dominance of the banking channel). In the future, profitability risks may arise in the life insurance segment due to the disappearance of lapse profits, and in the MTPL segment due to the high claim ratio in parallel with the effect of the low yield environment filtering through to the yields on technical provisions.
Corporate governance	Exercising ownership rights Internal governance Risk assessment system and ORSA Internal control system			Governance and ownership control are appropriate. Overall, the regulation and operation of internal control systems is appropriate. Insurers apply the S2 corporate governance rules. The risk level dropped from significant to moderate, owing to the transposition of the S2 Directive in 2015 with the assistance of the MNB, the preparatory recommendations and the early preparation that was launched in connection with these.
Financial and operational risks	Insurance risk Market risk Credit risk Operational risk Other relevant risks			In the life segment, the low yield environment represents a risk from the perspective of generating the guaranteed interest. In the non-life segment, MTPL claim ratios are high. With respect to operational risks, most of the shortcomings are in accounting, due to the IT systems.
Capital and reserve risk	Capital Reserves			The transition to S2 meant a positive shift for one-third of the sector with respect to solvency ratio. Sector-level solvency ratio is 204 per cent. The capital adequacy of 20 institutions is above 150 per cent. On account of the S2 rules' characteristics, volatility is expected to increase, which warrants the holding of a volatility capital buffer.
Market presence risk	Products Clients			Consumer protection penalties were imposed on several institutions for inadequate complaint handling, information provision and secrecy practices. Currently, the lifecycle of life insurance products is short, which suggests an unfavourable cost structure and low client confidence. As a result of the MNB's ethical life insurance concept and the increasing popularity of pension insurance products driven by the recommendation, this period is expected to lengthen.
Degree of risk				
				
high	significant	moderate	low	
Risk outlook				
				

Source: MNB.

With respect to sector-level risk assessment, it should be noted that the *risk rating of corporate governance has changed from significant to moderate* (with a stagnant outlook), which was facilitated by the transposition of the S2 (*2009/138/EC*) Directive's requirements concerning corporate governance in 2015 with the MNB's assistance, the preparatory recommendations and the early preparation that was launched in connection with these. In the new system, *market presence* risk received a *moderate* rating with a stagnant outlook. Financial and operational risks are still rated as *significant* with a stagnant outlook, due to the low yield environment and the risks identified in connection with the operation of IT systems, especially the lack of digitalisation and the often obsolete record-keeping systems, and these risks are not expected to diminish over the short term. In the business model risk category, the vulnerability is the lopsided marketing mix, and its risk rating is moderate with an increasing outlook. The deteriorating outlook is primarily justified by factors jeopardising the currently favourable profitability, e.g. the low yield environment and the risks surrounding the efficiency of the MTPL segment. The combined risk rating of *capital and reserve risk* is still *moderate*. The transition to S2 brought about positive changes for one third of the institutions, presenting serious problems for only one insurer. However, owing to the early intervention by the MNB and the size of the institution, this issue has no effect on the whole sector. In the category of capital and reserve risk, risks are expected to heighten, due to the volatility caused by the S2 system.

The MNB performs risk assessment not only at the sector level but also for individual institutions. This risk-based methodology is centred on the impact rating of the institutions. The individual institutions or groups of institutions are divided into different categories based on their impact on the financial system. The rating uses several quantitative categories (premium income, technical provisions, number of policies. etc.), and it differentiates between institutions with *strong, above medium, below medium* and *weak* impact (*MNB 2015, 2016*). The impact rating determines which risk is assessed to what depth by the MNB (*Table 5*).

Table 5
Place of institutions in the impact–probability matrix

		PROBABILITY				
		Low	Moderate	Significant	High	Total
IMPACT RATING	Strong impact		3	4		7
	Above medium impact		5	5	3	13
	Below medium impact		6	2		8
	Total		14	11	3	28

Source: MNB.

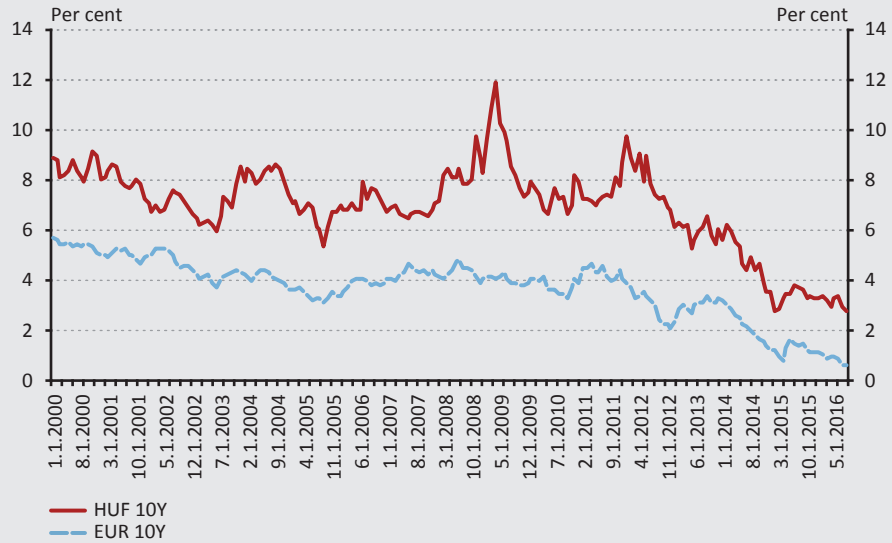
Based on the risk assessment of the institutions, *3* insurers received *high*, *11* received *significant*, and *14* received *moderate* risk rating. The high rating was caused by the rating of the capital and financial and operational risks. Overall, institutions can be said to face significant financial and operational risks due to the factors described in the section on sector-level rating. Although there is no low rating in the aggregate assessment of the institutions, it should be noted that several institutions received a low rating in the individual risk categories (typically in the case of capital and reserve risk).

According to the new methodology, the sectors' risks are *moderate*, while overall the financial and operational risks are *significant*, principally due to the functioning of the IT systems, and, in the case of insurance and market risks, the negative effects of the low yield environment.

4. The persistent low yield environment does not entail a systemic capital adequacy risk, but when combined with a market shock, it may cause stress for some undertakings

Government bonds yields started to fall in 2011 in the euro area, and in 2012 in Hungary (*Figure 4*), and as a result by 2016 yields had reached a historic low (*ECB 2015; Felcser et al. 2015*).

Figure 4
Developments in the benchmark rate of the 10-year government securities in Hungary and the euro area



Source: ÁKK (Government Debt Management Agency), ECB.

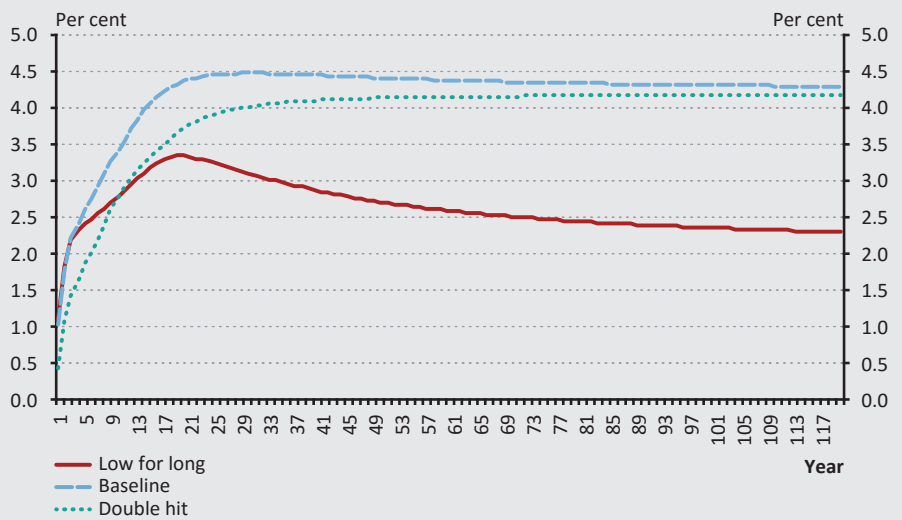
The impact of the low yield environment on the insurance sector was already examined by EIOPA Stress test 2014 (*ST2014*). In the survey that was based on end-2013 data, an individual entity level quantitative analysis had to be carried out on the national insurance markets, to establish how much the different low yield curves influenced the S2 financial position and the investment policy of the insurers, as well as their strategy regarding the range of life insurance products. The EU-level results showed that if yields remained persistently low, 24 per cent of the participating insurers would not comply with the S2 capital requirements (*EIOPA 2014*). In the Hungarian insurance sector, the survey indicated a more subdued impact than the European average (*MNB 2014b*).

In view of the drop in yields since the ST2014, it is not surprising that in its 2016 stress test (*ST2016*) EIOPA focused on examining the effects of the low yield environment. This is especially true considering that in its December 2015 Stability Report, EIOPA cited the low yield environment and the resulting reinvestment risk as the greatest risks faced by the insurance sector (*EIOPA 2015*).

In the ST2016, the effects of the persistent low yield environment (*"low-for-long"*) and the low yields combined with a market stress (*"double-hit"*), which were also part of the previous stress test, are compared to the baseline scenario, i.e. the values presented in the "Day 1" Solvency II submissions for 1 January 2016. In the

case of the *"low-for-long" scenario*, the yield curve used in the calculations had to include yields on its short- and medium-term section (1–5 years) that basically equalled the risk-free yield at the end of 2015, yet the long end of the yield curve converged towards 2.3 per cent compared to the 4.2 per cent in the baseline scenario. The *"double-hit" scenario* was prepared by the European Systemic Risk Board (*ESRB*) at the request of EIOPA. The term "double-hit" refers to the shock affecting both sides of insurers' balance sheet, in a way that the drop in the value of the assets side is coupled with a rise in the value of the liabilities. Accordingly, it was assumed during the calibration that due to the increase in risk spread, the expected yields of both government bonds and corporate bonds would rise, leading to a fall in the value of insurers' bond investments. Another assumption was that the impact of the bond market turbulence described above would feed through to other asset markets, and thus the price of stocks, properties and commodities would fall, and swap yields would drop (*ESRB 2016; EIOPA 2016a*). In most European countries, EIOPA derives the risk-free interest rate (RFR) used for calculating the technical provisions from the swap yields, and therefore a drop in the latter entails a decrease in the RFR as well (EIOPA 2016b). In the countries where the RFR is determined based on government bond yields (thus, *inter alia*, in Hungary), a drop in the RFR was also assumed in the *"double-hit"* scenario (*Figure 5*), which, even when only taking into account discounting, leads to an increase in technical provisions and thus the value of liabilities.

Figure 5
Risk-free yield curve and yield curves after a shock



Source: EIOPA.

It must be noted that the ST2016 only examined the impact of the individual scenarios on the balance sheet, i.e. own funds, and EIOPA did not expect the recalculation of capital requirements (minimum capital requirement, solvency capital requirement). However, the expected cash flows had to be included in the case of both the baseline and the stress scenarios.

During the ST2016, EIOPA mainly wished to analyse the effect of the shocks on institutions that have a portfolio with a guaranteed yield, i.e. traditional savings-type life insurance policies. Therefore, the ST2016 had to be performed at the institution level[11] for all scenarios, ensuring that market coverage was at least 75 per cent[12] in each Member State relative to the gross non-unit-linked life insurance technical provisions. Another requirement was that participants had to represent the national insurance market, and that the sample should include the institutions most exposed to the low yield environment. Accordingly, the MNB requested 11 insurers to take part in the stress test on a voluntary basis, and 10 of them prepared the study. The participating Hungarian institutions hold 87 per cent of the non-unit-linked technical provisions for 1 January 2016 in Solvency II terms. Although the final figures are not known yet, according to preliminary data, coverage is above the European average (77 per cent). We will now present the preliminary Hungarian ST2016 results that have passed the national and the first-round central validation. EIOPA is expected to publish the final, EU-level results in December 2016.

4.1. The impact of the persistently low yield environment is moderate

According to the "Day 1" submissions, the capital adequacy of the 10 institutions taking part in the ST2016 was 212 per cent, and we present the impact of the stresses compared to this. The persistently low yield environment continues to have a moderate effect on participants' capital position, whereas the "double-hit" scenario causes a substantial, 13 per cent decrease in aggregate capitalisation (*Table 6*). In addition, in the latter scenario, the capital adequacy of one institution drops below 100 per cent.

[11] During the ST2014, only the parent companies in an insurance group were expected to fill out the "double-hit" scenario, and therefore Hungarian insurers took part in the survey only indirectly.
[12] The minimum coverage expected during the ST2014 was 50 per cent.

Table 6
Impact of stresses on Hungarian insurers
HUF million

	Baseline	Double-hit	Low yield environment	Δ (DH; Baseline)	Δ (LY; Baseline)
Assets	2,065,115	1,917,106	2,084,184	–7%	1%
Liabilities	1,672,650	1,575,846	1,697,369	–6%	1%
Of this: Technical provisions	1,534,778	1,447,374	1,560,729	–6%	2%
Non-life insurance technical provisions	200,406	198,960	205,676	–1%	3%
Life insurance technical provisions	571,999	564,093	590,555	–1%	3%
Unit-linked technical provisions	762,373	684,321	764,498	–10%	0%
Own funds	348,289	301,965	339,461	–13%	–3%
Solvency capital requirement	164,461	164,461	164,461	0%	0%
Solvency ratio	212%	184%	206%	–13%	–3%

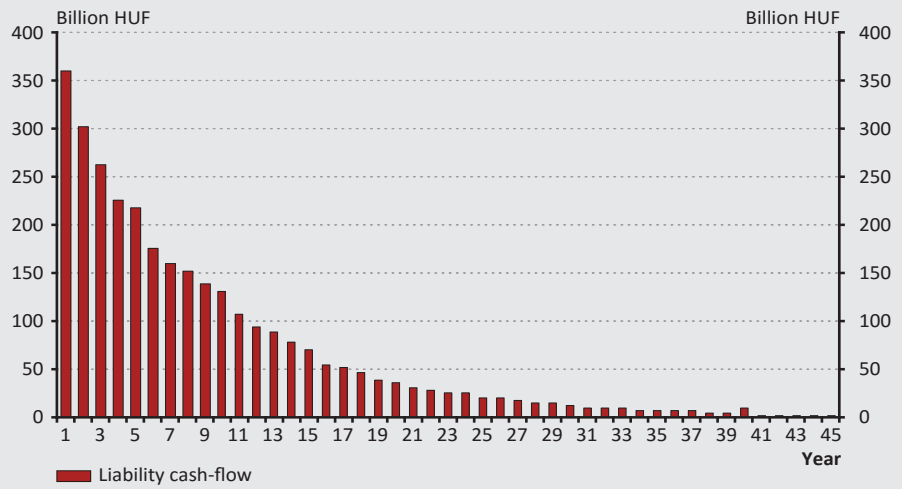
Source: MNB.

The moderate sensitivity to the low yield environment scenario can be attributed to two reasons. First, the overwhelming majority (90 per cent) of the participating insurers' cash flows taper off during the first 20 years (*Figure 6*), and therefore the fact that the long end of the yield curve converges to 2.3 per cent instead of 4.2 per cent has a marginal impact. Second, there is not much difference in the yields in the shock and the baseline scenarios. In the case of the RFR in the first 20 years, a drop of merely 57 basis points is observed, which is reduced further if we use the weighted values of the cash flows (34 basis points).

Thus, it is not surprising that the persistent low yield environment scenario has an effect of merely +0.9 per cent in the case of participating insurers' asset value, and +1.5 per cent in the case of their liabilities, and therefore it only marginally influences the solvency ratio of insurers (–3 per cent).

The more pronounced impact of the *"double-hit"* scenario on aggregate capitalisation (–13 per cent) is due to several reasons. On the one hand, more asset classes' value is reduced than in the other scenario (e.g. the value of stocks dips by 25 per cent), and on the other hand, there is a greater shift in the yield curve as well (70 basis points in the relevant first 20 years when weighted with the cash flows). As a result of the drop affecting several asset categories, the value of assets diminishes considerably, by 7 per cent, which cannot be offset by the decrease on the liabilities side; therefore own funds and thus, on account of the steady capital requirement, the solvency ratio is also reduced.

Figure 6
Participating insurers' liabilities run-off



Source: MNB.

In addition to the aggregate results, which can be considered sector-level figures, the resilience of the individual institutions to shocks is also worth examining. In the case of the persistently low yield scenario, no substantial effect can be identified at the individual level, but in the *"double-hit"* scenario we can see significant changes. In the case of all insurers, we can observe a decrease in capitalisation of between 2 per cent and 72 per cent as compared to the baseline scenario.

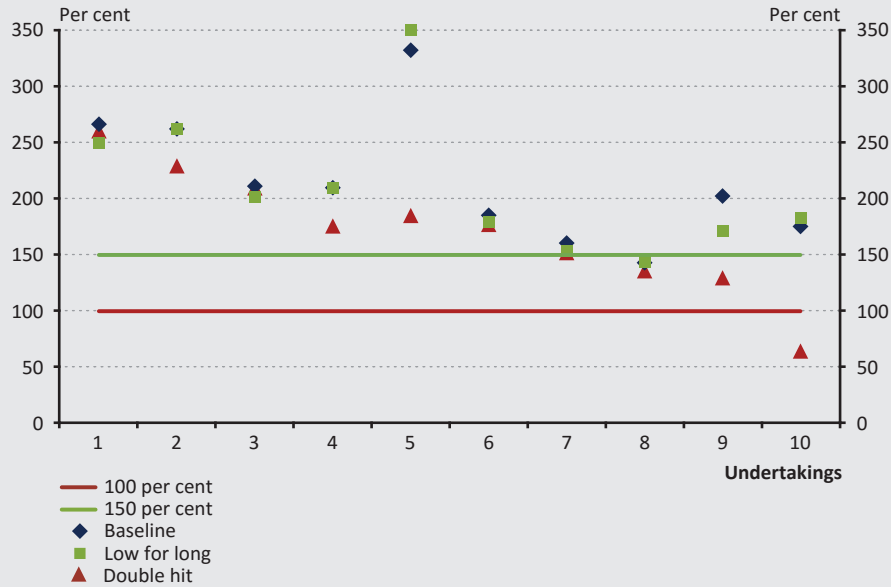
Although as we mentioned earlier, insurers did not recalculate the solvency capital requirements in the stress situations, which may materially influence the above results about capital adequacy,[13] we can safely say that the most sensitive insurers proved to be those with an overwhelming share of traditional life insurance in their portfolio (*Figure 8*).

It should be noted that in the case of the insurers that were affected the most by the "double-hit", the capital position was better in the low yield environment scenario than in the baseline scenario. This is because in their case, longer-term government securities dominate the assets side, the value of which rises more due to a drop in yields than that of the technical provisions.

Thus, the results of the ST2016 suggest no systemic risks in the case of the persistent low yield environment scenario or the scenario combined with a market shock either. However, in the case of some insurers, shocks have a substantial effect, which must be taken into consideration by both the institution concerned and the MNB.

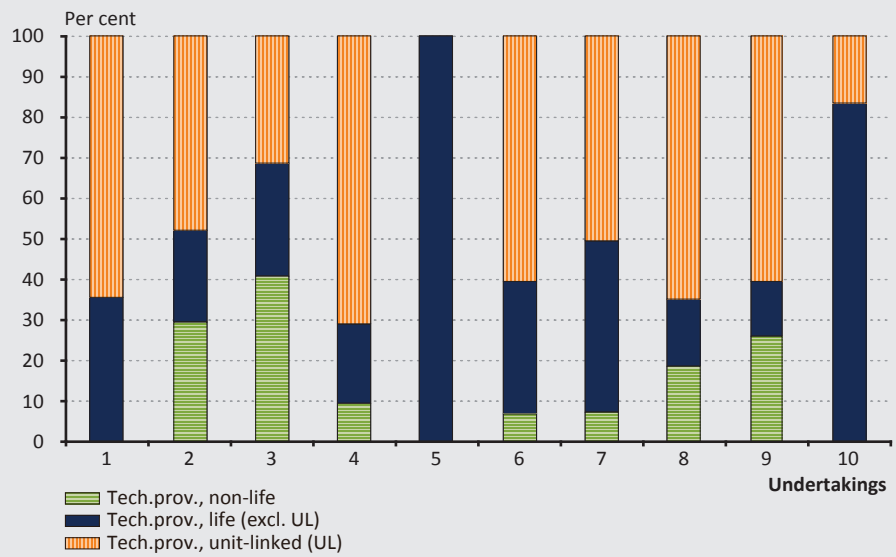
[13] For example, the capital requirement of equity and property risk equals the given percentage value of the exposure, i.e. if the value of the exposure decreases, the capital requirement becomes lower in line with that.

Figure 7
Impact of the stress scenarios on solvency ratio



Source: MNB.

Figure 8
Distribution of technical provisions by insurers



Source: MNB.

5. Summary

The transition to the Solvency II system was completed successfully and as planned, and the sector's aggregated solvency ratio for 1 January 2016 is adequate (204 per cent). During the audit control of the "Day 1" Solvency II submissions received by the 20 May 2016 deadline, smaller shortcomings in calculation were detected, which did not change the high sector-level capitalisation. As in the S2 system the valuation of assets and liabilities on a market basis and the risk-based calculation of the capital requirement entails the risk of volatility in own funds and the capital requirement, in its recommendation on holding a volatility capital buffer, the MNB suggests insurers a capital level of at least 150 per cent so that institution-level own funds continuously and reliably meet the capital requirement. For 1 January 2016, the S2 capitalisation of 20 out of the 28 institutions exceeds the minimum 150 per cent capital level in the recommendation, and out of the remaining 8, 6 institutions' capitalisation is between 120 per cent and 150 per cent, which was taken into account by the MNB during the institutions' risk assessment.

The first S2 risk assessment for Q1 with a risk-based methodology, which was developed in line with the unique characteristics of the S2 system and revised with a business model-based approach, ran smoothly. Based on the risk assessment of the whole sector, 3 insurers received high, 11 received significant, and 14 received moderate risk rating. In the case of the institutions with a high risk rating, the MNB has already taken action, as a result of which risks are expected to decrease in the future. One of the key areas of the S2 regulation's qualitative elements is the regulation of corporate governance, where, owing to the transposition of the Solvency II (*2009/138/EC*) Directive's relevant sections in 2015 with the MNB's assistance, the preparatory recommendations and the early preparation that was launched in connection with these, the sector-level risk rating changed from significant to moderate. Just like earlier, we identified significant financial and operational risks, which can be mainly attributed to the low yield environment and the risks associated with the functioning of IT systems.

