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The aim of the Magyar Nemzeti Bank with this publication is to inform professionals and the wider public in an easy-to-understand form about basic processes taking place in the Hungarian economy and the effect of these developments on economic players and households. This publication is recommended to members of the business community, university lecturers and students, analysts and, last but not least, to the staff of other central banks and international institutions.

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Summary

DEAR READER,

The Magyar Nemzeti Bank (MNB) is committed to making central bank analyses dealing with various topical economic and financial trends of general interest available to the wider public. With five articles, this publication is the second issue of the fourth volume of the MNB Bulletin. Focusing on topical issues of the Hungarian economy and central banking, the subjects discussed in this issue of the Bulletin ranges from the capital requirement of banks' operational risk, the withdrawal of 1- and 2-forint coins from circulation and the rounding of prices to HUF 5 to the interconnection between domestic exports and the size of corporations and foreign ownership, the current challenges of quantifying interest rate expectations from market yields and Hungary's sovereign risk.

Dániel Homolya analyses the distinct treatment of operational risks, as one of the novel concepts of the capital adequacy regulations introduced on 1 January 2008 in the Hungarian banking system which are applied generally in EU member states and aligned with Basel II standards. Credit institutions may decide to adopt a simple approach based on gross income indicators or an advanced one based on measuring actual risks. Based on the past one-year period, the capital requirement of the domestic banking sector's operational risks is about 8% of its total capital, which is a significant proportion. Although the reported, realised losses were lower compared to the capital requirement, the capital requirement is intended to provide protection against extreme, unexpected situations. A review at choice of methods by individual credit institutions reveals that mainly large institutions apply more advanced methods in both Hungary and abroad. This is attributable, in part, to the fact that the fixed costs of introducing of a more advanced approach are higher than those of the simple one and are more affordable for large institutions in the shorter run, and, in part, to the fact that large institutions can achieve greater gains by using a more advanced approach. Overall, the appropriate management of operational risks and the application of the relevant advanced approach contribute to the stability of the financial system.

Erika Leszkó's study is a reminder of the fact that nearly one and a half years have passed since the MNB withdrew 1- and 2-forint coins from circulation and the rule on the rounding of prices to HUF 5 entered into force on 1 March 2008. Although from a professional point of view, it was obvious that rounding would make the everyday management of cash easier, a large number of fears were voiced in relation to its introduction. Developments have, however, proven otherwise, as the fears have turned out to be completely unfounded. As symmetric rounding only affects the final amount to be paid, the withdrawal of 1- and 2-forint coins from circulation has had no inflationary effects, and neither has the application of the new rules of rounding caused any difficulty. It does not come as a surprise that the use of rounding did not cause any disruption in the economy, as rounding has a more than decade-long tradition in Hungary on account of the withdrawal of the filler in the 1990s. Presenting Hungarian and foreign practices, the article describes the rationale for and the economic soundness of rounding rules. Hopefully, the euro will be the legal tender in Hungary in a few years, and thus it is worth studying the practice of rounding in the euro area.

Zsuzsa Munkácsi examines the issue of Hungarian exporters. In the USA and most European countries exports activity is mostly pursued by a handful of corporations. The Hungarian Tax Authority's panel data reveal that the concentration of Hungary's industrial exports according to the size of corporations is significant; in addition, the concentration of exports according to foreign ownership is even higher; both types of concentration have risen markedly in recent years. The concentration of exports in other sectors of the national economy