In its 2016 stress test, EIOPA examined the impact of the persistently low yield environment and a scenario entailing market turbulence ("double-hit") on insurers' capital position. The Hungarian insurers that participated in the survey represented 87 per cent of the whole Hungarian non-unit-linked technical provisions, and therefore coverage can be considered high. The preliminary results do not point to systemic risks: the effect of the persistently low yield environment is negligible, while in the case of the "double-hit" scenario, there is still a substantial aggregate capital surplus despite the 13 per cent decline in the capital adequacy ratio. The resilience of the individual insurers to shocks varies widely: in some cases, the impact of the scenarios is marginal, while in the case of one insurer, the capital adequacy ratio drops below the statutory limit.

References

Insurance Act: Act LXXXVIII of 2014 on the Insurance Business

Bora, Zs. – Engler, K. – Holczinger, N. – Jakab, J. – Merész, G. – Nagy, K. – Zubor, Z. (2015): Mit hoz a Szolvencia II a hazai biztosítási szektor számára? (What does Solvency II bring for the Hungarian insurance sector?), *Biztosítás és Kockázat,* Vol. 2, Issue 1, pp. 50–52. http://www.mabisz.hu/images/stories/docs/biztositas-es-kockazat/biztositas-es-kockazat-2-evf-1-szam.pdf, Accessed: 8 September 2016

Bora, Zs. – Holczinger, N. – Merész, G. – Velcsov, G. – Zubor, Z. (2016): Az utolsó felkészülési célú Szolvencia II mennyiségi hatástanulmány eredményei (The results of the last preparatory Solvency II quantitative impact study), *Biztosítás és Kockázat,* Vol. 3, Issue 1, pp. 32–33. http://www.mabisz.hu/images/stories/docs/biztositas-es-kockazat/3_1/biztositas-es-kockazat-3-evf-1-szam-2-cikk.pdf, Accessed: 8 September 2016

Dénes, B. – Dobner, A. – Erdős, M. – Nagy, K. – Somogyvári, S. – Szebelédi, F. – Vizi, T. (2014): A biztosításfelügyelés változásai az Európai Unióhoz való csatlakozás tükrében (Changes in insurance supervision in the light of the European Union accession), *Biztosítás és Kockázat,* Vol. 1, Issue 1, p. 20. http://mabisz.hu/images/stories/docs/biztositas-es-kockazat/biztositas-es-kockazat-1-evf-1-szam.pdf, Accessed: 29 September 2016

EIOPA (2014): *EIOPA Insurance stress test 2014, EIOPA-BoS-14-203, 28 November. https://eiopa.europa.eu/Publications/Surveys/Stress%20Test%20Report%202014.pdf*, Accessed: 27 August 2016

EIOPA (2015): *Financial Stability Report*, December 2015, EIOPA-FSC-15-088/2015, 9/12/2015, https://eiopa.europa.eu/Publications/Reports/Financial_Stability_Report_December_2015.pdf, Accessed: 27 September 2016

EIOPA (2016a): *Insurance Stress Test 2016 Technical specifications*, EIOPA-BOS-16-109, 1 June, https://eiopa.europa.eu/Publications/Surveys/EIOPA-BoS-16-109%20Insurance%20ST2016%20Technical%20Specifications.pdf. Accessed: 27 August 2016

EIOPA (2016b): *Risk-free interest rate technical documentation.* https://eiopa.europa.eu/Publications/Standards/Technical%20Documentation%20%2830%20September%202016%29.pdf, Accessed: 1 October 2016

ECB (2015): *Annual Report*, p. 16. https://www.ecb.europa.eu/pub/pdf/annrep/ar2015en.pdf?51b9735eed394d1acf8e-ecf58bb0452e, Accessed: 27 September 2016

ESRB (2015): *Report on systematic risks in the EU insurance sector*. December. https://www.esrb.europa.eu/pub/pdf/other/2015-12-16-esrb_report_systemic_risks_EU_insurance_sector.en.pdf, Accessed: 2 September 2016

ESRB (2016): *Scenario for the European Insurance and Occupational Pensions Authority's EU-wide insurance stress test in 2016,* ECB-Public, 17 March. https://www.esrb.europa.eu/mppa/stress/shared/pdf/20160524_EIOPA_stress_test_scenario.pdf?bd4335636675958c-5ba0538a32ce595b, Accessed: 2 September 2016

EP (2009): *DIRECTIVE 2009/138/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 25 November 2009 on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II)*, Vol. 52, L 335, 17 December, http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32009L0138&from=HU, Accessed: 8 August 2016

EU (2014): *Commission Delegated Regulation (EU) 2015/35 of 10 October 2014 supplementing Directive 2009/138/EC of the European Parliament and of the Council on the taking-up and pursuit of the business of Insurance and Reinsurance (Solvency II).*

Felcser, D. – Soós, G.D. – Váradi, B.: A kamatcsökkentési ciklus hatása a magyar makrogazdaságra és a pénzügyi piacokra (The impact of the easing cycle on the Hungarian macroeconomy and financial markets), *Financial and Economic Review,* Vol. 14, Issue 3, pp. 39–59.

Haraszti, Zs. (2015): The Solvency 2 Directive in a Global Approach – Expectation for 2015. *Biztosítás és Kockázat,* Vol. 2, Issue 1, pp. 22–32. http://www.mabisz.hu/images/stories/docs/biztositas-es-kockazat/biztositas-es-kockazat-2-evf-1-szam.pdf, Accessed: 8 September 2016

Govt. Decree 43/2015 (12 March): *Kormányrendelet a biztosítók és a viszontbiztosítók szavatolótőkéjéről és biztosítástechnikai tartalékairól (Government Decree on the own funds and technical provisions of insurers and reinsurance companies)*

Lencsés, K. (2015): Merre tartanak a biztosítók? Beszámoló a MABISZ V. Nemzetközi Biztosítási Konferenciájáról (What lies ahead for insurance companies? Review of the 5th International Insurance Conference of the Association of Hungarian Insurance Companies [MABISZ]). *Financial and Economic Review,* Vol. 14, Issue 1, pp. 237–238.

Magyar Nemzeti Bank *Recommendation 3/2016 (6 June) on the own risk and own funds assessment system.* https://www.mnb.hu/letoltes/3-2016-ajanlas-sajat-kockazat-es-szavatolotoke-ertekeles.pdf, Accessed: 10 September 2016

Magyar Nemzeti Bank *Recommendation 6/2016. (June 14) on holding the volatility capital buffer ensuring continuous capital adequacy.* https://www.mnb.hu/letoltes/6-2016-ajanlas-volatilitasi-tokepuffer.pdf, Accessed: 10 September 2016

MNB (2014a): *Az MNB felügyeleti stratégiája (The MNB's supervisory strategy)*. https://www.mnb.hu/letoltes/14-07-31-felugyeleti-strategia-abra-1.pdf, Accessed: 16 September 2016

MNB (2014b): S*tressztűrők, de további figyelmet igényelnek a hazai és az uniós biztosítók (Hungarian and EU insurers are resilient but require further attention) – MNB press release,* http://www.mnb.hu/sajtoszoba/sajtokozlemenyek/2014-evi-sajtokozlemenyek/stresszturok-de-tovabbi-figyelmet-igenyelnek-a-hazai-es-az-unios-biztositok, Accessed: 27 August 2016

MNB (2015): *Bankszektorokon kívüli pénzügyi piacok kockázati jelentése (Risk outlook for non-bank financial sectors)*, June 2015, pp. 28–34. https://www.mnb.hu/letoltes/bankszektoron-kivuli-penzugyi-piacok-2015-eng-digitalis.pdf, Accessed: 13 September 2016

MNB (2016a): *Bankszektorokon kívüli pénzügyi piacok kockázati jelentése (Risk outlook for non-bank financial sectors)*. pp. 25–30. https://www.mnb.hu/letoltes/publikalando-jelentes-v4-digitalis.pdf, Accessed: 13 September 2016

MNB (2016b): *Biztosítói idősorok (Time series of insurance companies)*. https://www.mnb.hu/en/supervision/time-series/iii-the-insurance-sector/time-series-of-insurance-companies, Accessed: 26 October 2016

PSZÁF (Hungarian Financial Supervisory Authority) (2011): *A QIS5 magyarországi újrafuttatásának összegző értékelése – Publikus verzió (Summary analysis of the Hungarian rerun of the QIS5 – Public version)*. https://www.mnb.hu/letoltes/qis5bis.pdf, Accessed: 9 September 2016

PSZÁF (Hungarian Financial Supervisory Authority) (2012): *A 2011. évi Szolvencia II mennyiségi hatástanulmány összefoglalója (Summary of the 2011 Solvency II quantitative impact study)*. https://www.mnb.hu/letoltes/qis2011-hatastanulmany.pdf, Accessed: 9 September 2016

PSZÁF (Hungarian Financial Supervisory Authority) (2013): *Az EIOPA hosszú távú garanciás hatásfelmérés eredményei – Hazai eredmények és európai szintű fejlemények (Results of the EIOPA long-term guarantee impact survey – Hungarian results and European developments)*. https://www.mnb.hu/letoltes/ltga-ltga-hatasfelmeres-201308.pdf, Accessed: 9 September 2016

Szedlák, K. V. (2015): A biztosítási tevékenységről szóló 2014. évi LXXXVIII. törvény bemutatása (Presenting Act LXXXVIII of 2014 on the Insurance Business). *Biztosítás és Kockázat,* Vol. 2, Issue 1, pp. 12–20. http://www.mabisz.hu/images/stories/docs/biztositas-es-kockazat/biztositas-es-kockazat-2-evf-1-szam.pdf, Accessed: 8 September 2016

Zubor, Z. (2016): Volatilitási tőkepuffer a szolvencia II-es tőkekövetelmények megsértésének kivédésére (Volatility capital buffer to prevent the breach of the Solvency II capital requirements). *Financial and Economic Review,* Vol. 15, Issue 1, pp. 91–123.

The Wealth Position of Hungarian Households based on HFCS

Anna Boldizsár – Zsuzsa Kékesi – Balázs Kóczián – Balázs Sisak

Capturing the unique characteristics of market participants, micro-level statistics have gained significance in recent years, as macro data are not always detailed enough to give sufficient insight into the motivations of households. After the crisis, changes in borrowing attitudes, the subdued improvement in consumption and problems with monthly loan payments focused the attention on micro statistics. This gave rise to widespread demand for a European database on household wealth. Hungary joined the second wave of the survey. Presenting the results of the survey, this article provides a detailed overview of the real and financial wealth of households as well as the distribution and main statistical characteristics of their loans. In addition, we identified the demographic features that influence the saving and borrowing habits of Hungarian households. According to the data obtained, the value of their main residence tends to be the major asset for households: the most frequent motivation behind their saving or borrowing is to acquire or renovate their residential property. Since the majority of households hold a certain size of residential property accordingly, jointly, their net – real and financial – assets can be considered evenly distributed by international standards.

Journal of Economic Literature (JEL) codes: D14, D31, E21

Keywords: income, real wealth, financial wealth, loan, savings, financial assets, households

1. Introduction

The economic downturn and unfavourable labour market and income prospects resulting from the global financial crisis have changed the savings behaviour of the household sector significantly: as consumption faltered, households' outstanding debt fell sharply while their net savings began to edge higher. Indebted in a disadvantageous structure, households' debt burden rose sharply in the wake

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We owe a debt of gratitude to Mihály Szoboszlai, Tamás Berki, Ádám Valentiny, Péter Koroknai and the revisers of this study for their assistance and valuable advice.

The manuscript was received on 3 October 2016.

of the crisis due the depreciation of the forint and higher lending rates, and the debt service capacity of the sector deteriorated continuously. The forced savings necessitated by unfavourable income and labour market prospects and rising debt burdens affected specific groups of society differently. Households in an adverse income and wealth position were hit harder by the difficulties accompanying the increase in debt burdens. The global financial crisis demonstrated that aggregate indicators can conceal numerous phenomena relevant to the functioning of the economy. The need to understand and explore these phenomena shifted the attention from traditional indicators to more in-depth statistics. In recent years, the need has arisen to review and broaden, as appropriate, the information content of registration and accounting systems. For example, discussing the reforms of the available statistical accounts in detail, the *Stiglitz – Sen – Fitoussi* Report (*2009*) proposes a comprehensive assessment of wealth. According to the report, the relevant information of aggregate financial accounts should be supplemented by indicators that reflect the distribution of income, consumption and wealth.

In addition to income, it is the distribution of wealth that determines who has access to the goods and services produced in society, and to what extent. Indeed, consumption can deviate from income significantly: consumption can be expanded by using assets or taking on debt (negative financial wealth) and reduced by savings and the accumulation of assets. Therefore, there is a need to consider income and consumption jointly with wealth. Another important aspect to consider is the fact that income and wealth are distributed fairly unequally within a society. As the richest few members of society hold a significant part of financial assets, only a small segment of households may have a leading role in shaping aggregate statistics. Consequently, a single set of descriptive statistics (typically the arithmetic mean) cannot provide information on the financial well-being of various segments of the national economy.

In order to ensure the availability of the distribution indicators mentioned above, micro (individual or household) level information should be generated with respect to the target groups to be reviewed. High and low income households, wealthy and poor families, credit and liquidity constrained consumers or over-indebted households are all key groups that may respond to economic shocks very differently. Being aware of their behavioural responses supports policy decisions and generally assists in monitoring the evolution of aggregates more closely. Introduced in 2016, the MNB's new monetary policy forecasting model[1] is also intended to capture the diverging consumption and saving behaviour of individual groups, and the utilisation of the results of micro level surveys may help calibrate the model. In order to monitor the consumption, income and wealth status of households, the OECD

[1] For more detail about the forecasting model, see: Magyar Nemzeti Bank: Inflation Report, March 2016 (http://www.mnb.hu/letoltes/boritoval-hun-ir.pdf).

(Organisation for Economic Cooperation and Development) and the ECB (European Central Bank) designed a household survey for the euro area (HFCS – Household Finance and Consumption Survey) based on a uniform methodology. In addition to the compulsory participation of the euro-area Member States, Hungary and Poland voluntarily joined the second wave of the programme. For the purposes of this article, we used data from the "What do we live in?" household survey exploring the living standards and wealth of Hungarian households. The statistical characteristics, sample size and representativeness of the survey, as well as the main statistical features of the sample are discussed in detail in the study of *Simon – Valentiny* (*2016*) and are therefore excluded from this analysis.

In the first section of this study, we provide an overview of the relevant Hungarian and international literature. Each of the subsequent sections is devoted to the main results of the Hungarian survey from the aspects of concentration, real assets, financial instruments and loans. The structure of the sections discussing the results are the same: after introducing the relevant international literature (including the results of the first wave of the HFCS), we present a table summarising the most important characteristics affecting the given topic. We then propose stylised facts based on the results of the Hungarian and the international survey, which we attempt to justify by figures or tables.

2. Questionnaire surveys in Hungary and the HFCS

The survey that forms the basis of this article is the first detailed database on the real and financial assets of Hungarian households. Covering a broad range of wealth components, the questionnaire of the survey also inquired about the income, as well as the consumption and saving habits of household members. Consequently, the database is not only suitable for performing a disaggregate analysis of the assets and liabilities of households, but also for exploring systematic relationships between households' income and other demographic characteristics. Although the HFCS is not the first questionnaire-based survey on households' balance sheets, it is the first comprehensive survey covering household-level information on the total wealth, income and debt of the population. In the following, we outline a number of surveys that were dedicated to analyse household wealth from various aspects.

2.1. Previous questionnaire-based surveys on wealth in Hungary

Two surveys are conducted on a regular basis regarding Hungarian households: the Household Budget and Living Conditions Survey (*HBLS*) *and the Household Monitor. First and foremost, they collect data on consumption, income and demographic characteristics and also address wealth and saving attitudes.* Starting from 1993, the HCSO conducts the Household Budget and Living Conditions Survey (HBLS) every year, collecting detailed income, consumption and demographic data at

the household level. In recent years, the survey has included questions regarding subjective living conditions (*Gáspár – Varga 2009*). The second regular survey is Tárki's Household Monitor. Introduced in 1992, the Household Monitor's main focus is households' income situation, and it also provides details on additional information such as wealth, savings and consumption (*Szivós – Tóth 2013*). Moreover, the HCSO regularly collects micro-level questionnaire data on the stock of dwellings in its "What do we live in?" survey (*HCSO 2016*).

Based on the micro-level data available, *Cserháti and Keresztély* (*2010*) attempt to explore the harmonisation of macroeconomic releases and the micro-level data of the HBLS. Their intention is to utilise the data to facilitate a more accurate examination of households' income status by individual social groups. By imputation and by reweighting the data – depending on the availability of additional information – the authors succeeded in mitigating the deviations between micro and macro-level data (resulting from the time lag of HBLS data releases and the incorrect data supply of respondents) with different results in individual income categories. Examining the international methodology, *Szabó* (*2004*) found that the surveys differ from country to country depending on national traditions and survey objectives and are difficult to standardise despite the harmonisation attempts of EUROSTAT.

2.2. Results of previous Hungarian surveys

Researchers have been mainly interested in the assets side, in particular, real wealth, in the recent period. Bukodi and Róbert (*2000*) explored Hungarian households' access to durable goods, individual assets and cultural activity over time and among specific social groups. According to their results, households' wealth largely depends on education and various labour market parameters (position, activity). Examining the groups defined on the basis of income categories they found that financial standing did not improve in proportion to the increase in income; the wealth of income earners in the highest income quintile was spectacularly greater compared to the rest of the groups, while the analysis of age groups revealed that the wealth status of middle-aged families was more favourable than that of younger or older generations. Tárki's Household Monitor also addresses the issue: in a 2012 survey, it presented households' estimated value of housing in a demographic and geographic breakdown (*Szivós – Tóth 2013*). In the Tárki survey (*Szivós – Tóth 2015*) – the results of which are compared in subsequent chapters to data derived from the Hungarian section of the HFCS survey – the vulnerability of households was examined in more detail through the characteristics of their assets – in particular, real property and financial assets – and loans.

Previously published studies processing additional Hungarian questionnaire-based surveys relevant to our paper were mainly focused on the topic of lending. According to the questionnaire-based survey conducted before the crisis, the shock-absorbing capacity of indebted Hungarian households appeared to be adequate from the

aspect of banking portfolio quality (*Holló 2007*). At the same time, the study pointed out that a more significant depreciation and interest rate increase, as well as rising unemployment, could substantially raise the ratio of debt at risk (potential non-performing loans). Articles published after the crisis investigated the adjustment of households. According to the micro-simulation performed on the basis of the HBLS (*Gáspár – Varga 2009*), the households that found themselves in difficulty after the crisis were mainly the ones whose debt-to-income ratio exceeded 40 per cent; loss of employment played a lesser role in this regard. After the crisis, the increasing monthly instalments resulting from the effective depreciation of the forint exchange rate and rising interest rates caused payment difficulties mainly among the low-income strata due to the overstretched income position of these households, while the main challenge for the medium-income strata was loss of employment (*Hosszú 2011*). Examining the over-indebtedness of households, *Balás* (*2013*) demonstrated using the HBLS database that the debt service burden increases in line with a decline in incomes. 14 per cent of households – mainly low-income families – faced critically high instalment levels seeing more than half of their income spent on monthly payments. In a subsequent study, staff members of the central bank surveyed in detail the demographic background of distressed households (*Dancsik et al. 2015*). The study provides a comprehensive overview of the characteristics of non-performing loans, describes the demographic and geographic characteristics of the affected households (age, education, residence) and evaluates their financial standing and income situation (loans/wealth, payment-to-income ratio).

2.3. General characteristics of the Hungarian HFCS survey

The HFCS is the first internationally harmonised statistical dataset, collecting information in a single analytical framework on households' consumption, income, real and financial assets and loans. Numerous countries had previously conducted surveys on households' assets and sources of finance. In the United States, the population has been queried about its financial standing triennially since the 1980s, and similar surveys were conducted several times in some European countries even before the financial crisis. The data demand arising in the wake of the financial crisis prompted the European Central Bank to launch the HFCS survey based on a uniform methodology and questionnaire. The initial field work was carried out between 2008 and 2010 with the participation of 15 euro-area Member States. During the second wave starting in 2014, five additional countries were added to the original group of survey participants: Ireland (a euro-area member that did not take part in the first wave), Latvia which joined the euro area following the first wave, and Poland and Hungary which joined the data collection voluntarily. Since the results of the second wave are not available as at the date of this study, except for Hungarian and Irish data, the international comparisons presented in the paper

refer to the results of the first wave. It is important to keep in mind that this may influence the comparisons in some cases.

In the previous wave of the HFCS, the aggregate variables derived from micro-level data were cross-checked with national account level information in several countries. The comparison may assist in evaluating the quality of the survey and answering questions about the usability of the database. It may also serve as a baseline for the breakdown of aggregate figures, which allows for a more in-depth analysis of specific wealth components. In the case of Austria, Finland, Italy and the Netherlands, the analysis also examined the extent to which aggregate figures derived from the national accounts were reflected in microdata (*Andreasch – Lindner 2014, Honkkila – Kavonius 2013*). In this paper, we added Hungarian data to the ratios published for these countries (*Table 1*).

Numerous methodological problems previously arose with regard to questionnaire-based surveys, which were also encountered in relation to the database underlying the findings of this study. The data quality of the surveys conducted in the first wave is heterogeneous. While the coverage of real assets was above 80 per cent and 40–90 per cent of the credit variables were identified, in the case of financial assets the coverage was only in the range of 20–50 per cent. Analysts attempted to resolve this problem by over-representing wealthy households (*Simon – Valentiny 2016*).

In general, the survey underestimates the financial assets of households: consolidated, less than half of the macro-level financial assets are reflected in the HFCS database (*Table 1*). Proportions between micro and macrodata vary in different countries across the examined asset categories. The Italian survey produced the smallest coverage for individual instruments, but the survey identified relatively few components of household wealth even in Austria. By contrast, an explicitly large portion of (grossed up) data computed from the Finnish HFCS for individual instruments was consistent with macrostatistics, which may be explained by the addition of administrative sources to the questionnaire-based survey (*Honkkila – Kavonius 2013*). Compared to international data, the Hungarian HFCS database has relatively high coverage. According to aggregate data computed from the Hungarian survey, in analysing individual instruments on the assets side, financial account categories were identified in a relatively high proportion. With respect to loans, however, the coverage ratio falls significantly short of the Finnish and Dutch data.

Table 1
Ratio of aggregate HFCS financial assets to financial accounts data
(by asset category)

	Finland	Italy	Netherlands	Austria	Hungary
Deposits	55%	33%	49%	35%	73%
Bonds and other debt securities	15%	17%	55%	33%	64%
Insurance (pension, life)	21%	16%	24%	37%	52%
Investment funds	69%	28%	67%	51%	52%
Quoted shares	87%	36%	21%	30%	19%
Total financial wealth	39%	22%	30%	44%	47%
Loans	90%	45%	92%	n.a.	65%

Note: The coverage of the HFCS database is relatively low in the case of total financial wealth, which may reflect the fact that the survey does not include the full range of certain country-specific financial assets. In Hungary, for example, receivables from the government with respect to the private pension fund are included in the financial accounts, whereas HFCS data do not contain information regarding this instrument.
Source: Andreasch – Lindner (2014), Honkkila – Kavonius (2013) and own calculations based on the HFCS and financial accounts.

International literature has also attempted to identify the factors that may account for the differences. Variations may arise from differences in micro and macrodata approaches, temporal and methodological differences in data collection, the coverage of households and the sampling procedure. Moreover, while macrodata may contain the assets and loans of the self-employed, sole proprietors and non-profit organisations as well, they are not included in the household survey. Low coverage rates with respect to wealthier households may also give rise to data collection difficulties, restricting the information available on high-value wealth components (*Honkkila – Kavonius 2013*).

Although some of the differences listed above may be resolved during the sampling procedure (e.g. by over-representing high-income households, the difference between the two databases may be mitigated at the tail end of the distribution), due to the unresolvable differences, the two statistical datasets are not meant to replace each other. At the same time, HFCS data may complement financial accounts during analyses, as the distribution of wealth across individual asset categories is similar in both data sources (*Andreasch – Lindner 2014*).

3. Concentration of net wealth[2]

The concentration of wealth is one of the key indicators of economies in several regards. According to some studies, for instance, a higher concentration of wealth may reduce economic growth. On the one hand, a higher concentration of wealth may constrain the consumption of masses of people at the bottom of the distribution, which may decelerate economic growth. On the other hand, as the OECD pointed out, with a higher level of wealth concentration too many people may be forced out of high-quality education with severe negative impact on the economy and on the well-being of society (*OECD 2015*).

3.1. Relevant results of the first wave

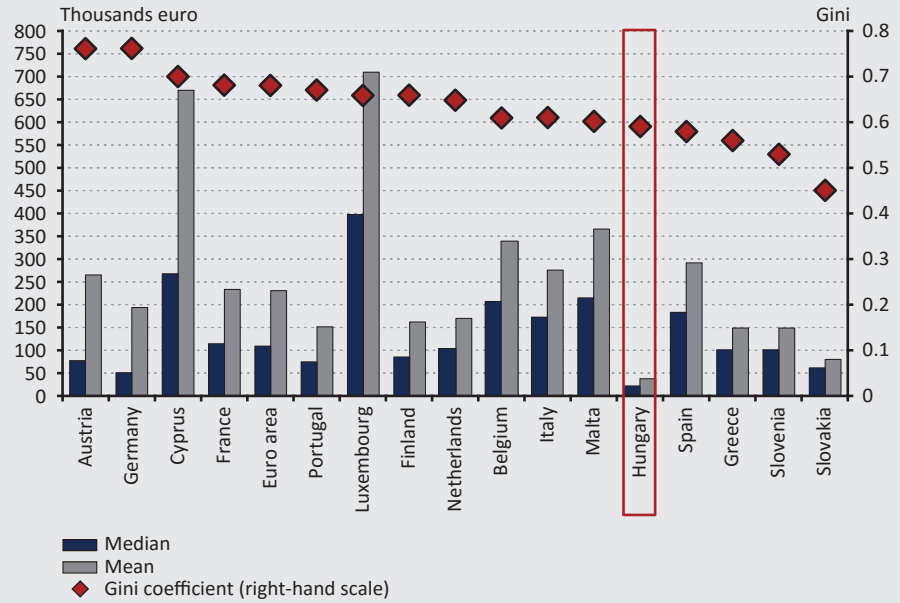
The concentration of wealth can be measured in a number of different ways. The most frequently used representation is the Lorenz curve, which shows the distribution of wealth components compared with perfect equality. The farther away the distribution curve from the 45 degree line of perfect equality, the more unequal the distribution of the given wealth component is among the members of society. The Gini index condenses the information content of the Lorenz curve into a single coefficient, which is especially useful for cross-sectional comparisons. In addition, inequality is often gauged by indicators that measure the distance between certain deciles. One of the most frequently used indicators is the quotient of two selected percentile values (e.g.: p90/p50), which measures the concentration of a certain part (e.g. the top) of the distribution.

The results of the first wave of the survey show that mean net wealth exceeds the median value significantly – albeit to a different degree – in all countries, which is indicative of the distribution's strong positive skewness. Disparities in the net wealth of households are most prominent[3] in Cyprus, Luxembourg, Germany and Austria, while inequalities are more moderate in countries with lower net wealth, such as Hungary, Greece, Slovakia and Slovenia (*Figure 1*). This is confirmed by the measure of concentration, the Gini coefficient, which is relatively high in all participating countries; its value for the euro area as a whole is 0.68. Similar to Slovakian, Slovenian and Greek households, the concentration of the net wealth of Hungarian households is below 0.6 per cent, while that of German, Austrian and Cyprian households is above average, over 0.7 per cent (*Bezrukovs 2013*).

[2] The description of households' wealth components is intended to be aligned to the financial accounts, the most detailed macro-level statistics of households' financial assets and liabilities. Accordingly, the financial assets (or gross financial assets, as appropriate) of households include the financial receivables held by households (e.g. bank deposits, securities, stocks and cash). Households' liabilities, in turn, are mainly understood as loans to households. As is the case with the financial accounts, the net financial assets of households are computed as the difference between two items (financial assets minus liabilities). Since the survey also covers real assets, adding the value of households' real assets – mainly their real estate holdings – to their net financial assets will give us the total wealth of households.

[3] A household's net wealth is the sum of its real assets and financial assets minus loans.

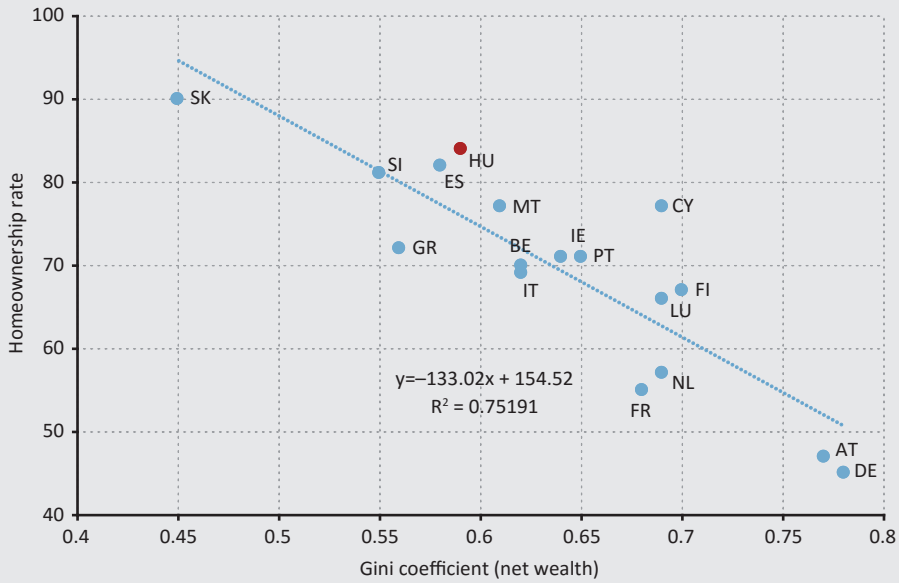
Figure 1
International comparison of households' net wealth and its concentration



** Data were collected in 2014 in Hungary and in the first wave of the survey between 2009 and 2010 in the rest of the countries.*
Source: ECB (2013).

In an international comparison, the net wealth of Hungarian households (including their financial assets and liabilities and their real assets) is distributed relatively evenly across households, which is mainly related to their relatively high holdings of real estate properties. Several studies have shown that inequality and the holding of real estate assets are negatively correlated. Examining wealth inequality on data pertaining to German households, *Bezrukovs* (*2013*) found that real estate holdings had the largest downward effect on inequality, while the role of financial assets and valuables was negligible. Accordingly, the holding of real estate property is negatively correlated with the Gini index measuring inequality (*Figure 2*). Purchasing the main residence is the most important form of saving for the poorer half of households (*Kaas 2015*). This correlation may partly account for the higher wealth inequality observed in less developed countries.

Figure 2
Wealth inequality and homeownership

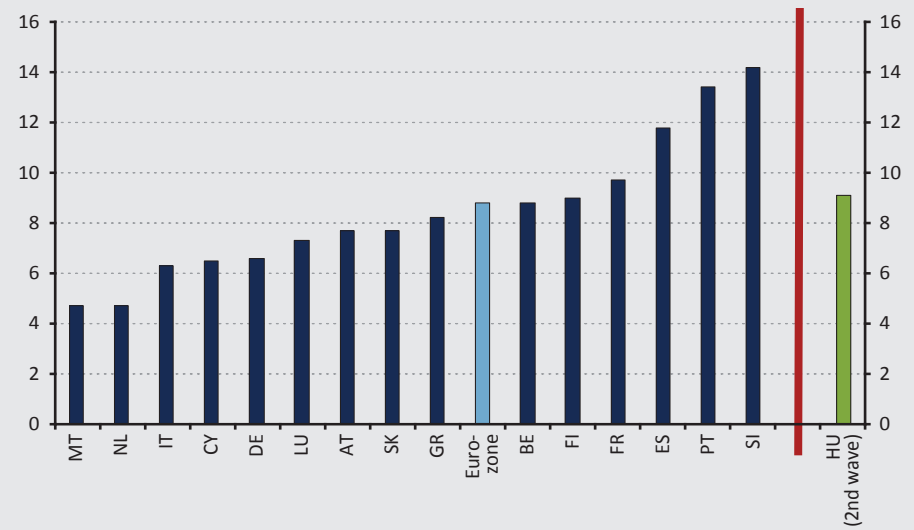


Source: HFCS, Kaas (2015).

3.2. International and Hungarian results related to concentration and stylised facts

Similar to other countries, the concentration of financial assets is significant among Hungarian households. Regarding financial assets, international literature found evidence of considerable concentration in general. According to a Belgian study relying on data from the first wave, in the euro area the financial wealth of households in the ninth decile is more than nine times higher than that of households in the medium decile (*Du Caju 2013*). This indicator (p90/p50) points to a nine-fold difference in the case of Hungarian households as well, which means that Hungary is among the countries characterised by relatively high inequality (*Figure 3*). At the same time, the indicator considerably exceeds the Hungarian value in Slovenia, Portugal and Spain. It should be noted, however, that the Hungarian survey took place 3 or 4 years later which, especially after the financial crisis, may have a considerable impact on the comparison. Indeed, post-crisis precautionary considerations may have prompted households to accumulate savings; thus the financial assets of wealthier households with higher income may have increased more sharply.

Figure 3
Concentration of financial assets
(p90/p50)



Source: HFCS, Du Caju (2013).

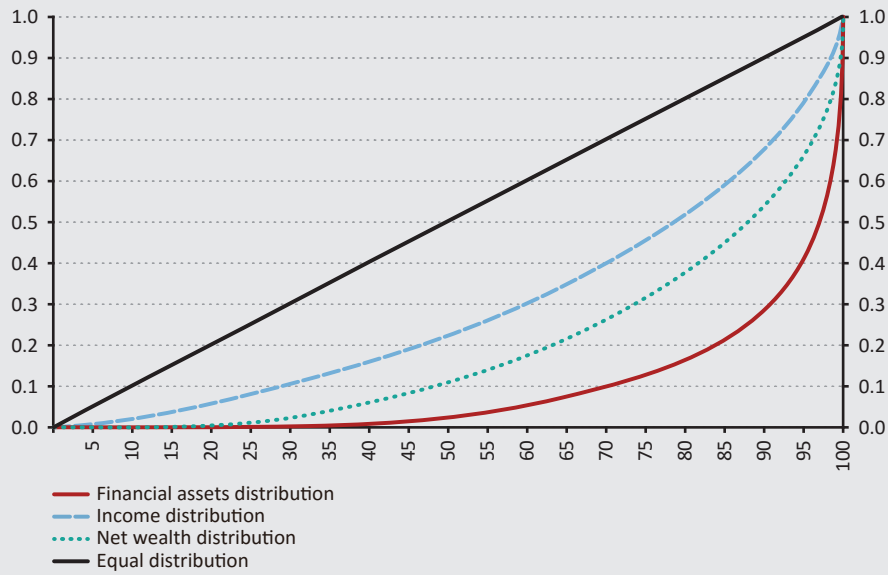
Comparing real assets with financial assets, financial assets tend to be more concentrated among Hungarian households. Data compiled during the questionnaire-based survey in the autumn of 2014 indicate that around 40 per cent of Hungarian households do not have any appreciable financial wealth (*Figure 4*); moreover, 80 per cent of financial assets are held by about 15 per cent of households. The Gini coefficient quantifying the concentration stands at 0.82 (where 0 expresses perfect equality and 1 indicates the concentration of wealth in the hands of a single individual). Importantly, some studies emphasise that the concentration ratio may be even higher than that; the observation of such occurrences, however, is cumbersome, due to limited availability and willingness to respond. The distribution of real assets, on the other hand, indicates a higher degree of equality, which can be attributed to the fact that – as discussed below – the vast majority of households own their own main residence. For this reason, real assets are distributed far more evenly than financial assets, with a Gini coefficient of merely 0.50.

Owing to the dominance of real estate wealth, the distribution of net wealth – which includes households' financial and real assets as well as their loans – is almost as even as in the case of real assets. Since Hungarian households are characterised by a high ratio of homeowners, in order to gain a more accurate picture of the concentration of wealth, in addition to net financial wealth we also examined the

concentration of real estate property. Although we observed a far greater degree of wealth equality, the wealth held by nearly half of the population is still only around 10 per cent of total wealth. The more even distribution of net wealth is also reflected in the value of the Gini coefficient: its value declined from 0.82 – which considered financial assets only – to 0.59.

It should also be noted that several analysts found that the distribution of financial assets is heavily concentrated and distributed much more unequally than income (*Fessler – Schürz 2015*). According to the survey, this is also true for Hungary: the concentration coefficient of income[4] is only 0.43, far lower than the concentration of financial wealth or net wealth.

Figure 4
Lorenz curves expressing the concentration of the net wealth – including real estate property and loans – and incomes of households



Source: HFCS.

[4] On the basis of the dataset, all household incomes were taken into account: in addition to wages and salaries they include, among other things, returns on investments, pensions, capital incomes, rental incomes from real estate property and other household incomes.

4. Real assets of households

As indicated by the more moderate concentration of net wealth relative to financial wealth, Hungarian households attach key significance to acquiring real wealth, in particular, real estate property. With some exaggeration, we can state that nearly all households own real estate property – if not, they strive to acquire some. In the paragraph below we examine in detail the characteristics of Hungarian households' real estate holdings. Due to the limitations of this study, we merely touch upon the data on other real assets (vehicles, valuables).

4.1. Relevant results of the first wave

Taken together, the real asset wealth of the population of the countries participating in the survey can be considered significant, with the majority of households owning their main residence. Real assets (real estate property, vehicles, valuables) account for around 85 per cent of households' financial and non-financial assets, of which household main residence is the most predominant asset category (*Arrondel et al. 2014*). The share of households owning their main residence is 60.1 per cent on average; however, cross-country variation is significant: while less than half of German and Austrian households live in their own residence, the corresponding ratio exceeds 80 per cent in Spain, Slovakia and Slovenia (*Table 2*). Based on the results of the HFCS, at EUR 500,000 the median value of residential properties is extremely high in Luxembourg, while it is below EUR 100,000 in Slovakia and Portugal. Expressed in euro, the value of Hungarian real estate properties falls significantly short of the values observed in other countries; this difference, however, may also reflect the time difference between the data collections: the Hungarian survey was conducted in 2014 – four years later than the rest of the surveys – when Hungarian real estate prices may have bottomed out. In addition, real estate values may also have been influenced by the fact that, similar to other financial assets, the real estate values stated in the survey were based on households' self-assessment.

Along with residential property, vehicles constitute the most prevalent part of households' real wealth: according to the first round of the HFCS, the ratio of vehicle owner households is above 70 per cent in all participating countries except Finland and Slovakia, where the ratio is somewhat lower, at 60–70 per cent (*ECB 2013*). Hungary recorded the lowest ratio of vehicle ownership: only one half of Hungarian households own a vehicle.

Based on the data collected during the survey, after Slovakia, Hungary boasts the second highest ratio of main residence ownership among the respondent countries. The lowest percentages of households owning their main residence were recorded in Germany, Austria and France, presumably because of their highly developed rental property markets.

Table 2
Participation in real assets in respondent countries

	Household Main Residence (%)	Median HMR values (EUR thousand)	Any real assets (%)
Slovakia (2010)	89.9	55.9	96.0
Hungary (2014)	84.2	29.1	85.6
Spain (2008)	82.7	180.3	95.3
Slovenia (2010)	81.8	110.9	96.2
Malta (2010)	77.7	186.6	94.8
Cyprus (2010)	76.7	240.3	95.8
Greece (2009)	72.4	100.0	92.2
Portugal (2010)	71.5	90.0	90.1
Ireland (2013)	70.5	150.0	95.5
Belgium (2010)	69.6	250.0	89.8
Italy (2010)	68.7	200.0	97.7
Finland (2009)	67.8	129.7	84.3
Luxembourg (2010)	67.1	500.0	93.6
Netherlands (2009)	57.1	240.0	89.8
France (2010)	55.3	193.8	100.0
Austria (2010)	47.7	200.0	84.8
Germany (2010)	44.2	168.0	80.2

Source: HFCS, Arrondel et al. (2014), Lawless et al. (2015)

4.2. Main characteristics of the real wealth of Hungarian households and stylised facts

In general, it can be stated that, due to the specificities of the housing market, home ownership is a key consideration for Hungarian households. As opposed to many Western European countries, it is important for Hungarian – and based on the previous round of the HFCS, Slovakian – households to own the residential property in which they live. In Hungary, this is reflected by the fact that more than 84 per cent of households reside in homes which (in part or in full) they own (*Table 3*). At the same time, the value of the real property owned by Hungarian households is extremely heterogeneous, partly as a result of the geographical disparities of income distribution. The value (as well as the ownership ratio) of residential properties tends to be higher in the higher-income quintiles; in other words, higher incomes allow households to purchase more valuable real estate properties. Examining the median value for each income quintile we find that in the top quintile it is 2.5 times the value of the first quintile, while the difference is even higher with respect to net financial wealth. In the autumn of 2014, the median value of real estate properties was close to HUF 8 million. According to the survey, another 7 per cent of households do not need to pay for the property they rent even though they are not the homeowners, while 9 per cent of households own their main residence. These figures are largely consistent with the proportions derived from the HCSO's "What do we live in?" survey (*HCSO*

2016). It can also be observed that the likelihood of the ownership of residential property increases only moderately with an increase in education (from 81 per cent to 85 per cent) – presumably due to the higher income earned with a higher education level – while the median value of such properties shows considerable improvement.

Only a smaller fraction of households (*23 per cent*) *own a second real estate property, the value of which is typically lower than that of the main residence.* While the value of the first residence is close to HUF 8 million, households owning a second real estate property estimate its value at only HUF 6 million. The lower value might be explained by the fact that the second property often implies a vacation home, a hobby garden, a garage or a family farm, usually of lesser value than the main residence. As regards income quintiles, second homes are far less frequently owned than first homes in all quintiles. Compared to the rest of the groups, the frequency of ownership tends to be higher in the top income and wealth quintiles and among those with tertiary education. The median value of the second real estate property is higher in the lowest wealth quintile, which may be indicative of bank financing or suggest that the real estate is a family farm.

Table 3
Households' participation in real estate wealth

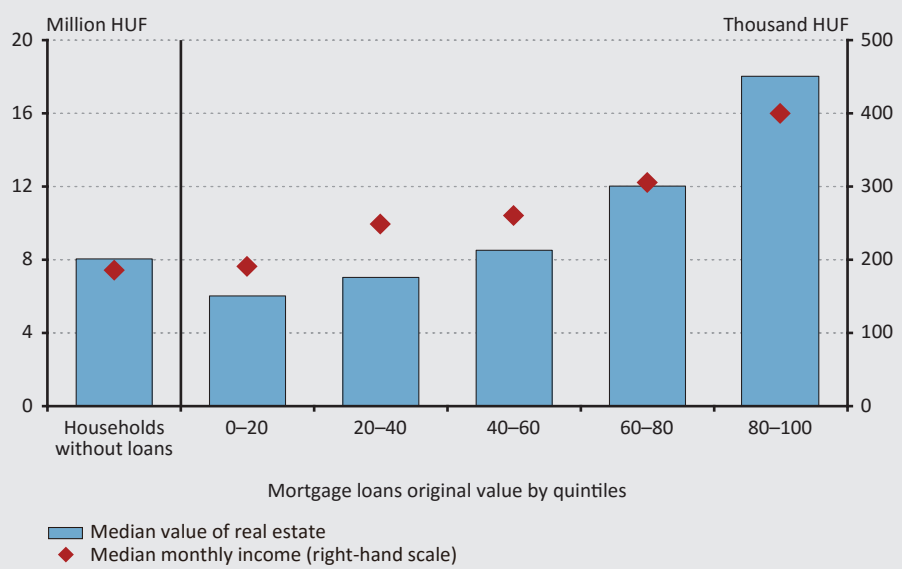
	Household Main Residence		Second real estate property	
	median value (HUF)	participation rate (%)	median value (if any) (HUF)	participation rate (%)
Total households	8,016,000	84.2	5,952,000	23.0
By income				
Less than 20	5,010,000	77.9	3,006,000	10.7
20–39	6,012,000	82.1	3,006,000	15.5
40–59	8,016,000	84.6	6,012,000	21.8
60–79	9,019,000	86.3	5,010,000	26.6
80–100	14,029,000	90.2	8,016,000	40.1
By net wealth				
Less than 20	1,503,000	34.2	5,010,000	14.3
20–39	3,507,000	91.3	2,505,000	13.0
40–59	6,513,000	98.9	3,006,000	17.5
60–79	11,022,000	98.8	4,008,000	23.5
80–100	20,041,000	97.9	8,957,000	46.6
By education				
Primary or less	4,509,000	81.0	2,505,000	8.8
Secondary	8,016,000	84.8	4,008,000	20.2
Tertiary	13,027,000	85.4	8,016,000	37.5

Source: HFCS.

Stylised fact 1: Larger loan amounts improve households' access to real estate properties or more valuable real estate. Borrowing allows households to invest or consume their future incomes in the present. This is especially apparent when the value of households' real estate property is examined. Indeed, the value of the real estate property owned by a household increases in line with the amount the household has borrowed in the past. Therefore, questionnaire data also confirm that borrowing expands the investment opportunities of households and raises the value of the property they can purchase. Moreover, the median value of the real estate owned by the borrowers of larger amounts (starting from the fourth quintile) exceeds the median value of the real estate properties held by non-borrowers.

Stylised fact 2: An increase in monthly (regular) income will also raise the value of the real estate owned and the loan amount. Households were surveyed in September 2014, before the MNB's payment-to-income ratio and loan-to-value ratio came into effect in early 2015. Even at the time, however, it was clear that higher loan amounts – and higher expected incomes – correlated positively with higher-value real estate properties. This indicates that households earning higher incomes can afford to spend a higher portion of their income on loan repayment; consequently, they are capable of borrowing more substantial amounts which allows them to purchase higher-value properties (*Figure 5*). By and large, the value of the property owned by a household increases in parallel with the value of its housing

Figure 5
Monthly income and value of real estate held by households with housing loans and non-borrowers

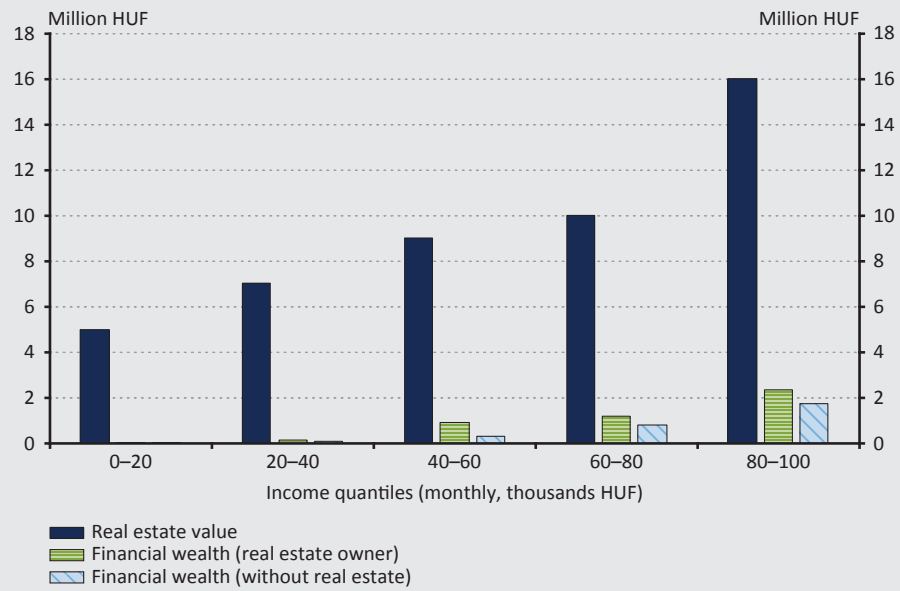


Source: HFCS.

loan which, in turn, partly depends on the household's income level. Obviously, this also reflects banks' risk management: an excessively high loan-to-value ratio is monitored closely by credit institutions.

Stylised fact 3: The first priority of Hungarian households is to own their main residence which, based on the data available, appears to be more important than the accumulation of financial assets. Despite substantial write-downs during the financial crisis, the main priority of Hungarian households is to own their main residence. As regards households' participation in wealth, based on the survey the value of the financial assets held by households in the lowest quartile of financial wealth is below HUF 1 million (*Figure 6*). Presumably, this is below the required downpayment and – unless the given household is a homeowner – it is insufficient to cover the purchase of a real estate property (the median of non-homeowners' financial assets amounts to only HUF 130,000).

Figure 6
Median value of the total real estate property and financial wealth of households by income quintile



Source: HFCS.

An analysis of the relationship between housing wealth and financial assets reveals that only in 200,000 households did the value of financial assets exceed the value of housing wealth, while real estate holdings represent a higher value in the case of more than 4,100,000 households. Households holding financial assets in excess of their housing wealth account for less than 5 per cent of all households.

Median financial wealth amounts to as high as HUF 6 million in the case of those holding financial assets in excess of the value of their residential property, while the financial wealth of the top decile exceeds HUF 21 million. In other words, we may assume that households with financial assets in excess of the median wealth make a conscious decision to accumulate wealth in various forms of financial savings rather than in real estate – given that the median value of residential property was below HUF 9 million and thus presumably, this group may well be able to purchase (an even more valuable) real estate property. The ratio of those with higher education is slightly higher among households where the value of financial assets exceeds the value of the real estate assets owned, although the difference cannot be considered significant.

5. Financial wealth of households

In the HFCS survey, the gross financial wealth of households is constructed in such a way that it essentially maps the headings of the financial accounts. The survey specifically requests households to indicate the individual instruments (e.g. time deposits, current accounts, bonds, mutual funds) in which they hold their savings. Moreover, the survey was designed to assess households' participation in business wealth which, similar to the financial accounts, is considered to be a financial asset category.

5.1. Relevant results of the first wave

Besides real assets, financial assets account for the lesser half of the wealth in participating countries, and the vast majority of such assets comprise savings in safe financial instruments. The HFCS surveys found that nearly all households own some financial assets irrespective of income and wealth position; the value of such assets, however, falls significantly short of the real assets held by the households in question. Taking all participating countries together, the median value of real asset holdings is EUR 145,000, but the median value of financial assets is less than 8 per cent of this value, just over EUR 11,000. Safe assets have a predominant share in all financial assets, with bank deposits representing the most popular asset category. With the exception of Greece and Cyprus, participation in bank deposits is above 90 per cent in all countries. Although these assets comprise the bulk of financial savings, the median value of savings held in bank deposits remains below EUR 20,000 in most countries and does not exceed EUR 140,000 even among the wealthiest households. In other words, the amount of savings held in bank deposits is limited, as rich households diversify their portfolios (*Arrondel et al. 2014*).

Based on international experience, the portfolio allocation choices of households show a rather one-sided picture. Generally speaking, a large share of households hold financial assets, but the distribution of these assets across various asset

categories is fairly monotonous. The vast majority of households opt to hold traditional banking products (bank deposits, current accounts for transaction purposes), while they have little interest in financial investment products (mutual fund shares, bonds, stocks). It was found that, despite considerable cross-country differences and variations across individual social groups with respect to portfolio composition, only a small fraction of households (5–15 per cent) own risky investments, bond or stock market interests. Participation in more sophisticated financial products such as mutual fund shares, bonds and stocks is more prevalent among high-income households with greater net wealth, which may suggest that diversification considerations play a more prominent role in the asset allocation decision of wealthier households (*ECB 2013; Arrondel et al. 2014*).

5.2. Main characteristics of the financial wealth of Hungarian households and stylised facts

As regards the financial wealth of Hungarian households, while almost all households have a bank account, only a fifth of them have investments. In analysing household wealth, we classified savings into two groups, distinguishing between "less risky" (bank deposits, pensions) and "risky" (all other financial investments) forms of saving. Based on the literature, some pension-type investments might be considered risky; however, given that pension fund savings are long term and that employer's payments are also considerable in Hungary – which makes the decision less premeditated – for the purposes of our analysis such savings were deemed to be "less risky". The survey found that even though the share of risky assets is much smaller in households' assets, the median amount invested into these forms of savings (almost HUF 4 million) is much higher than the median value (around HUF 300,000) of less risky financial assets.

The financial wealth of households increases in line with an increase in income, and households in the top income category typically own more risky assets. According to the survey, the share of households with investments (riskier assets) gradually increases with growth in income: compared to 3.2 per cent in the lowest income quintile, nearly 30 per cent of households in the highest income quintile hold financial assets (*Table 4*). As income grows, the median value of financial savings – both in the case of less risky and risky assets – edges up gradually. In lower income categories, households tend to hold their savings in less risky assets – typically bank deposits – while participation in riskier assets (investments) is higher among households with higher incomes. The top income quintile holds the bulk of the investments; in the case of these households, the median value of investments approaches HUF 13 million. Moreover, the share of deposits is lower among households in the higher income categories, as they typically prefer riskier investment forms. It should be noted that even though this group has the largest share of riskier assets, only one third of the households concerned hold such

savings; consequently, risk appetite is assumed to be low even in the top income category.

An increase in net wealth also raises the value of financial assets. The participation of households holding investments in addition to deposits also increases in line with net wealth; however, the median value of savings held by individual groups is lower than we have seen in the case of income categories. When we compare the median values of investments in a breakdown by income and net financial wealth, we find that in the case of the latter the values are lower. This could be attributed, for example, to the fact that the household has lower net wealth due to its mortgage debt (which puts it in the first quintile) even though it has higher income, and thus, more investments. Based on this, we can presume that the value of financial assets is fundamentally determined by income. Indeed, the survey data confirm our hypothesis that higher-income or wealthier households (accumulated real assets included) typically dispose over more financial assets. It is worth remembering, however, that – as shown in the section on the concentration of financial assets – the stock of financial assets is extremely low in the lowest income bracket, and that the value of the financial assets held by the top income quintile is significantly higher than the value of the assets held by the rest of society together.

The breakdown of households by education level is similar to what we have observed with income and net financial wealth: individuals with primary education typically have a lesser share in financial assets and predominantly hold their savings in bank deposits. The household's share in investments is much higher in the case of families where the head of the household has a higher education level, given that the share of such households in financial assets is also higher. This suggests that better educated households have higher risk appetite and are more prone to diversify their financial assets.

Table 4
Financial assets of households

	Deposits and pensions	Investments	
	median value (HUF)	median value (if any) (HUF)	participation rate (%)
Total households	300,000	4,008,000	11.8
Percentile of income			
Less than 20	17,000	1,002,000	3.3
20–39	100,000	1,335,000	6.7
40–59	500,000	2,458,000	9.1
60–79	1,020,000	3,006,000	11.0
80–100	1,647,000	12,696,000	28.7
Percentile of net wealth			
Less than 20	66,000	501,000	2.2
20–39	100,000	1,002,000	4.5
40–59	207,000	1,469,000	4.2
60–79	670,000	2,004,000	11.7
80–100	1,500,000	8,016,000	36.2
Education of reference person			
Primary or less	23,000	902,000	2.3
Secondary	208,000	2,484,000	8.3
Tertiary	1,075,000	5,317,000	24.2

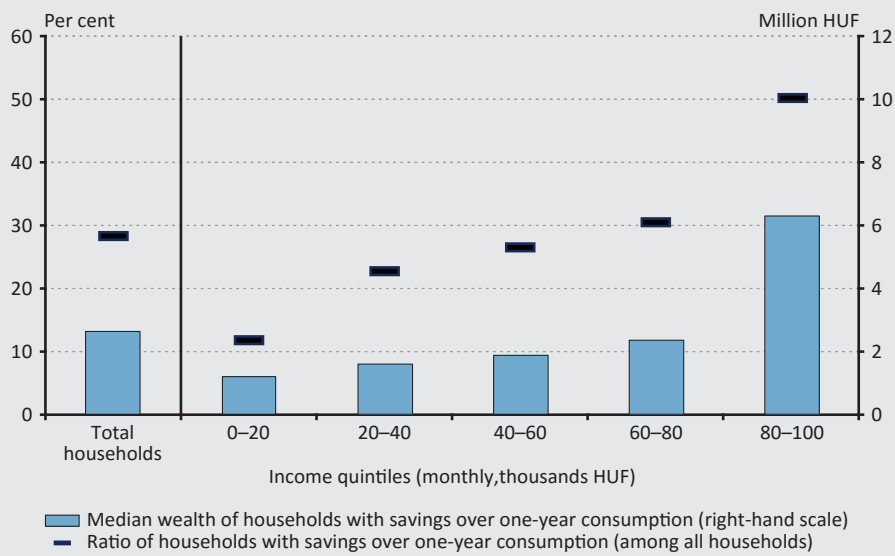
Note: The deposits and pensions category includes current accounts and deposit accounts as well as pension accounts. The investments category includes bonds, investment funds, stocks and other investments.
Source: HFCS.

Stylised fact 1: Among households earning higher incomes, the share of those with enough financial assets to sustain them for a year is higher, and accumulated financial wealth grows in line with income. More than 70 per cent of Hungarian households do not have sufficient financial wealth to cover the household's consumption needs for a year, but 60 per cent do not even have sufficient wealth to sustain the household for a period of six months (*Figure 7*). Looking at the variation across income, it is only in the top income category where the ratio of households that are capable of financing consumption from previously accumulated financial assets over the long run approaches 50 per cent. Only 10 per cent of the households residing in the lowest income quintile hold sufficient financial wealth to cover the household's consumption for a period of one year.

Despite the low participation rate, even the lowest income category includes households with substantial savings. Although the median value of financial

assets is rather low overall among households in the lowest income quintile, the financial assets of those in possession of financial wealth in excess of their yearly consumption needs amount to nearly HUF 1.2 million, which – save for those in the top quintile – only slightly falls short of the wealth of those in higher income categories. The median value of the financial assets of those who hold financial assets in excess of their yearly consumption needs increases only slightly across the first four income quintiles and exhibits a spectacular rise in the top income quintile. Consequently, the level of financial wealth improves gradually across income categories, which indicates that in the long run, only those in the top income category are capable of accumulating a substantial amount of financial wealth. Our results are consistent with the findings of the survey by *Bukodi and Róbert* (*2000*) in relation to durable consumer goods. The authors also registered a sharp improvement in the wealth status of households in the highest income quintile.

Figure 7
Share of households with financial assets covering consumption needs for longer than one year and the median value of asset portfolios

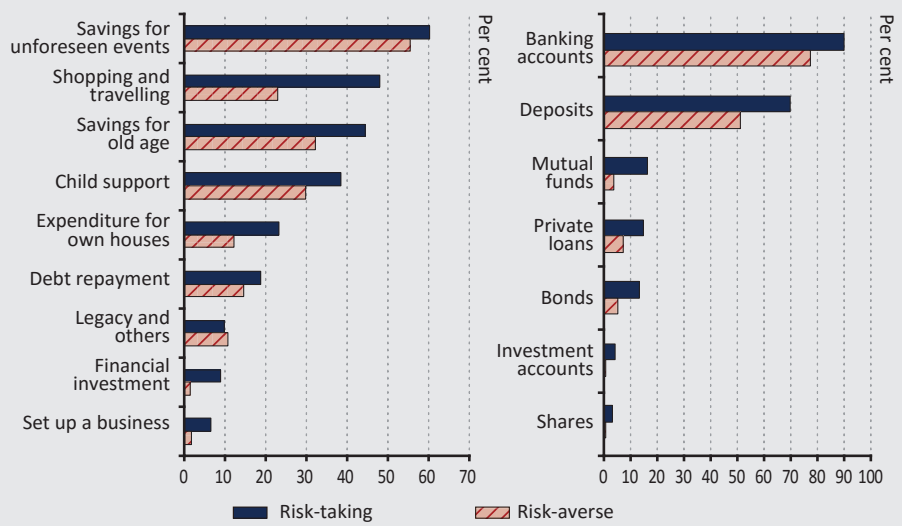


Source: HFCS.

Stylised fact 2: Hungarian households have a preference for more liquid forms of saving. Nearly all households have a current account and more than one half of households also have time deposits; this means that Hungarian households prefer to hold their savings in readily available, liquid assets. The questionnaire also asked heads of households to indicate whether they considered themselves to have a risk-taking or a risk-averse attitude with respect to savings (*Figure 8*). Although

a higher percentage of risk-taking households hold banking instruments, the difference is far more perceivable in the case of investment-type assets. Households considering themselves risk-taking are much more likely to hold mutual fund shares and bonds despite the fact that in Hungary, the most prominent investment instruments in these two categories are government bonds; i.e. securities that are considered to be especially safe (bond funds, government bonds). Only risk-taking households reported to have investment accounts and stocks. In line with the above, accumulating reserves for unforeseen expenditures and saving money for consumption purposes are the two most frequently reported saving motives. The latter is more typical among risk-takers. The prominence of saving for old age among the saving motives is somewhat surprising, especially in view of the limited popularity of long-term savings. By contrast, the least popular saving motives are financial investments and saving to build up own business, which presumably reflects the fact that it is typically higher-income segments that can afford longer-term investments. Similarly, willingness to take risks is more typical among wealthier households or higher-income groups and accordingly, risk-takers – who are more likely to invest in long-term instruments – have a dominant share in all saving motives.

Figure 8
Household saving habits by investment attitude

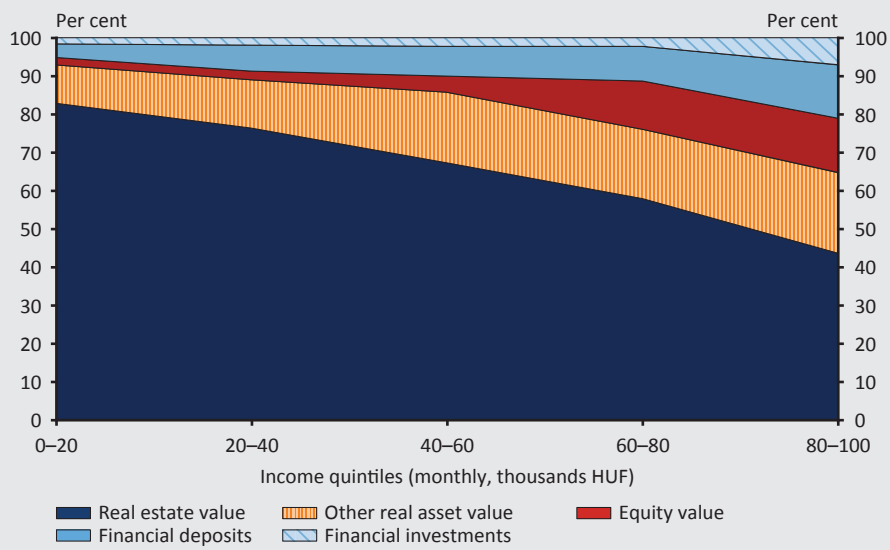


Note: Respondent households were allowed to select more than one savings objective. The figure shows the percentage of households selecting the given savings motive, as well as the percentage of households holding their savings in the given instrument.
Source: HFCS.

In the first wave of the HFCS, precautionary savings represented the most important saving motive besides saving for old-age provision. Interestingly, precautionary motives were the most prominent in the Netherlands (92 per cent) and the least important in Germany (42 per cent). Preferences for other saving motives were rather heterogeneous across countries. Saving to pay off debts tended to be more important in countries with relatively substantial household indebtedness (*Le Blanc et al. 2014*), such as Hungary.

Stylised fact 3: Households with higher income tend to distribute their wealth increasingly evenly across individual asset categories. Looking at the total asset portfolio by income quintile, it can be observed that the higher a household's income, the smaller share its main residence represents within the household's total wealth (*Figure 9*). While households' main residence accounts for more than 80 per cent of the total wealth of households in the lowest income quintile, this ratio is only 40 per cent of the total wealth of households in the top income quintile. At the same time, the share of other real assets – additional real estate, vehicles and other valuables – increases in parallel with income. Moreover, lower-income households have no business share to speak of, while business share accounts for about 20 per cent of the wealth of high-income households in the fourth and fifth quintiles. Presumably, this means that those with equity stakes are capable of earning a higher income than those without such interests. The share of financial assets within the total wealth of the population is fairly low, irrespective of the income quintile and

Figure 9
Distribution of household assets by income quintile



Source: HFCS

it is only considerable in the case of 20 per cent of households in the top income bracket. The financial assets of households in the highest income quintile comprise 20 per cent of total assets, while the share of financial assets among the rest of the households ranges between 5 and 10 per cent only. Financial investments represent a negligible weight within financial assets in the first four income quintiles, but their share is more substantial in the case of households in the highest income category.

6. Household debt

Having discussed the assets side, this chapter provides details about the liabilities of households. We determine the percentage of households with debt holdings for various debt types (mortgage loans, consumer credit) and the typical value of the loans disbursed. Similar to previous chapters, we explain how specific demographic characteristics may influence the debtor's willingness to borrow/borrowing capacity and loan size. In the first step, we compare the data collected during the Hungarian survey to international experiences.

6.1. Results of the first wave

As regards participation rates, the indebtedness of Hungarian households cannot be considered high compared to other European countries. Among HFCS participants only Slovakia recorded lower participation rates than Hungary, although the number of indebted households also does not differ significantly from the figures reported by some Southern European countries. Drawing comparisons is somewhat difficult as households in general attempted to downsize their debts after the crisis. Since the Hungarian survey was conducted 3–4 years later, the adjustment of Hungarian households may have been more significant compared to the data collected in 2010 during the first wave of the HFCS. In addition, the relatively low participation of debtors may also be explained by Hungary's relative underdevelopment compared to euro-area Member States (both in terms of income conditions and the financial system's level of development).

As regards mortgage-based housing loans, the Hungarian participation rate is somewhat higher but regarding consumer loans, it is somewhat lower than the average of the countries participating in the first wave. In terms of the share of Hungarian households with mortgage debt within the total population, Hungarian households are in the middle of the group (*Table 5*). Hungary's high participation rate compared to its relative level of development may reflect households' preference for owning their main residence, which is rather prominent by international standards. Hungarian consumer credit figures, however, are somewhat lower than those reported in the euro area, which might be attributed to lower income levels and to the relatively underdeveloped financial system. Numerous studies have been published in recent years processing the data of the liabilities side of households' balance sheets. Below is a summary of the most important findings.

Table 5
Household participation by loan type, percentages

	Total debt	Household main residence mortgage	Other property mortgage	Non-mortgage debt
Hungary (2014)	32.2	20.1	8.1	26.6
Euro area (first wave)	43.7	19.0	5.6	29.3
Belgium (2010)	44.8	28.5	3.2	24.2
Germany (2010)	47.4	18.0	6.0	34.6
Greece (2009)	36.6	13.9	3.9	26.1
Spain (2008)	50.0	26.8	7.3	30.7
France (2010)	46.9	16.9	10.1	32.8
Italy (2010)	25.2	9.60	1.6	17.8
Cyprus (2010)	65.4	35.0	15.4	47.9
Luxembourg (2010)	58.3	32.8	8.4	36.9
Malta (2010)	34.1	12.1	4.5	25.2
Netherlands (2009)	65.7	43.9	2.5	37.3
Austria (2010)	35.6	16.6	2.4	21.4
Portugal (2010)	37.7	24.5	3.3	18.3
Slovenia (2010)	44.5	12.5	1.6	38.9
Slovakia (2010)	26.8	9.3	0.6	19.9
Finland (2009)	59.8	32.8	M	M
Ireland (2013)	56.8	33.9	5.9	41.4

Source: HFCS, Arrondel et al. (2014), Lawless et al. (2015).

Similar to the results of the Hungarian survey during the second wave, international data collected during the first wave of the HFCS indicate the prominence of HMR mortgage debt within total household debt (*Bover et al., 2013*; *ECB, 2013*). Income levels also affect the indebtedness of households, as those with higher earnings have access to a broader range of loans compared to low-income households. Households' indebtedness is also shaped by socio-demographic characteristics such as income, age and education. It is characteristic of all countries participating in the survey that more substantial debt holdings are observed in households with higher real wealth and higher education levels and in which the reference person is aged 35–44. Their loans are mainly mortgage-related.

The borrowing habits of households within specific groups can be shaped both by demand and supply processes. Presumably, households with more substantial financial wealth or those whose reference person is older or self-employed make a conscious decision not to apply for larger loans, whereas households with low-income or unemployed reference persons are likely to face credit constraints

(*Costa – Farinha 2012*). We tested both statements – i.e. that wealthier households are less likely to borrow and that lower-income households have no access to loans – on Hungarian data.

Among the studies processing the data of the first wave, several papers analysed the determinants of liquidity constraints. Based on the statistical analysis presenting the main results (*ECB 2013*) on international data, it appears that income and wealth are the most important determinants of access to credit. Liquidity constraints were examined on the basis of specific survey questions, which asked the respondents whether they had (partly or fully) rejected loan applications, or whether they decided not to apply for a loan or credit for fear of being rejected by the bank. Since the answers were based on self-assessment with a high probability of non-response, several studies introduced such proxy variables as the possession of credit cards or overdraft facilities, or the existence of low net (liquid) financial assets. Including these two additional indicators in the analysis of international data, according to the probit model proposed by *Le Blanc et al.* (*2014*), the self-assessment based question did not show a significant variation within the lower-income segment, but in the case of the other two indicators (no credit facility/no credit card; low net financial assets) the probability of liquidity constraints declined in line with an increase in income. Growing wealth reduced the chances of liquidity constraints in the case of all three indicators.

6.2. Main results concerning household debt and stylised facts

One quarter of Hungarian households have some type of consumer credit, and one fifth of the respondents reported to have mortgage loans. The median value of consumer credit is HUF 350,000, and the median of mortgage loans is HUF 3.5 million. The participation rate of households in mortgage loans and in consumer credit is 20 and 26 per cent, respectively. According to *Tárki's Household Monitor* (*2014*), more than 18 per cent of households are indebted to banks; therefore, the level of indebtedness should be significantly higher based on the HFCS. This may be attributed to the fact that the HFCS database includes, in addition to bank loans, private debt and leasing contracts as well.

Income and the magnitude of borrowing are positively correlated. The survey found that participation in mortgage loans gradually increases in line with income levels: in the lowest income quintile 11 per cent of households reported to have mortgage loans, compared to more than 30 per cent in the top quintile (*Table 6*). Participation also increases in the case of consumer credit; however, the two highest quintiles do not show significant differences between the groups. Both in the case of mortgage loans and consumer credit, the median value of outstanding borrowing gradually increases in line with income levels. This means that in the case of consumer credit, it is not the ratio of indebtedness that increases in the top income category, but rather the value of the amounts borrowed.

The participation of households in debt declines gradually in line with an increase in net wealth; in the case of the median value, however, such a clear correlation has not been established. We also examined borrowing characteristics according to net wealth. By definition, a significant fraction of indebted households fall in the first wealth quintile, given that the loan amount reduces net wealth. Accordingly, indebtedness is relatively high within this group, and this category reported the highest median debt value as well. In this regard, however, it should be noted that the group with the lowest level of net (financial) wealth also includes non-homeowner households, which – given the lack of mortgage loans among such households – reduces the share of indebted households in the first quintile. The share of homeowner households – and thus, the level of indebtedness – is higher in the second quintile. Growing wealth reduces the indebtedness of households exponentially, but the median value of outstanding borrowings remains consistently within the range of HUF 3–3.5 million in the case of mortgage loans, while the median value ranges between HUF 250,000 and 350,000 in the case of consumer credit. In other words, although the ratio of indebted households is generally lower in higher wealth categories, the loan amount itself is higher. We address this correlation in more detail below.

Households whose reference person has higher education are more likely to become indebted and the disbursed loan amount is also higher in their case. Households were classified into groups according to the education level of the best-educated member of the given household (primary, secondary or tertiary education). Since education and income are positively correlated, it is not surprising that persons with university/college degrees are more likely to apply for loans compared to those with primary education, and the loan amount is also higher in their case. As is the case with the income variable, in terms of participation in consumer credit or mortgage loans, there is no perceivable difference between households with secondary and higher education. It appears that households in the highest education category are not more likely to become indebted – even though they could – while persons with primary education face credit constraints. We examine the liquidity constraints of the lowest income and education categories in more detail below.

Table 6
Main characteristics of Hungarian household debt

	Mortgage debt		Consumer (non-mortgage) credit	
	median value (HUF)	participation rate (%)	median value (HUF)	participation rate (%)
Total households	3,500,000	20.1	360,000	27.4
Percentile of income				
Less than 20	2,500,000	11.4	300,000	17.3
20–39	2,500,000	12.5	260,000	22.5
40–59	3,000,000	19.5	350,000	27.3
60–79	3,500,000	26.2	380,000	33.6
80–100	5,000,000	30.1	500,000	36.5
Percentile of net wealth				
Less than 20	5,330,000	20.6	500,000	36.1
20–39	3,000,000	25.5	260,000	29.5
40–59	3,000,000	20.7	380,000	26.0
60–79	3,500,000	16.4	260,000	25.4
80–100	3,500,000	17.2	400,000	20.1
Education of reference person				
Primary or less	2,100,000	12.3	190,000	18.5
Secondary	3,000,000	21.9	300,000	30.1
Tertiary	5,000,000	22.8	678,000	28.2

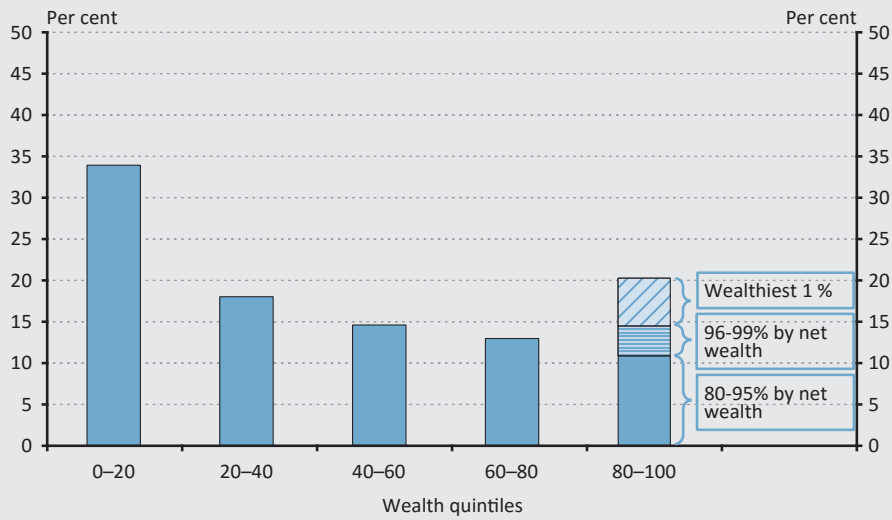
Source: HFCS.

After the presentation of the most important debt-related findings of the survey, we analyse in detail the distribution of outstanding borrowing across wealth categories, the characteristics of liquidity-constrained households and the borrowing motives of households.

Stylised fact 1: Households with more substantial net wealth apply for loans less frequently as they are more inclined to finance their consumption and investments from existing assets. According to *Table 6,* households in the first wealth quintile were more likely to become indebted: they reported the highest median loan amount and their participation rate is also high. As we examine total outstanding borrowing separately in each net wealth quintile, we find that 35 per cent of the loans outstanding were taken by households residing in the first quintile (*Figure 10*). Accordingly, the percentage of loans outstanding declines, albeit to a different degree, as we progress upwards in the medium wealth quintiles. In the top wealth

quintile, however, the percentage of debt becomes higher once again; moreover, the top 1 per cent of the highest net wealth quintile included in the survey hold 5 per cent of total debt. This is consistent with the findings of the study presenting the results of the survey conducted among Irish households, where debt was higher among the wealthiest households than among those with medium wealth (*TASC 2015*). The question arises: what motivates households in the bottom and top income quintiles to apply for loans? Is it borrowing for consumption, or do wealthy households tend to finance residential investment from the debt?

Figure 10
Debt participation according to net wealth by wealth quintile

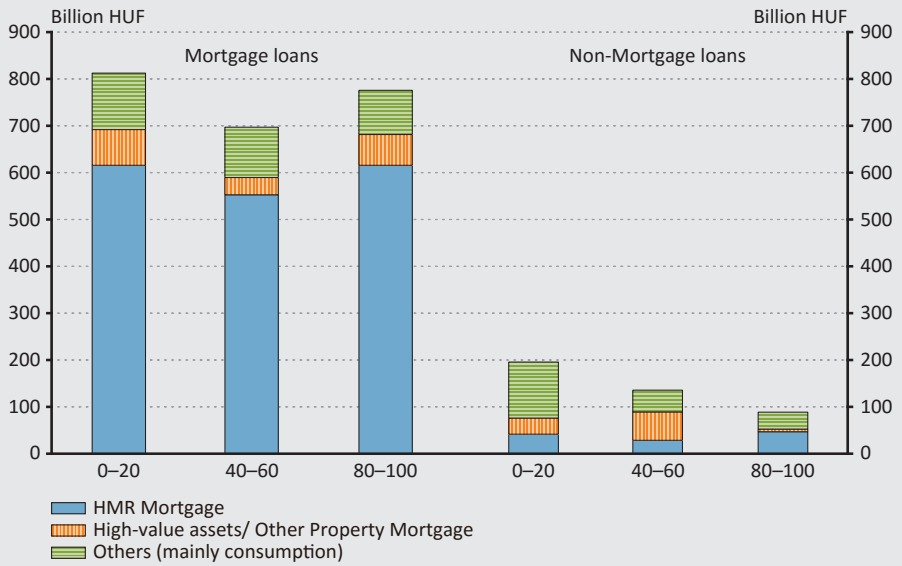


Source: HFCS.

To answer these questions we attempted to identify the motivating factors behind households' indebtedness within each wealth quintile. *Figure 11* shows that home purchase/renovation were dominating factors in households' indebtedness in each wealth category. The higher debt observed in the top wealth quintile compared to medium-wealth groups is also primarily related mortgage loans, in particular, housing loans, but the contribution of mortgage-backed loans taken for valuables was also significant, albeit to a lesser degree. Consumer credit is the least prominent contributor in the top wealth quintile: wealthy households are less likely to finance their consumption from credit than relatively poorer households. Mortgage debt dominates the first wealth quintile as well, but the stock of non-mortgage debt is also high. For lack of sufficient financial assets, households with moderate net wealth are more frequently forced to finance their consumption from debt. Based on the above, although a smaller fraction of wealthier households finance

consumption from debt, this category is far more likely to finance their home purchase investments from loans than less wealthy households.

Figure 11
Debt by loan purpose in the bottom, medium and top wealth quintiles



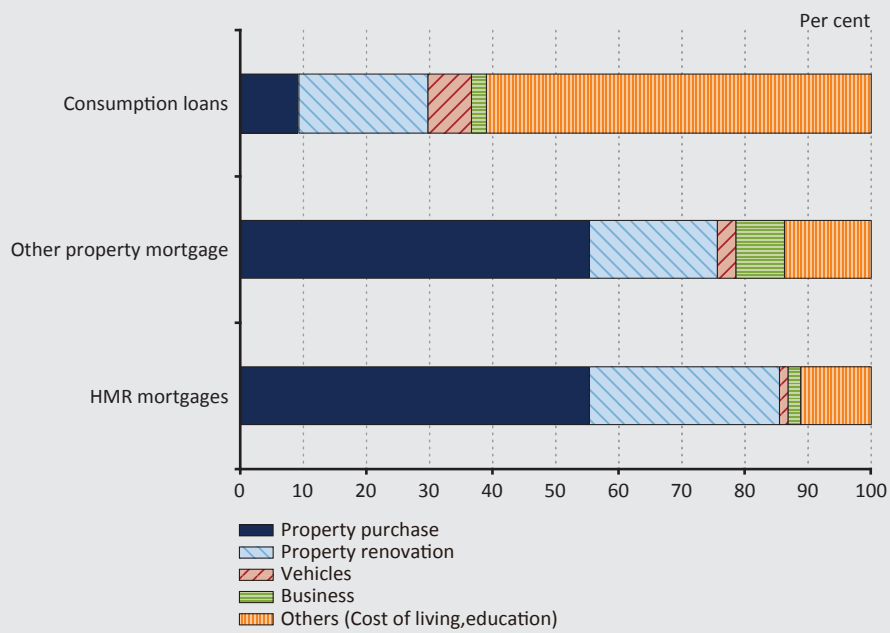
Note: Housing loans: home purchase and renovation. Valuables: second real estate property, vehicle, transportation equipment. Other: Business, repayment of other debt, financing education, financing sustenance.
Source: HFCS.

Stylised fact 2: Borrowing is one of the most important determinants of access to housing; most households apply for loans for the purpose of home purchase. Besides the loan amount disbursed to households, the purposes of the loan are also important factors to consider. During the survey we requested households to identify the purposes of the (mortgage or consumer) loans taken (*Figure 12*). According to the results, nearly 800,000 households had loans collateralised by the household's main residence. In the case of this loan category, the acquisition of a main residence is the primary motivation, affecting nearly half of the population. The second most frequent motive is the renovation of residential property. The number of households identifying the renovation of a residence as the loan purpose was higher than expected, partly because the respondents assumed that the expansion of their main residence should be also included. In addition to the household's main residence, the questionnaire also included questions regarding other real estate property owned by the household. Borrowing motives were fairly similar to those cited in the case of HMR mortgage debt; however, the share of

loans taken for other real estate property is higher in this case; in other words, it is conceivable that households also financed a part of their other property from debt.

Stylised fact 3: Borrowing for consumption is aimed at alleviating liquidity constraints. The picture is more heterogeneous in the case of borrowing for consumption purposes: in addition to loans intended to ease liquidity constraints, borrowing "for investment purposes" (education, home renovation) is also typical. The motives behind borrowing for consumption are more heterogeneous: besides renovation, borrowing for supporting sustenance, borrowing for other purposes and borrowing for the repayment of debt or for the financing of education each represents a nearly identical weight of 10–14 per cent. At the same time, only 7 per cent of households with consumer credit indicated that the loan purpose was vehicle purchase. This may be because households had repaid a substantial portion of their pre-crisis vehicle loans already, and after the crisis they presumably opted for financing their vehicle purchases from own funds. Interestingly, some households applied for consumer credit in order to purchase their main residence – these households may have tried to put up the downpayment required for the home purchase by resorting to consumer loans.

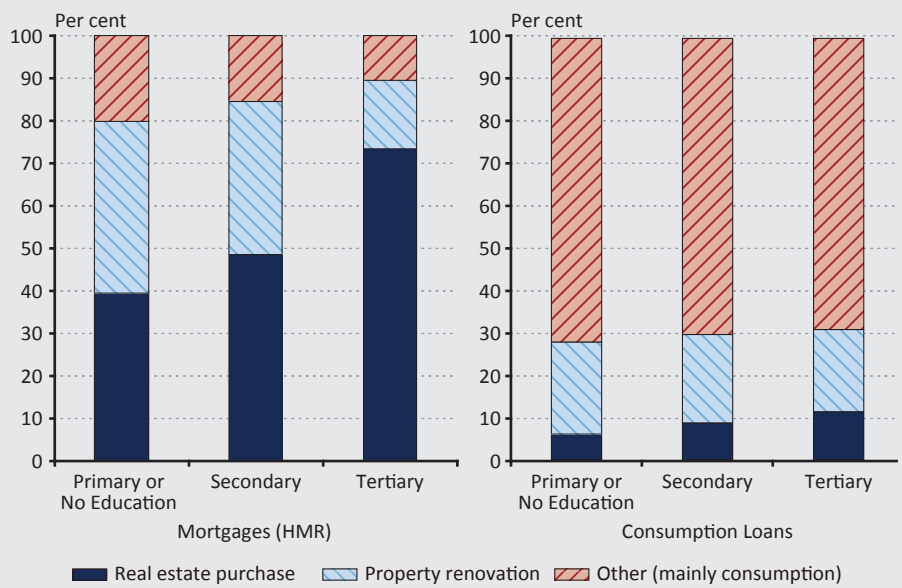
Figure 12
Motivations behind household borrowing by loan category



Source: HFCS.

Stylised fact 4: While poorer households take out loans to support their sustenance needs, wealthier families tend to spend the loan amount on purchasing high-value items, primarily real estate. Borrowing for the acquisition of a household main residence is typical among heads of household with higher education. We also examined whether the motivations behind borrowing change in function of the education level of income-earner, adult household members (*Figure 13*). We then checked the most frequent purposes of mortgage-backed housing loans and consumer loans among these households. As regards mortgage loans, the frequency of housing loans rises in line with the parent's education level. In the case of parents with lower education levels – presumably because of the lower level of household income – the most typical loan purpose is the financing of home renovation or the financing of consumption expenditures. The picture is less heterogeneous in the case of consumer credit: the groups defined on the basis of households' education level reported fairly similar proportions. The analysis performed on the basis of income quintiles yielded very similar results.

Figure 13
Motivations behind household borrowing by education level



Source: HFCS.

7. Summary

This study was intended to provide a detailed account of the main results of the first harmonised, detailed survey on Hungarian households' financial saving and consumption habits. After the crisis, there was a growing need to compile detailed microstatistics in order to provide deeper insight into economic processes. Hungary joined the second wave of the *Household Finance and Consumption Survey* (*HFCS*) initiated by the European Central Bank. Relying on a harmonised methodology to map the wealth position of households, the survey yielded internationally comparable data.

In our study, we presented the main results of the Hungarian survey, comparing them to the currently available international findings of the first wave. We analysed the real and financial assets and loans of households and provided a comprehensive overview of income and wealth distributions. We relied on survey data and the international literature to propose stylised facts that may assist in clarifying the results of the survey even further.

Based on the above, we can establish in general that the key priority of Hungarian households is to own their main residence. This is also the primary purpose of their borrowing in general, allowing them to purchase higher-value residential properties. Examining the financial assets of households in general, we found that, while 40 per cent of households have no considerable financial wealth, a substantial portion of households' assets is concentrated within a single, narrow social segment. Net wealth – including real assets – is distributed more evenly than financial assets, which can be explained by the high percentage of Hungarian households owning their main residence. As regards financial assets, Hungarian households appear to have a preference for more liquid forms of saving. A greater diversification of financial assets can only be observed among higher-income households.

However, covering more than 6,200 households, the database offers numerous additional research opportunities. By exploring the demographic and income processes in more detail, providing a more in-depth analysis of specific topics and using regression analysis, we may gain deeper insight into the saving and borrowing habits of Hungarian households.

References

Andreasch, M. – Lindner, P. (2014): Micro and Macro Data: A Comparison of the Household Finance and Consumption Survey with Financial Accounts in Austria. *ECB Working Paper Series,* No. 1673, May.

Arrondel, L. – Bartiloro, L. – Fessler, P. – Lindner, P. – Mathä, T. – Rampazzi, C. – Savignac, F. – Schmidt, T. – Schürz, M. – Vermeulen, P. (2014): How do Households Allocate Their Assets? Stylized Facts from the Eurosystem Household Finance and Consumption Survey. *Discussion Papers 12,* Deutsche Bundesbank, Research Centre.

Balás, T. (2013): Households: Indebtedness and Debt Service Ratio. *MNB Bulletin,* Special Issue, October 2013.

Bezrukovs, D. (2013): *The Role of Housing in Wealth Inequality in Eurozone Countries.* Online: *https://www.ecb.europa.eu/events/pdf/conferences/131017/papers/Session_6_Bezrukovs.pdf?8b6bb34eeb0e37d0b53a1b71c69d2fe3* Downloaded: 23 August 2016

Bover, O. – Casado, J. – Costa, S. – Caju, P. – McCarthy, Y. – Sierminska, E. – Tzamourani, P. – Villanueva, E. – Zavadil, T. (2014): The Distribution of Debt Across Euro Area Countries. The Role of Individual Characteristics, Institutions and Credit Conditions. *ECB Working Paper Series,* No. 1639, February.

Bukodi, E. – Róbert, P. (2000): Vagyoni helyzet – kulturális fogyasztás (Wealth Status and Cultural Consumption). *Social Report,* Volume 6, No. 1, pp. 346–376.

Costa, S. – Farinha, L. (2012): Households' Indebtedness: A Microeconomic Analysis Based on the Results of the Households' Financial and Consumption Survey. *Financial Stability Report,* May, Banco de Portugal.

Cserháti, I. – Keresztély, T. (2010): A megfigyelési egységektől a makrogazdasági aggregátumokig — a mikroszimulációs modellezés néhány módszertani kérdése (From Observation Units to Macroeconomic Aggregates – A Few Methodological Issues of Microsimulation Modelling). *Hungarian Statistical Review,* Volume 88, No. 7–8, pp. 789–802.

Dancsik, B. – Fábián, G. – Fellner, Z. – Horváth, G. – Lang, P. – Nagy, G. – Oláh, Zs. – Winkler, S. (2015): Comprehensive Analysis of the Nonperforming Household Mortgage Portfolio Using Micro-Level Data. *MNB Occasional Papers,* Special Issue, October.

Du Caju, Ph. (2013): Structure and Distribution of Household Wealth: An Analysis Based on the HFCS. *National Bank of Belgium Economic Review,* September.

ECB (2013): The Eurosystem Household Finance and Consumption Survey – Results from the First Wave. *Statistics Paper Series,* No. 2, April.

Fessler, P. – Schürz, M. (2015): Private Wealth Across European Countries: The Role of Income, Inheritance and the Welfare State. *ECB Working Paper Series,* No. 1847, September.

Gáspár, K. – Varga, Zs. (2009): A bajban lévő lakáshitelesek elemzése mikroszimulációs modellezéssel (Analysis of Housing-Loan Borrowers in Difficulty, Using Micro-Simulation Modelling). *Economic Review,* Volume LVIII, pp. 529−542, June.

Holló, D. (2007): Household Indebtedness and Financial Stability: Reasons to be Afraid? *MNB Bulletin,* November.

Honkkila, J. – Kavonius, I.K. (2013): Micro and Macro Analysis on Household Income, Wealth and Saving in the Euro Area. *ECB Working Paper Series,* No. 1619.

Hosszú, Zs. (2011): Pre-Crisis Household Consumption Behaviour and its Heterogeneity According to Income, on the Basis of Micro Statistics. *MNB Bulletin,* October.

Kaas, L. – Kocharkov, G. – Preugschat, E. (2015): Wealth Inequality and Homeownership in Europe. *CESifo Working Paper,* No. 5498.

HCSO (2016): *Miben élünk? A 2015. évi lakásfelmérés főbb eredményei (What do We Live In? Main Results of the 2015 Housing Survey).* Online: https://www.ksh.hu/docs/hun/xftp/idoszaki/pdf/miben_elunk15.pdf Downloaded: 23 August 2016.

Lawless, M. – Lydon R. – Mcindoe-Calder T. (2015): The Financial Position of Irish Households. *Quarterly Bulletin Q1,* Central Bank of Ireland.

Le Blanc, J. – Porpiglia A. – Teppa, F. – Zhu, J. – Ziegelmeyer, M. (2014): Household Saving Behaviour and Credit Constraints in the Euro Area. *DNB Working Paper,* No. 428, July.

OECD (2015): *In It Together: Why Less Inequality Benefits All*. OECD, ISBN 9789264235120.

Simon, B. – Valentiny, Á. (2016): Miből élünk? Az első átfogó hazai háztartási vagyonfelmérés bemutatása (What Do We Live On? An Overview of the First Comprehensive Hungarian Household Wealth Survey). *Hungarian Statistical Review,* Volume 94, No. 7.

Stiglitz, J. – Sen, A. – Fitoussi, J.P. (2009): *Report of the Commission on the Measurement of Economic Performance and Social Progress*, Paris. Online: http://library.bsl.org.au/jspui/bitstream/1/1267/1/Measurement_of_economic_performance_and_social_progress.pdf Downloaded: 11 May 2016.

Szabó, Zs.K. (2004): Nemzetközi körkép a háztartás-statisztikai felvétel gyakorlatáról (A Comprehensive Overview of the International Practice of Household Statistical Surveys). *Hungarian Statistical Review,* Volume 82, No. 5, pp. 478–491.

Szivós, P. – Tóth, I.Gy. (2013): *Egyenlőtlenség és polarizálódás a magyar társadalomban (Inequality and Polarisation in Hungarian Society).* Tárki Monitor Reports 2012, Budapest, April.

Szivós, P. – Tóth, I.Gy. (2015): *Jól nézünk ki (?!) Háztartások helyzete a válság után (Looking Good [...?!] – The Situation of Households After the Crisis).* Tárki Monitor Reports 2014, Budapest, March.

TASC (2015): *The Distribution of Wealth in Ireland* Online: http://www.tasc.ie/download/pdf/the_distribution_of_wealth_in_ireland_final.pdf Downloaded: 11 May 2016.

Value-Creating Uncertainty – A Real Options Approach in Venture Capital

Balázs Fazekas

This article investigates how venture capital is able and willing to enter the scene of innovative startup enterprises as a primary source of finance, despite the significant degree of uncertainty surrounding these firms. The paper explores venture capital's unique risk attitude by proposing a real options approach. The tools and mechanisms applied by venture capitalists enable them to take advantage of the flexibility and uncertainty associated with startups, to exploit the value-enhancing ability stemming from continuous corporate learning, and to profit from the opportunities offered by such firms. As a result, young, innovative enterprises receive a higher rating from venture capital investors who are willing to participate and compete with other sources of finance in the financing of such enterprises. At the same time, the article points out that adapting the valuation applied in the case of financial options to venture capital investments is methodologically problematic; supplementing the real option valuation by decision trees may better capture the value-enhancing effect of the flexibility inherent in startups.

Journal of Economic Literature (JEL) codes: G24, O31, M13

Keywords: venture capital, innovation, startup, real options

1. Valuation problems in the case of venture capital investments

Classical venture capital investments[1] primarily focus on startups; consequently, in order to understand the operational mechanism and unique nature of venture capital, it is essential to define this corporate category and its characteristic features. Startups are institutions based on human capital designed to create a new product or service under conditions of extreme uncertainty (*Ries 2011*). This definition involves four key factors: the key role of human capital, organisational structure, innovation and high uncertainty.

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The author would like to thank Patrícia Becsky-Nagy for her invaluable assistance during the writing of this paper.

Our editorial office received the first version of the manuscript on 8 September 2016.

[1] Classical venture capital denotes a group of private equity investments that is specifically aimed at the financing of young, innovative enterprises.

Startups are innovative enterprises that bring new, novel products to the market. This novelty can be fairly diverse: it could be a new scientific discovery, a novel application of existing technologies or methods, a new business model or know-how, or an innovative use of an existing product. Due to the innovative nature of these enterprises, the operation of startups is associated with a significant degree of uncertainty. It is primarily the factor of extreme uncertainty that defines all operating areas of startups, and it accounts for the differences between the management techniques and areas applied in the case of mature companies operating in traditional industries.

Although the definition proposed by Ries (*2011*) does not define the criteria of high growth potential explicitly, it is an important feature of startups stemming from the high degree of uncertainty. Indeed, uncertainty is a double-edged sword that includes the possibility of both unfavourable and favourable outcomes. The high probability of a negative outcome is demonstrated by the high ratio of bankruptcy among startup companies. At the same time, the fact that successful enterprises can increase their business value many fold over the short run is a testimony to their high growth potential.

The valuation of young, innovative enterprises is a peculiar area of business valuation, due to the special features of such companies; for this reason, in their case traditional business valuation methods cannot be applied properly and cannot provide a realistic view. The conditions for the application of DCF methods are not in place in the case of young, innovative firms. Firstly, these firms may not even have assets upon which a prediction of future cash flows could be based, or their operating history is too short to provide a reliable estimate about the assets' cash-generating capability. Another problem is posed by the fact that a significant part of the costs (is expected to yield) returns only in future; therefore, the earnings potential of the enterprise cannot be determined clearly. Determining the growth rate is another key question in the valuation of young enterprises that cannot be answered – supported by adequate valuation methods – satisfactorily. Growth estimates are especially significant in the case of venture capital investments as venture capitalists primary seeking the high growth potential (*Chemmanur et al. 2011*).

As Damodaran (*2009*) pointed out, value creating growth arises only when a firm generates a return on capital greater than its cost of capital. To determine an adequate discount rate, a required rate of return estimated in accordance with the Capital Asset Pricing Model (CAPM) developed by Sharpe (*1964*) can be applied in the case of equity-type sources of finance. Young firms, however, pose estimation challenges as the relative risk ratio that plays a pivotal role in the model (β) can only be estimated on backdata, which are not available for newly established enterprises. Moreover, the CAPM assumes that only undiversifiable market risks

are relevant to the investor, as the model postulates well-diversified investors. If, however, this condition is not in place, as is the case, for example, with the founders of the firm, who typically invest a substantial portion of their wealth in the firm, and unique, company-specific uncertainty will also play an important role. Such idiosyncratic risks play a particularly important role at innovative enterprises, as systemic risk is not the greatest risk such firms need to face: it is the idiosyncratic risk component that plays the most dominant role (*Cochrane 2005, Ewens et al. 2013*). As a result, the CAPM's exclusive focus on systemic risks is disadvantageous for venture capitalists (VC's) as well.

The conditions for the application of traditional DCF-based valuation are not in place in the case of venture capital investment valuations; this method fails to estimate the value of these companies adequately and yields unrealistic results. Relative valuation applies various indicators to assess the firms compared to other companies, but even these relative valuation techniques are exposed to the problems specific to young companies, due to the unique characteristics of such firms, which impedes the application of DCF-based valuation methods.

First of all, it is difficult to identify both the indicator which might be an adequate point of reference and the company or companies that could be the basis for comparison. Only a company similar to the company to be evaluated can serve as a benchmark. This, however, gives rise to a Catch-22 situation: if we manage to identify a similar firm, we will face exactly the same problems in determining the indicators as the ones encountered in the case of the company to be assessed. Moreover, since these similar companies are presumably not listed on the stock exchange, their market value is not available explicitly. In selecting the benchmark, the most expedient choice (the lesser evil) is to select a listed company operating in a similar sector which, however, has completely different risk, return and growth features. Controlling for the low survival rate of the companies and risk measurement are other challenging areas of relative valuation.

2. Appearance of real options in venture capital investments

As we have seen above, traditional valuation techniques do not provide an accurate estimation of the value of startup companies, primarily because these valuation methods fail to properly address the uncertainty and flexibility inherent in startups (*Abrams 2010*). The innovation processes of startups imply continuous uncertainty as the environmental effects and the learning process induce changes in the activity of the enterprises. The key question in valuation is how to compute and address the uncertainty and flexibility inherent in startups. This can be accomplished by applying the real options method. Using the real options reasoning, analysts can present the increase in business value generated by the learning curve of startups on the one hand, and on the other hand, they can explore why venture capital is able and willing to appear as a primary source of finance in this particular corporate category.

The wave model developed by Szerb (*2006*) demonstrates the changes in the enterprise's need for and access to external funds during the different lifecycle stages of the enterprise, with regards to the different financing types. The model is based on the fact that different amounts and different types of financing are available to the enterprise in its individual lifecycles, and the firm's demand for funds is also not linear: at certain stages demand increases sharply, followed by stagnation within the cycle. According to Szerb's (*2006*) conclusions, young, newly established companies may face funding gaps when enterprises with significant growth potential are unable to obtain sufficient funds due to the insufficient supply of financing sources. The primary reason behind the emergence of funding gaps is the high information asymmetry associated with this particular corporate category (*Becsky – Nagy 2014*). Moreover, few investors are willing to put up with the high degree of uncertainty characterising these firms (*Karsai 2010*). Venture capital plays an important role in the narrowing of this funding gap (*Nagy 2004*).

According to the literature, VC's may participate in the financing of young, innovative firms leveraging their special expertise.[2] This expertise allows for the efficient selection of investment-worthy companies and hence, it assists in resolving the problem of adverse selection; furthermore, through the cooperation following the investment the investors are able to create added value for their portfolio companies (*Chemmanur et al. 2011*).

Real options can be viewed as a decision-making method, valuation technique or a tool for strategic planning (*Driouchi – Bennett 2012*). A real option is an investment in organisational capabilities, physical and human assets that provides the opportunity to respond to potential future events (*Kogut – Kulatilaka 2001*). The real options approach underpins that, in addition to the explanation presented above, it is venture capital's special attitude to uncertainty that prompts it to finance young, innovative firms. The real options valuation of venture capital is rooted in the fact that the tools and mechanisms of this financing form enable investors to take advantage of the flexibility of startups and to exploit the value-enhancing ability stemming from continuous corporate learning. Accordingly, it can profit from the options offered by the enterprises while also creating new options. In this sense, the flexibility and uncertainty inherent in the enterprises are factors enhancing business value (*Rózsa 2004*), which can be leveraged with the assistance of the knowledge and resources offered by VC's. The institution of classical venture capital financing emerged as an answer to the financing difficulties of young, innovative enterprises; its evolution process shaped those characteristic features and instruments of venture capital that allow VC's to take advantage of the potential behind these enterprises.

[2] See, for example: *MacMillan et al.* (*1998*), *Fried, V. H. – Hisrich, R. D.* (*1994*), *Harding* (*2002*), *Karsai* (*1997*).

The real options approach not only builds on the expertise of VC's as emphasised in the literature, but also supplements it. It should be noted that uncertainty in itself does not create options; management's ability to recognise and leverage options is a crucial component as well (*Copeland – Keenan 1998, Miller 2002*). Profits can only be realised from the options offered by the enterprises if the required knowledge, tools and resources are available (*Rangan 1998*). Consequently, the potential value-generating effect of uncertainty will only arise if the conditions required for recognising, shaping and implementing the options are in place.

By being actively involved in the enterprise, VC's can influence the operation of the company and the future of their investment. In addition, they are in possession of the human capital, business and management skills (*Carvalho et al. 2005*) required for the recognition of the options. The financing mechanisms of venture capital, such as multi-stage financing, monitoring, the application of convertible securities, are tools applied by investors that allow them to benefit from the real options available at the enterprise.

The application of multi-stage financing enables VC's to provide the total capital requirement of the investment in several instalments, after the enterprise has achieved certain pre-defined milestones. Consequently, VC's can test the performance of the firm with relatively small funds invested; they can gather information on its operation and, based on the information obtained, they can reject the possibility of further financing if the firm proves to be non-viable or continue to provide funding in the case of positive market feedbacks. Thanks to the information gleaned from the operation of the firm, the potential markets of the startup can be explored and a modification of the basic idea may even attract new markets, giving rise to growth options. Financing via convertible bonds is of key significance for VC backed enterprises (*Kaplan – Strömberg 2003*). Such securities can reduce losses in the event of the enterprise's failure, because, retaining its credit nature, it precedes equity during the liquidation of the company, giving the investor a senior claim and at the same time, in the case of conversion it guarantees the benefits from any increase in the business's value for the investor (*Hellmann 2006*).

Through the real options approach it is easy to see why venture capital is willing to participate in the financing of startups despite the uncertainty involved. In the case of options, the volatility of the underlying product has a positive impact on the value of the options; in the case of high uncertainty, the existence of real options lowers the semi-variance of the investment, but because of the extreme deviations from the expected value, the investor has a possibility to obtain extremely high returns.

Since there are no other financing forms where, as is the case with venture capital, a toolset is available to take advantage of the options offered by the firms, in the case of all other financing sources an increase in uncertainty will reduce the value

of the investment. If, however, the investment is viewed as a real option, this uncertainty will become a value-enhancing factor (*Yeo – Qiu 2003*). This increase in value, in turn, may influence investment decisions; indeed, if the upside potential of real options is ignored in the valuation of startup companies, the firms will be underestimated, which might lead to the rejection of investment opportunities. By contrast, when the value-enhancing effect of real options is factored in, VC's may attach a higher value to such firms, increasing the odds of potential venture capital financing.

3. Real options valuation methods and their limitations

Real options, therefore, are clearly present in the case of venture capital investments, and the real options reasoning demonstrates their value-enhancing effect on portfolio companies. In order to define this added value, in addition to the real options argument, the toolkit of real options valuation should also be checked against venture capital investments. Ever since *Myers* (*1984*) proposed the application of option pricing in the case of real instruments with underlying flexibility and introduced the concept of real options, real options valuation has become a widely discussed topic and has gone through a great degree of development. The questions about the proper application of the method, however, remained open. After the initial enthusiasm, the limitations of transposing the procedures applicable in the case of financial options have increasingly come to the foreground and the focus shifted to the methodological problems affecting the application of real options valuation primarily for the following reason. Even though the functioning of financial markets tends to converge to the assumptions on which the methods used for the valuation of financial options are based (although they do not fully hold even there), corporate investments may still be far from satisfying these assumptions.

The pricing of financial derivatives is based on replicability (*Medvegyev 2011*); in other words, with the combination of a risk-free instrument and the underlying instrument, it assumes the creation of portfolios whose future payment corresponds to the payment of the derivative. This is because the derivative's source of risk is the underlying instrument itself, and since they are in perfect correlation, by taking the appropriate positions consistency between the payment of the two portfolios can be ensured. A risk free portfolio can be created by adjusting the weight of the underlying instrument and the derivative in the portfolio properly, where the rate of return on the portfolio should be identical with the risk-free interest rate (*Black – Scholes 1973*). This argument allows for no-arbitrage pricing and risk neutral valuation (*Dömötör 2011*), which renders the estimation of the risk premium – which might be subjective and hence, may bias the results – unnecessary. Instead,

risk neutral valuation allows for the objective and consistent application of the risk-free interest rate for option pricing.

Real options valuation was conceived in response to the problem that, in the case of flexible real asset investments, no discount rate can be defined that properly reflects the uncertainty of the investment and the reactions of decision-makers to various outcomes. As *Trigeorgis* (*1996*) pointed out, no-arbitrage pricing and risk neutral valuation can be achieved – similar to financial options – even in the case of real assets, by using comparable replicating securities of similar risk; consequently, the tools of options valuation can be used in the case of investments in real assets with inherent flexibility. However, while the risk source is identical for both the underlying instrument and the related derivative in the case of financial options and the investor can construct a replicating portfolio generating the return of a risk-free security, similar financial products are not available in the case of real assets; therefore, the conditions for risk neutral valuation are not in place.

The transposition of options valuation to the environment of real asset investments may offer a seemingly elegant solution for the valuation of the flexibility behind the investments, and enables analysts to circumvent the estimation of expected returns, which – as *Száz* (*2011*) pointed out – may be arbitrary and elusive. At the same time, when the formulas created for the valuation of financial options are applied in situations where the required conditions are not in place, we may receive biased results.[3]

Table 1 summarises the approaches aimed at the valuation of investments with the methods of option pricing.[4] The classical approach suggested by *Amram – Kulatilaka* (*1999*) applies the models used for the valuation of financial options to the valuation of real options, taking the conditions existing for financial options as a given. As we can see, the classical approach proved to be the only purely option-based evaluation attempt. It is, however, indicative of the limitations of the model's applicability that the authors were subsequently forced to revise and modify the classical approach, recognising that – due to the unique, project-specific uncertainty involved in the case of real assets – it is impossible to create a portfolio that is a perfect copy of derivative payments; consequently, risk neutral evaluation is also impossible.

[3] Think of a watch whose condition for use is that it is not water-resistant. It will show completely different times outside of the water than under the water.
[4] For a detailed methodological description of individual valuation procedures, see Borison (2005).

Table 1
Real options valuation methods and their applicability

	Assumption	Valuation model	Applicability:
The classic approach (Amram – Kulatilaka 1999)	Replicating portfolios can be constructed from traded products; i.e. the existence of a replication security is assumed that correlates perfectly with the investment and moves closely together with a geometric Brownian motion; consequently the no-arbitrage argument is sound.	A method applied for the valuation of financial options such as the BS or the CRR model based on the market data of the replication security.	Conditions for the classic approach are rarely given. It can be applied if an adequate traded replicating security exists. In the lack of such instrument, however, if project-specific idiosyncratic risks are determinant, the method cannot be applied.
Subjective approach (Luehrman 1998)	It assumes the existence of a replicating portfolio and therefore the applicability of no-arbitrage arguments. It also assumes the portfolio's co-movement with a geometric Brownian motion.	A method applied for the valuation of financial options such as the BS or the CRR model based on the 'price' derived from the DCF-based valuation of the project and estimated volatility.	While the data of the replicating portfolio do not play a key role in the valuation, the reliability of subjective data is questionable. For lack of a replicating portfolio, the application of a valuation method founded on the no-arbitrage argument is inconsistent.
Marketed asset disclaimer (MAD) approach (Copeland – Antikarov 2001)	The replicating security is the project's NPV itself, without flexibility; therefore, the assumptions are the same as those applicable to the use of NPV: the computation of expected returns is based on the existence of (replicating) securities of similar risk. Asset price movements can be described by geometric Brownian motion.	Valuation with a binomial tree method. A CAPM-based discount rate is applied for the calculation of the project's NPV. A subjective estimate of cash flows and volatility.	There is no need for a replicating portfolio. Owing to the subjectivity of the data, assets and options might be mispriced. Estimating subjective data is problematic. A security of similar risk is required for proper NPV calculation.
Revised classic approach (Amram – Kulatilaka 2000)	The model supplements the classic approach, given that the classic approach is based on fairly restricting assumptions. It cancels the assumptions of the former.	Application of decision trees. Allocation of subjective odds to individual outcomes. Subjective estimate of cash flows. NPV calculation by using the appropriate WACC discount rate.	Its application is justified when project-specific risks dominate instead of the risk priced in by the market. Due to the subjectivity of data, mispricing can occur.
The integrated approach (Smith – Nau 1995)	Partially complete market: complete market in terms of market risks, but incomplete market in terms of project-specific (private) risks.	The option pricing model is applied to risks that can be hedged by traded securities and decision trees are applied to project-specific risks.	Due to the integration of the decision tree and the option pricing methods, this approach can be universally applied. Market risks and project-specific risks need to be separated. The perception of project-specific risks is subjective.

Source: Own compilation based on Borison (2005).

With respect to the different valuation approaches it was an important recognition that only a part of the uncertainties surrounding real assets can be considered market-priced risk,[5] while the remainder of the uncertainties can only be assessed by subjective methods. As a result, however tempting it may be, some estimation of the expected return cannot be circumvented in real options pricing. Similarly, as we have seen in the summary of the valuation models, classic option pricing methods are supplemented or replaced by simulation, NPV-based or decision-tree valuation components. Selecting between the models outlined in *Table 1* primarily depends on the risk profile of the given investment and on the extent to which the decisions made during the life of the investment are surrounded by project-specific uncertainties versus risks that can be objectively assessed with the assistance of a benchmark investment or security.

4. Application of the real options valuation in venture capital investments

While option pricing assumes complete markets, it is specifically the market imperfections characterising their portfolio companies that provide the niche exploited by venture capital investors (*Becsky-Nagy – Fazekas 2015*). If real options valuation is to be used for the purposes of venture capital investments, first we need to examine the risk profile of such investments. This investment form is typically aimed at enterprises and manifested in projects which, due to their previously discussed innovative nature, can be viewed as unique in the market. Accordingly, these investments tend to be dominated by a high degree of risk and uncertainty that are typically project-specific, idiosyncratic risks. The unique uncertainties surrounding venture capital investments, however, fundamentally define and at the same time, restrict the valuation procedures applied to the options written for traded financial products, as the replicating security constituting the basis of these methods cannot be found. Consequently, it is not possible to define the weights that are to be allocated to specific outcomes and that are required for options valuation to ensure reliable risk neutral valuation.

As a result, it is not enough to simply use the pricing techniques applied in the case of purely financial options for the valuation of venture capital investments; these techniques should be supplemented by additional methods. The integration of decision trees and options valuation – as described by *Smith – McCardle* (*1998*) and *Smith – Nau* (1995) – may offer a solution for capturing flexibility.

[5] For the purposes of discussing the topic, it is important to distinguish between risk and uncertainty. According to *Bélyácz* (*2011*), the concept of risk denotes known possible outcomes with known probabilities assigned to them, while in the case of uncertainty the probabilities associated with specific outcomes are unknown, and even possible outcomes are not necessarily unambiguous.

The basis of the valuation is the decision tree that represents the decision alternatives arising during the life of the investment. In the case of venture capital investments, decision alternatives are typically related to product development, market entry and exit, although they may be fairly broad-ranging depending on the sector and on the focus of the investment. Alternatives arising at the product development stage could be the continuation or the rejection of the project. The option of rejecting the project is typically stipulated in investment contracts in the form of multi-stage financing, where each stage is subject to certain conditions. As a result, depending on the capital requirement of the given period or the capital required for achieving a pre-defined milestone, partial disbursements are made from the funds required for the financing of the project. In addition, modification options may arise at the product development stage due to the innovative nature of the firms and continuous corporate learning. As regards market entry, the greatest source of uncertainty is the level of demand, in relation to which growth options may occur in the investments.

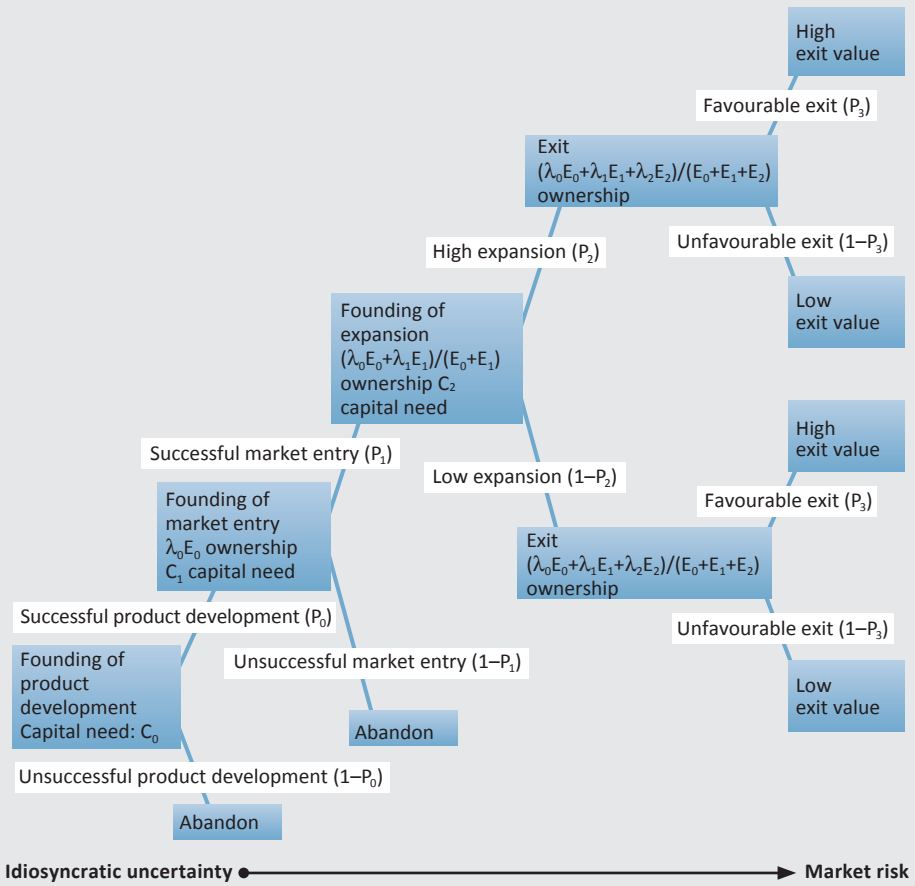
Essentially, based on risk features, the integrated approach classifies individual decision alternatives into two categories, distinguishing between market risks that can be hedged by trading securities and private uncertainties, where similar hedging is not an option. In the case of decision alternatives, therefore, it is important to assess whether the source of risk for the given alternative is a market factor or a company-specific private factor. While in the case of the former, copycat portfolios may be constructed and thus risk-neutral weights can be defined and applied for valuation purposes, in the case of the latter, subjectively estimated odds are allocated to individual outcomes in order to evaluate each available possibility, also in consideration of investors' risk preferences.

In the case of venture capital investments, the different stages of the company's lifecycle and the risk sources determining the decision alternatives are not independent of each other. The risks surrounding the decisions made during the seed stage of the investment are typically company-specific uncertainties and can be estimated by subjective methods. By contrast, with the decisions arising during subsequent stages, following market entry, the focus shifts to market risks. This stage opens up the possibility of the application of financial option pricing.

Figure 1 illustrates the basic decision-making possibilities arising during the life of venture capital investments aimed at young, innovative firms.[6] By investing into a particular firm, the investor acquires a stake in the company and at the same time, he also acquires an option to keep financing the firm if the company proves to be valuable. This further increases the investor's stake, which can be subsequently sold

[6] Since individual decision alternatives are company-specific, there is no universal model to describe the real options valuation of venture capital investments based on the integrated approach; at the same time, however, the individual steps of the valuation can be generalised for evaluating the investments.

Figure 1
Decision tree to illustrate the options arising during the life of venture capital investments



Note: 'λ_t' means the new stake acquired after the investments, and 'E_t' means the increment in the firm's equity at date 't'. Pt means the odds and weights allocated to the outcomes of individual decisions.
Source: Authors' compilation.

at a favourable price during the investor's exit if the firm's value has increased.[7] If the firm's value has declined, however, the option of further financing is rejected, which protects the investor from sustaining further losses in addition to the initial, typically smaller-scale, investment.

[7] For example, in the case of the first investment, by making investment C_0, the investor obtains the option to acquire, if he opts for continuing to finance the firm, an additional stake in the company through capital investment C_1. Financing will continue if the expected cash flows of the investment exceed the capital requirement of the investment.

In order to define the expected values linked to the individual points of the tree, individual outcomes should be weighted. The seed stage is clearly dominated by unique uncertainties; therefore, only subjective estimates are available to define the odds of each individual outcome. By contrast, market risks become increasingly prominent as the exit draws near (*Korteweg – Nagel 2016*). At this stage, by using a similar security and constructing risk neutral weights, the methods used for the pricing of financial options also become applicable. As to how much investors can rely on market data versus subjective estimates for decisions arising between these two points in time depends on how unique the company's activity is and the extent to which it is comparable to the securities of similar enterprises.

The optimal decision strategy and the estimated value can be defined by 'rolling back' the decision tree. VC's can realise the returns on their investments by selling their stake and exiting the company; consequently, their objective is to maximise the exit value of the stake acquired (*Becsky-Nagy 2006*). The value of the investment can be defined by rolling back the cash flow expected upon exit; in other words, the investor needs to define the discounted value of the cash flows expected upon exit for each individual outcome (i.e. cash flows reduced by the amount of the investments) in such a manner that only the value of the decision representing the highest value is considered.

Integrated with options valuation, a similar use of decision trees will enable analysts to model the flexibility in individual investments and to present the decision alternatives underlying the investments. At the same time, since the valuation procedure is itself a combination of various methods, interpreting the result might be ambiguous. While options valuation would show the market value of a given investment objectively, the value derived from the application of decision trees and subjective valuation methods and from the integration of investors' risk preferences in the discounting of cash flows cannot be considered to be the market value of the given investment. This integrated valuation approach can be primarily used as a tool of an optimal investment strategy, supporting investors in making their decisions.

5. Summary

This article attempted to investigate how venture capital can and is willing to enter the field of innovative startup enterprises as a primary source of finance, despite the significant degree of uncertainty surrounding these firms. The conclusion of the article is that the answer to this question should be sought in the unique attitude of venture capital to uncertainty, which can be best described by the real options approach to venture capital investments. Venture capitalists rely primarily on their professional experience to efficiently select the investment-worthy companies, thereby reducing the efficiency losses caused by adverse selection in the market.

On the other hand, they can contribute to the increase of firm's value during the cooperation following the initial investment. This article supplemented this explanation that is prevailing in the literature.

The description of startup companies showed that the innovation processes of these firms generate a great deal of uncertainty, but with the assistance of organisational learning and sufficient flexibility, these processes provide the possibility of a significant, sharp increase in the firm's value. Through the use of various tools and mechanisms – such as personal involvement, monitoring, multi-stage financing, the application of convertible bonds – VC's can take advantage of the real options offered by the investments and leverage their toolkit to shape these options. Real options are designed to impose a lower limit on the risks of individual investments (in order to mitigate losses), while the odds of upside uncertainties (the possibility of high returns) are retained.

The question is how to determine this added value. The market of corporate investments and the market of products traded in financial markets are very different; therefore, the methods designed to valuate financial options cannot be fully transposed to real options valuation. The source of the high degree of uncertainty characterising the initial stages of enterprises can be typically attributed to company-specific factors and decisions which, due to their unique nature and in the absence of an adequate benchmark, can only be estimated by subjective methods. With the progress of the company's lifecycle market risks become increasingly prominent, which allows for the application of the methods designed for the valuation of financial options during these stages. Consequently, the flexibility of the investments and the decision alternatives can be best captured by a combination of options valuation and the decision tree approach, also in consideration of the special features of venture capital.

Since there are no other financing forms where, as is the case with venture capital, a toolset is available to take advantage of the options offered by the firms, in the case of all other financing sources an increase in uncertainty will reduce the value of the investment. By contrast, using the options valuation, uncertainty becomes a value-enhancing factor, which boosts the value of the startups with inherent real options, allowing VC's to evaluate these businesses higher, and thereby increasing the odds of startup companies obtaining capital via this funding form. Accordingly, VC's may attach a higher value to certain portfolio companies than other financiers, and are willing to participate in the financing of startups despite the higher degree of uncertainty.

References

Abrams, J.B. (2010): *Quantitative Business Valuation – A Mathematical Approach for Today's Professionals.* Second edition. Hoboken, Wiley.

Amram, M. – Kulatilaka, N. (1999): *Real Options: Managing Strategic Investment in an Uncertain World*, Harvard Business School Press, Boston.

Amram, M. – Kulatilaka, N. (2000): Strategy and Shareholder Value Creation: The Real Options Frontier. *Journal of Applied Corporate Finance,* Vol. 15(2) pp. 15–28.

Becsky-Nagy, P. (2006): Kilépések politikája – Hogyan válnak meg a kockázati tőkések a befektetéseiktől? *(*Exit policies – How do Venture Capitalists Leave Their Investments Behind?*). Competitio,* Vol. 5(2) pp. 83–98.

Becsky-Nagy, P. (2014): Growth and Venture Capital Investment in Technology-based Small Firms. *Annals of the Oradea of Economic Science,* Vol. 2(2) pp. 828–836.

Becsky-Nagy, P. – Fazekas, B. (2015): Speciális kockázatok és kockázatkezelés a kockázatitőke-finanszírozásban (The Special Risks and Risk Management of Venture Capital). *Vezetéstudomány (Budapest Management Review),* Vol. 46(3) pp. 57–69.

Bélyácz, I. (2011): Kockázat, bizonytalanság, valószínűség (Risk, Uncertainty, Probability). *Financial and Economic Review,* Vol. 10(4), pp. 289–313.

Black, F. – Scholes, M. (1973): The Pricing of Options and Corporate Liabilities. *Journal of Political Economy,* Vol. 81(3) pp. 637–654.

Borison, A. (2005): Real Options Analysis: Where Are the Emperor's Clothes? *Journal of Applied Corporate Finance,* Vol. 17(2) pp. 17–31.

Carvalho, A.G. – Calomiris, C. – Matos, J.A. (2005): Venture Capital as Human Resource Management. *NBER Working Paper Series,* National Bureau of Economic Research, Cambridge, May 2005.

Chemmanur, T.J. – Krishnan, K. – Nandy, D.K. (2011): How does Venture Capital Financing Improves Efficiency in Private Firms? A Look Beneath the Surface. *Review of Financial Studies,* Vol. 24(12) pp. 4037–4090.

Cochrane, J.H. (2005): The Risk and Return of Venture Capital. *Journal of Financial Economics,* Vol. 75(1) pp. 3–52.

Copeland, T.E. – Antikarov, V. (2001): *Real Options: A Practitioner's Guide.* Texere, New York.

Copeland, T.E. – Keenan, T.E. (1998): How Much Is Flexibility Worth? *McKinsey Quarterly,* No. 2, pp. 38–49.

Damodaran, A. (2009): *Valuing Young, Start-Up and Growth Companies: Estimation Issues and Valuation Challenges.* Online: http://dx.doi.org/10.2139/ssrn.1418687. Downloaded: 24 June 2015.

Dömötör, B. (2011): A kockázat megjelenése a származtatott pénzügyi termékekben (Appearance of Risk in Financial Derivatives). *Financial and Economic Review,* Vol. 10(4) pp. 360–369.

Driouchi, T. – Bennett, D.J. (2012): Real Options in Management and Organisational Strategy: A Review of Decision-making and Performance Implications. *International Journal of Management Reviews,* Vol. 14(1) pp. 39–62.

Ewens, M. – Jones, C.M. – Rhodes-Kropf, M. (2013): *The Price of Diversifiable Risk in Venture Capital and Private Equity*. AFA 2013 Washington, DC Meetings.

Fried, V.H. – Hisrich, R.D. (1994): Towards a Model of Venture Capital Decision Making. *Financial Management,* Vol. 23(3) pp. 28–37.

Harding, R. (2002): Plugging the Knowledge Gap: An International Comparison of the Role for Policy in the Venture Capital Market. *Venture Capital: An International Journal of Entrepreneurial Finance,* Vol. 4(1) pp. 59–76.

Hellmann, T. (2006): IPOs, Acquisitions and the Use of Convertible Securities in Venture Capital. *Journal of Financial Economics,* Vol. 81(3) pp. 649–679.

Kaplan, S.N. – Strömberg, P. (2003): Financial Contracting Theory Meets the Real World: An Empirical Analysis of Venture Capital Contracts. *Review of Economic Studies,* Vol. 70(2) pp. 281–315.

Karsai, J. (1997): The Possibilities of Venture Capital in the Financing of Small and Medium-Size Firms. *Economic Review,* Vol. 44(2) pp. 165–174.

Karsai, J. (2010): A Blessing or a Curse? The Impact of Private Equity Investments on the Economy. *Vezetéstudomány (Budapest Management Review),* Vol. 41(3) pp. 14–25.

Kogut, B. – Kulatilaka, N. (2001): Capabilities as Real Options. *Organisation Science,* Vol. 12(6) pp. 744–758.

Korteweg, A. – Nagel, S. (2016): Risk-Adjusting the Returns to Venture Capital. *The Journal of Finance.* Accepted Author Manuscript. doi: 10.1111/jofi.12390.

Luehrman, T.A. (1998): Investment Opportunities as Real Options: Getting Started on the Numbers. *Harvard Business Review,* Vol. 76(7–8) pp. 3–15.

MacMillan, I.C. – Kulow, D.M. – Khoyilian, R. (1988): Venture capitalists' involvement in their investments: extent and performance. *Journal of Business Venturing,* Vol. 4(1) pp. 27–47.

Miller, K.D. (2002*):* Knowledge Inventories and Managerial Myopia. *Strategic Management Journal,* Vol. 23, pp. 689–706.

Myers, S.C. (1984): Finance Theory and Financial Strategy. *Interfaces,* Vol. 14(1), pp. 126–137.

Nagy, P. (2004): *Az informális kockázati tőke szerepe a finanszírozási rések feloldásában (The Role of Informal Venture Capital in Plugging the Financing Gaps)*. VIII. Industrial and Corporate Economics Conference, University of Pécs, October 21–22 2004.

Rangan, S. (1998): Earnings Management and the Performance of Seasoned Equity Offerings. *Journal of Financial Economics,* Vol. 50. pp. 101–122.

Ries, E. (2011): *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.

Rózsa, A. (2004): Stratégiai beruházások reálopciós megközelítése (The Real Option Approach to Strategic Investment). *Vezetéstudomány (Budapest Management Review),* Vol. 35(2) pp. 53–61.

Sharpe, W.F. (1964): *Capital Asset Prices:* A Theory of Market Equilibrium under Conditions of Risk. *The Journal of Finance,* Vol. 19(3) pp. 425–442.

Smith, J.E. – McCardle, K.F. (1998): Valuing Oil Properties: Integrating Option Pricing and Decision Analysis Approaches. *Operations Research,* Vol. 46(2) pp. 198–217.

Smith, J.E. – Nau, R.F. (1995): Valuing Risky Projects: Option Pricing Theory and Decision Analysis. *Management Science,* Vol. 41(5) pp. 795–816.

Száz, J. (2011): Valószínűség, esély, relatív súlyok (Probability, Chance, Relative Weights). *Financial and Economic Review,* Vol. 10(4), pp. 336–348.

Szerb, L. (2006): Az informális tőkebefektetés és a kockázati tőke szerepe a vállalatok finanszírozásában (The Role of Informal Direct Investment and Venture Capital in Corporate Financing). In: Zsolt Makra (ed.): *A kockázati tőke világa (The world of Venture Capital).* Aula Kiadó.

Trigeorgis, F. (1996): *Real Options: Management Flexibility and Strategy in Resource Allocation*. Cambridge MA, MIT Press.

Yeo, K.T. – Qiu, F. (2003): The Value of Management Flexibility – A Real Option Approach to Investment Evaluation. *International Journal of Project Management,* Vol. 21(4) pp. 243–250.

Systemic financial crises

Balázs Világi

Gary B. Gorton:
Misunderstanding Financial Crises – Why We Don't See Them Coming
Oxford University Press, 2012, 296 p.
ISBN-13: 978-0199922901

Many books have been published on the 2007-2008 financial crisis, analysing in detail the characteristics of the financial markets before the crisis, the subprime mortgage market and the process of securitisation. These volumes are full of expressions exotic for layman such as CDO, SPV, CDS, mezzanine tranches, NINJA loans, etc. However, these books make one common mistake: it is difficult to find out the essence from them. They discuss in detail the individual characteristics of the 2007-2008 crisis, but it does not actually turn out from these why all this is important.

The book of Gary B. Gorton titled *Misunderstanding Financial Crises – Why We Don't See Them Coming* is in sharp contrast to this approach. While he looks for an answer to the question of why the majority of the economist profession was surprised by the crisis in 2007, he also provides an answer to what the common root of the systemic financial crises is. The principal virtue of the book is that it places the current crisis in an economic history context and sheds light on the similarity between the classic banking panics of the 19th century and modern financial crises.

The proposition of Gorton is that this general cause is the inherent vulnerability of the liability-side of the financial intermediary system. Specifically, this means that on the liability-side of the banks and other mediators there are short-term debts or sight deposits, whereas on the asset side there are longer-term investments. In normal periods, maturity transformation does not represent a problem. However, in periods when bad news about the condition of the economy starts to proliferate, confidence in the banking system falters as well, and at this time, if there is a run on the banking system in the form of large-scale withdrawal of deposits or if the short-term loans of the banks are not renewed on a large scale, then a systemic financial crisis occurs.

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Systemic financial crises are essentially liquidity crises. In the case of an individual bankruptcy, the assets of the bank are impaired due to its deficient investment policy or fraud or simply bad luck, and the bank cannot repay its debts. In the case of a systemic financial crisis, it is not that the asset side of the entire banking system is impaired, but instead the creditors of the banks withdraw their credits on a large scale and immediately due to a loss of confidence. This has taken various shapes in economic history: creditors intended to convert bank notes to gold or deposits to bank notes on a large scale, the current crisis took place on the money markets in a less evident manner, however, in terms of its essence, it was the same phenomenon.

The vulnerability of the financial intermediary system has structural reasons. On the one hand, behind the investments of the asset side of the banks, all things considered, there are real economy investments, which, stemming from their nature, are long-term investments. On the other hand, the short-term liabilities of the banks play an important role in the operation of the economy, since those are the transaction media of the economy, they play the role of money. And the economy is unable to operate adequately without transaction media.

The 2007-2008 global financial crisis started in the United States and, similarly to the crises in 1837, 1857, 1873, 1893, 1907 and 1933, it started with a liquidity run on the financial system. This was the largest financial crisis since the great crisis of the 1930s and its consequences have been felt up to now as well. It has clearly proven the untenability of the opinions that there will be no systemic financial crisis in modern, developed economies any more.

In the 2007-2008 crisis, the panic went on not in the market of depositors, but in the money markets, the market of repo and other short-term instruments. Similarly to historical bank crises, the panic was started by bad economic news, namely the problems in the subprime mortgage market. As a result of this, there was a run on repo, and creditors demanded their money immediately. However, it is important to emphasise that the collapse of the subprime market is insufficient to explain the extent of the crisis. Just like in the past, it was not the impaired assets but rather the run on debt that created the crisis.

The mortgage market crisis played a role in starting the panic, but liquidity was at the centre of the crisis this time as well, just as in the case of all the past systemic crises. When they were not willing to renew the short-term credits of certain banks on the money markets, banks had to obtain cash, thus, they had to fire sell their assets, below the fundamental price fire sale. As a consequence of decreasing asset prices, other banks ran into trouble as well, and hence they were also compelled to sell their assets causing prices to fall even more. Thus, a self-reinforcing spiral was started, which finally led to a systemic crisis.

All this, of course, has serious regulatory consequences. In the United States in the 1930s the introduction of deposit insurance – which is a liquidity-type regulatory instrument – created the "quiet period", there was no systemic financial crisis during the period until 2007. However, the outbreak of the latest crisis was exactly the result of the fact that a so-called shadow banking system was created, in addition to the traditional financial intermediary institutions, that was not regulated and its liability-side was subject to liquidity panics just like the traditional banking system had been before the introduction of deposit insurance. Thus, if we intend to avoid systemic crises in the future, all the elements of the financial intermediary system must be regulated.

After the review of all this, the author makes an attempt to answer the initial question of the book, i.e. why did the majority of economists misunderstand the operation of the financial intermediary system and why did they deny the possibility of systemic financial crises?

As a point of departure, Gorton calls the attention to the fact that the personal experience of an event is not substituted by reading or studying about it. If someone was a witness in some form of the 2007-2008 panic or experienced the negative consequences of that, then that person will think about financial crises in a different way than a person who met that only as a dry, historical data set. Similarly, the great crisis of the 1930s was a critical experience of an entire generation of economists: they fanatically attempted to understand it and to avoid similar cases in the subsequent period. By contrast, for the subsequent generations the great crisis was only an extreme, rarely occurring deviation in the data which does not necessarily have to be explained.

Many people share the opinion that the knowledge of economists is distorted because they use too many models. However, the problem is not with the models, in general, but with the way in which we validate those. Macroeconomic models are mostly tested with the data of the "quiet period". But if a theoretical model is created in such a way that it explains the data of a crisis-free period, that model will obviously fail in connection with the forecast and the interpretation of crises.

The main mistake of economics is not that it produces theories, since no science can exist without theories. The problem is that, when selecting from the theories, it did not depend on facts properly, it was not sufficiently empirical. However, it should be emphasised as well that this is often not a simple task at all, because of the lack of appropriate data.

The lack of data is an especially relevant question in terms of the subject of the book. Financial crises occurred relatively frequently in capitalist economies. But here the emphasis is now on the word "relatively". Financial crises are frequent events

compared to what an ordinary person or even what an average economist thinks. But these are rare compared to how much data would be necessary for making statistically significant statements.

However, the problem of financial crises is too important to give up their analysis based on some kind of statistical purism. There are situations in other areas of life, but in science as well, when we have to make decisions or statements that are based on some anecdotal evidence and not on significant statistical relationships. If rigorous nature and relevance can be implemented only at the expense of each other, current economics votes for the former instead. It is a typical trend that researchers are more interested in preparing formally perfect, but completely uninteresting studies. By contrast, the really interesting and relevant studies are often rejected by the editors of scientific journals, because they find these as not sufficiently sophisticated in terms of methodology.

According to the author, economics has come to a fork in the road after the 2007-2008 crisis. It faces an important choice: in the future, either it will embrace reality, or, ignoring the lessons of the financial crisis and its own failure, it will languish in irrelevancy.

Growth differently – a bio-dynamic economic model

Sára Farkas

John Thackara:
How to Thrive in the Next Economy
Thames & Hudson Ltd., London, 2015, 192 p.
ISBN-13: 978-0500518083

Having a special field of expertise, outside the traditional economic disciplines, John Thackara provides a bird's eye view perspective for placing our current, unsustainable economic system, on new foundations. Throughout his entire life, his writing and producing activity was subordinated to the examination of various lifestyles serving a sustainable future, and thus, his global-level experiences and obsessions provide sound basics for the shifts, which support viable renewal processes. The author shares his stories and conclusions with the reader's community on his blog; moreover, with the invitation of project leaders carrying best practices, he has sent the core messages in the framework of several international festivals and national biennials, which he has organised, including the events "Designs of the Time" in Great Britain and the "City Eco Lab" in France with his name. As an institution leader his wide-ranging experiences were collected by his directorial position in Netherlands Design Institute and by his research director status in the Royal College of Art in London. He is currently the founding director of "Doors of Perception", a design organisation specialising on sustainability and social innovation. As a writer, he has already published 10 books, his latest title *"How to Thrive in the Next Economy"* was introduced in November 2015 by the London-based Thames & Hudson Publishers.

Moving away from the narrowly-defined financial profit driven growth model, in the new economy Thackara sets new objectives for the economic mechanisms. Establishing a new framework for economic activities, inserted into a more sustainable social and environmental structure, *Thackara subordinates the growth objectives to the reasonable human needs.* As a practicing expert, in this book the author aims to highlight new, working solutions which are already operating at the community level and offer alternative answers to the challenges of social alienation, insufficient health services, poverty and climate change. In order to discuss this,

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the book first outlines more theoretical frames, characterising the new economy, questioning its foundations, the profit and performance-centred orientation of the economy developed until now. Along this, he establishes the *increase* in *the welfare of the society* and *raising the quality of the environment* as the objectives of growth.

In the new economy for the *implementation* of development and for the direction of this lively, continuously changing system, *he* recommends *to create a dynamic balance* with its special system of aspects, based on diversity. The foundations of growth are constituted by social capital (1), self-governed communities, formed by individuals with a wide-ranging knowledge base, and such new infrastructure solutions (2), which result more efficient water management and reduced mobility needs (arising from a compact, well-established built environment and spatial structure of city regions), where these networks are co-ordinated at a higher level.

In fact, these thoughts represent the delivery of a so-called *"Doughnut Economics"* model,[1] which has emerged in the international community of economic researchers since 2012. The book indirectly presents several new practices and social innovations customised to local and regional specifics, which support the feasibility of this model. The author identifies the following issues as signs of shifts toward the renewal and as forecasters in the economic processes: community gardening in cities with social benefits; new types and "smart management" of urban infrastructure systems, for example in rainwater drainage; upcycling activities which are higher value added forms of recycling activities increasingly popular among designers; moreover, the new emergence of local moneys; or the proliferation of the so-called peer-to-peer (P2P) networks providing more personal and direct connections. Thackara thus also stipulates the fact that the change towards a re-established economy, in the framework of local-level community initiatives, *has already begun*. In the system of transformation processes, introducing new types of community co-operation forms (1) are essential but not enough, new design solutions (2) and financing practices operating with the available simplest and shortest leverage (3) also serves as critical *catalysts*. According to Thackara, these processes will result in integrated, technology-intensive and highly urbanised services, whose global spreading will establish economic growth on the bases of knowledge.

[1] The concept of "Doughnut Economics", which can be translated as an economy closed in a doughnut or ring, is connected with the name of Kate Raworth, who is a senior visiting research associate at Oxford University's Environmental Change Institute, a senior associate of the Cambridge Institute for Sustainability Leadership and a member of the Club of Rome. The objective of Kate Raworth is to determine the system of processes and ways of the economy corresponding to the challenges of the 21st century. In her model, the limits of economic mechanisms are drawn by the capability of supporting the environment and social rules appreciating human rights. Her theory will be published in a detailed form in her book titled "Doughnut Economics: seven ways to think like a 21st century economist", to be published in 2017, but the author has already revealed mosaics of this in several cases in academic journals, UN reports, Twitter messages and in the framework of TEDX conversations. (http://www.kateraworth.com/)

Arriving from the fields of the arts, John Thackara forms a bridge between the individuals perceiving the economic sphere as external observers or users, and the society of economists. He transplants new concepts and introduces new definitions in connection with bio-dynamic systems, already widely known from the field of biology, to the economic framework (for example “vitality-monitoring” and “mycorrhizae formations” [a symbiotic association composed of a fungus and roots of a vascular plant]), which, on the one hand, serve the deeper understanding of the global challenges of the 21st century, on the other hand, they make the dialogue between experts outside the economic sphere and economic researchers more understandable and active. However, the greatest merit of the book is its inspirational impact on the reader. Namely, with his brief volume John Thackara encourages a move towards the changes and rethinking our connections formed with our communities and environment at the individual level.

The king has no clothes – the reality behind numbers

János Szakács

Charles Wheelan:
Naked Statistics: Stripping the Dread from the Data
W. W. Norton, 2014, pp. 304
ISBN: 978-0393347777

Charles J. Wheelan's two best-known works are characterised by a focus on the applicability of economic theories in real settings. *Naked Economics* is a book teaching the basics of economics that does not get lost in the maze of economics that is full of numbers and models, but places the emphasis on applicability in real life. *Naked Statistics* does the same, focusing on the subject of statistics: instead of dwelling on complex mathematical methods, it tries to provide readers with methods of using statistics in everyday life, and, first of all, it draws attention to the correct interpretation of results and the importance of the human factor.

One of the key messages of the book, as its subtitle (*Stripping the Dread from the Data*) suggests, is that in many cases we think that the methods of statistics are unnecessarily complex and incomprehensible, and this gives rise to fears. However, the large number of statistical indicators used in everyday life are applied in an easy manner by most people – although often unconsciously – even in everyday conversations. A good example for that is the index used in the United States to evaluate baseball players, which compresses complex information into one single numeric indicator, and thus makes the performance of the players comparable (and serves as a useful guide for betting, too). In its methodology, the Gini coefficient used for the measuring of economic inequalities is not much different from the indicator that measures the performance of players, but it may seem an incomprehensible thing for an average baseball fan.

Wheelan tries to convey two key messages in the whole book. On the one hand, he attempts to refute the above misconceptions, in order to bring statistics closer to the reader, as it may offer a useful aid to anyone in the understanding and solution of complex problems. On the other hand, he wishes to provide the reader with an interpretive approach, so that the reader can identify the many manipulative

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uses of statistics, and be able to make informed decisions on the basis of numbers. Because of its nature, it is worth laying more emphasis on the latter, as that is what readers probably meet less frequently in textbooks or other educational materials.

Before becoming acquainted with methodologies, anyone wishing to correctly interpret statistics should be aware that the relevance of these may be reduced by many – intentional or unintentional – errors, which allow companies or even politicians to misinterpret the meaning of figures that are very useful tools for convincing people. This is true even for simple descriptive statistical tools such as the mean, the median or the standard deviation. For instance, if Bill Gates walks into a bar, the average income of those sitting in the bar may be multiplied, but it would be rather misleading to qualify the guests of that bar as rich based on that. The same problem emerges, of course, in the case of using more complicated methods, in a way that is more difficult to detect. One of the most frequent examples is the arbitrary selection of the projection base: a telecommunication company may use geographical coverage as a good advertisement, even if that is not identical with the coverage of the population. The comparison of "apples and oranges" is also well-known. For example, film studios indicate revenues from films at current prices, boasting higher and higher records, while decades earlier, when ticket prices were lower, other classics may have attracted far more spectators. Another thing that may lead to wrong conclusions is that the co-movement of factors is interpreted as a cause and effect relation. For example, in schools that achieve the best test results, the teachers are not necessarily the best teachers, as the harder terms of admittance already predetermine the outstanding results of more talented students.

Apart from these problems that lead to misinterpretations, each statistical tool may contain individual drawbacks that characterise the given method. The author pays considerable attention to probability calculus, which is used every day in a number of areas. The calculation of the probability of the occurrence of certain events may help decision-making through the definition of expected values. Companies make good use of patterns drawn by statistical probabilities in customers' behaviour. A spectacular application of the method is related to the name of the American brewery Schlitz, which set out on a brave enterprise in 1981: in the most expensive commercial spots in the USA, at halftime of the Super Bowl , they aired blind taste tests live, having volunteers drink beer. And not just any volunteers: the people they invited from the street to taste beer all claimed that they usually drank the beer of Shlitz's competitors. This was the ingenuity of this marketing campaign! In fact, Schlitz played safe with the commercials. For an average consumer, in a blind taste test, beers of similar price categories are hard to distinguish, and even if someone usually drinks a certain brand, it is not sure at all that he will recognise it in a blind taste test. So the chance that a consumer would select Schlitz in a blind taste test is roughly 50 per cent. But the fact of only half of the consumers selecting

the brand would not look too good in itself. However, half of the consumers of the competitive brand preferring Schlitz beer sounds rather impressive. Therefore, on the basis of preliminarily completed blind taste tests, the manufacturer had a good reason to suppose that half of the consumers of the competitors would prefer its beer in the live show, too.

However, when using probability in decision-making, several aspects need to be considered. It is a common mistake to suppose that the examined events are independent of each other, when they are not. A sad example for this typical error is the case of court trials regarding so-called sudden infant deaths (SID) that happened in Great Britain the 1990s. As the probability of SID within the same family is very low (1/73 million), the judgements said this was a proof of crime in almost all of these cases. However, a decade later, several hundreds of cases were examined again, as it turned out that these SIDs might have been related because of genetic or other reasons, and this significantly increased the probability of deaths within the same family. The opposite of this error can also occur. Statistical examinations showed that football players hitting the target in many cases will hit the target next time with the same chance, so the feeling of "having the goal" is rather fans' illusion. A similar phenomenon is the correction after an above-average performance, which leads to various disillusions. According to an American urban legend, the performance of athletes published on the cover page of Sports Illustrated drops in matches following the publication. But the reason is not a curse on the magazine: the players were put on the cover page because they had achieved an outstanding performance before, so it could be expected that their subsequent performance would be closer to the average.

No matter how good the methodology is, however, research and the results indicated by them are only as good as the data used in them. Poor quality data will generate poor quality results. According to the author, the data used should meet three key criteria. First, the data should refer to a sample that covers a representative slice of the population. The second criterion is that the data provide enough basis for comparison. Finally, the third criterion is simply that the relevant data should be available. Lots of examples demonstrate the results of not meeting these conditions: mistakes in public opinion polls before presidential elections, misunderstanding the reasons of some medical treatments or the identification of factors explaining the success of some schools.

For decision-makers, on the other hand, it is obviously not the methodology applied or the scope of data used that is the key question, but the proper interpretation of the results. The process of programme evaluation is when the impact of individual decisions or interventions are assessed, and decisions are made on the basis of that. However, the examination of the separate effects of individual interventions is not always clear because of complex relations. Therefore, the best means of programme

evaluation are random examinations, the examination of natural events or the examination of differences between situations that are similar in other aspects ("the difference of differences"). A good example of correct programme evaluation is the American research where the impact of police presence on crime was examined, bearing in mind that sometimes the higher rate of crime triggers higher presence of police, so the relation is not obvious. Therefore, the research examined what happens on days when the presence of police is stronger than other times, but for a reason independent of "everyday" crime: days with danger of terrorist attacks (when more policemen are on the streets) were compared with other days. Based on the final result, one can conclude that the higher level of police presence does result in lower levels of crime. In the USA, this was an important lesson for the policy-makers concerned.

All in all, in today's world, full of information, it is very easy to examine almost any social science issue using different data. In general, this is advantageous, as we can find really (or seemingly) correct answers to millions of questions. What will be the future of American football? What causes the drastic increase in the number of autistic children? How can we identify and award really good teachers? How can we fight global poverty best? What do other people know about us?

It must be borne in mind, however, that the human factor is more important than any well-composed statistical methodology: the correct interpretation of numbers and making the right decisions based on the numbers cannot be substituted with complex calculations.

Structural reforms for increasing competitiveness – Report on the annual conference of the *Global Forum on Productivity* (7-8 July 2016, Lisbon)

Barnabás Virág

Even though more than 8 years have passed since Lehman Brothers filed for bankruptcy protection in September 2008 and the financial crisis emanating from the American mortgage market became a worldwide crisis, global economic growth remains subdued, especially in the developed countries. The opinion of the world's economists about the reasons for the moderate growth rate is divided. Some think that, as a legacy of the financial crisis, the high debts and significant non-performing loan portfolios in the balance sheets of commercial banks continue to be a problem even today and this permanently restrains the demand prospects of the economies. According to other evaluations, the reasons for this slow growth are structural supply factors which had already characterised the developed economies before the crisis, but the effects of these factors were masked by the rapidly rising indebtedness. In identifying these factors, these analyses mostly underline the ageing of societies and the slowdown in productivity growth.

At the initiative of the OECD and with the participation of the academic world and economic policymakers, a new global forum was established in 2015 in Mexico City with the purpose of exploring the reasons for the permanent slowdown in productivity observable in the developed economies and finding answers to the question of what must be done to reverse this unfavourable trend. The annual conference of the forum in 2016 was held in Lisbon. The leaders and experts of 32 OECD member countries, large emerging economies (China, Russia, Brazil and Argentina), the Asian Productivity Organization (*APO*), the European Union (*EU*) and the European Central Bank (*ECB*) participated in the event. Structural reforms aimed at improving productivity were the special subject of the presentations and panel discussions at this event. The following provides a brief summary of the main findings of these forums.

In his opening presentation, *Manuel Heitor* (Portugal, Minister Science, Technology and Higher Education) called attention to the role of human capital and research and development in economic growth. He emphasised that, in the future, countercyclical

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elements must also be strengthened in the development of new economic policy thinking. A good example for this is the current economic environment. In several economies at the periphery of Europe which are struggling with recession and budget problems, permanently high unemployment has eroded human capital, while the funds intended for development and research have often been victims of adjustments. In accordance with this, it is important to develop a framework where financing education, the knowledge base and research is ensured continuously and independently of economic cycles.

Also in the opening section, *Gabriela Ramos* (*OECD*) emphasised the connection between the slowdown in productivity and the increasing inequalities of incomes. According to her analysis, businesses with lower productivity have employees with lower wages; furthermore, they do not invest in innovation and the development of human capital. By failing to do so, they essentially preserve the low income of the employees working there, which also results in the achievement of lower qualifications in the case of the children of these workers, and the final result of this is a negative loop. Economic policies preventing the slowdown in productivity and establishing a growth trend thus also assist in handling income inequalities.

In his presentation, *Jonathan Haskel* (Professor at Imperial College London) focused on the increased role of intangible assets and their connection to productivity. According to Haskel, on the one hand the slowdown in productivity can be attributed to Keynesian reasons related to a lower investment rate and capital accumulation, while on the other hand the fundamental transformation of the structure of production also plays a role in this. In contrast to previous decades, in the current world investments in intangible assets play a much greater role in the production of value added and incomes (in the broader sense, IT investments, development costs and the development of competences must also be classified here). This has a serious statistical effect as well. The methodology of the national accounts currently in use is able to measure investment in tangible assets and the products thus produced more exactly, but it can also underestimate investment in intangible assets and the value of services produced in connection with such investment. According to his observation, investments generally declined after the crisis: however, this was more typical for tangible investments, whereas in the case of intangible investments, after a smaller decline, a faster rise started. Unfortunately, this phenomenon has been less typical for the EU.

The enhanced role of intangible investments significantly influences the trend in productivity growth and its distribution within economies via four channels: first, it emphasises the effect of financing opportunities; second, the advantages stemming from intangible investments appear more strongly at the companies undertaking such investments, making catching-up more difficult for companies which are left out from the developments or enter later on. Third, intangible investments

have a strong spillover impact in the direction of economic efficiency (*total factor productivity, TFP*), and thus the role of these investments has increased in the explanation of economic cycles. Finally, these investments fundamentally affect the productivity of the labour force and, via this, wage setting as well, and thus they also have an effect on the trend of income inequalities.

Using Italian data, *Andrea Linarello* (Banca d'Italia) and *Ottavio Ricchi* (Italian Treasury) presented some reasons for the permanently low productivity growth. According to their evaluation, poor allocation of resources also contributes to the development of this phenomenon in Italy. According to their results, after the crisis financing restraints also hindered the spread of new technologies, especially in the case of SMEs, contributing to the slow corporate diffusion of leading novelties.

Mario Centeno (Portugal, Minister of Finance) emphasised the importance of the forum as an opportunity which promotes international co-ordination, so that the roots of the productivity paradox can be understood better: despite the significant advances achieved in the areas of education, technology and global integration, productivity growth has slowed down. Although the measurement of productivity is one of the greatest challenges, he argued that cyclical factors played a role in the slowdown in productivity, proportionally with the slowdown in investments. Structural changes – i.e. the shift towards services, the stalling diffusion of innovations among companies and the immobility of labour force between sectors – also made it difficult to achieve higher productivity increases, aggravating the persistence of wage inequalities. In terms of the advances, it is important that policies supporting higher productivity growth should result in higher income for average voters, since it has become clear by now that real economy problems entail political consequences. Portugal is taking specific steps through its national reform programme, which focuses on improving human capital and skills, R+D co-operation between companies and universities, and regional and social cohesion.

Angel Gurria, Secretary-General of the OECD, mentioned that approximately eight years since the start of the global financial crisis, the global economy finds itself in the trap of low growth, characterised by weak productivity and business investments, a slowdown in trade, weakened labour markets and significant inequalities. The accumulated loss of productivity growth already amounts to 10 per cent in this period. Productivity growth is not manna from heaven; it is the consequence of pursuing appropriate policies and removing incorrect policies. Today, we live in the newest wave of digital innovation, but research has shown that these advantages do not spread to all companies. Reforms must be found which improve access to education, healthcare, and traditional and modern infrastructures.

Jonathan Timmis (OECD Secretariat) underlined that an enormous body of literature is available on the effects of trade in goods on productivity, and in connection with this, research on globalisation and productivity up to now has been based on trade in final products, but noted that we know less about the specific role of global value chains. The policy lessons drawn from studies on trade in final products and services cannot be transposed directly to the world of global value chains. Services are an area of vital importance for global value chains, this is why it is emphasised that there are still – until now less explored – policies, such as the policy related to competition in the service market, which are worth improving.

The connection of global value chains and productivity needs to be examined in more detail, especially with respect to the fact that, in terms of geography, global value chains move towards areas outside traditional production locations (North America and Europe) and they appear in central hubs of key importance (e.g. in China within Asia) and supplier countries connecting to larger areas (e.g. in Vietnam), or in countries of the periphery. These developments may have an effect on productivity growth and the spread of productivity, altering the hubs and the new peripheries. Global value chains provide indirect assistance – especially to small and medium-sized enterprises – so that they can profit from the spillover effects.

Peng Zhang (China State Information Center) examined how industrial productivity is affected by the connection to global value chains. Increasing participation in global value chains correlates with higher industrial total factor productivity, but the relation is not linear. Total factor productivity decreases in the case of participation at the highest level in global value chains.

Keiko Ito (Senshu University, Japan) examined what effect global procurement costs and transaction costs between companies have on domestic supplier networks in Japan. Japanese data have shown that companies conduct a disproportionately large amount of business with the suppliers which are closest in space. The activity of companies performed in other countries leads to a churning of their domestic buyers and suppliers, and it is more likely that the companies procure the materials necessary for production from domestic suppliers further away, but the average distance of suppliers decreases. This is why policies aimed at decreasing search and transaction costs, and information asymmetries are of key importance in realising the productivity advantages provided by participation in global value chains.

Joaquim Oliveira Martins (OECD Secretariat) summarised the work performed by the Public Governance and Territorial Development Directorate up to now in connection with the contribution of cities to growth. He pointed out that there is a positive (but not linear) connection between the density of cities and productivity growth. Urbanisation goes together with development, but it is only a necessary condition. The advantages are derived mostly from the transfer of knowledge and

the interaction of skills, whereas external economic effects and costs stem mainly from congestion and environmental pollution. He noted that the proximity of cities in general is accompanied by growth in productivity, and therefore, the contribution of urban areas to productivity growth is usually significant. The productivity growth of cities is often in positive connection with the size of cities. In terms of the role of policies, he emphasised that the results highlight the importance of good urban governance (leading bodies in good working order can improve the welfare level of city dwellers), whereas fragmentation is liable to decrease the growth contribution of urban agglomerations. The advantages of agglomeration economies are: sharing facilities, gains stemming from specialisation, appropriate labour market (ample specialised labour force, low hiring and training costs), and rapid spread of new ideas.

Manuel Caldeira Cabral (Portugal, Minister of Economy) noted that the slowdown in productivity and the widening deviation of productivity growth between companies were problems that had an effect on almost everything (e.g. on profitability, investments, inequality of incomes) and that affected most OECD economies, among them Portugal as well. Moreover, since 2010 real wages have already increased slower than the productivity of labour, which has an impact on domestic demand. The minister outlined the growth and competitiveness strategy of the Portuguese government, which features five strategic pillars: capitalisation, innovation, simplification, internationalisation and education. The government's "Industry 4.0" programme has determined priorities for the digitalisation of the industry. In the framework of the "Simplex +" programme, efforts have been made for decreasing the burdens of bureaucratic procedures for companies.

In the closing session, *Dirk Pilat* (OECD, Deputy Director, Directorate for Science, Technology and Innovation) formulated some findings of key importance. The first group of questions raised was about the fact that there is an urgent need for determining the state of affairs: what is happening with productivity and what are the triggering factors of the trends in progress? The measurement of productivity still represents a challenge. This is an especially important question in the case of services (and the public sector), but in general also in connection with the wide-ranging digitalisation of economies. Measuring the most important elements of the political system of the individual countries represents a serious challenge from the point of view of empirical analysis. Measuring the main forces of productivity, such as intangible investment, business dynamics and management quality, represents a challenge in and of itself as well. Solving the measurement problems is a prerequisite for improving policy-type analyses. We must better understand to what extent the current trends are cyclical in nature and to what extent they are based on structural basic questions.

Pilat underlined that the fall in productivity growth has also had an effect on social integration. Companies which fall behind are unable to increase wages in the absence of reallocation, they contribute to the inequalities of incomes. In several countries the lack of appropriate skills is probably a factor of key importance between wage inequality and the distribution of productivity. Employees often do not find an appropriate job at companies where they could achieve their full production potential.

In terms of policies this means that further structural reforms must be carried out unambiguously, especially in the area of services. Urgent investments are necessary in the areas of skills, infrastructure and intangible assets, and policies must support these investments and must encourage a dynamic business environment and the timely allocation of funds.

References:

OECD: Summary Record (2016) (http://www.oecd.org/global-forum-productivity/events/Summary_report_GFP_Lisbon_Final.pdf)

OECD Presentations (2016) (http://www.oecd.org/global-forum-productivity/events/presentations7thjuly.htm and http://www.oecd.org/global-forum-productivity/events/presentations-friday8july2016.htm)

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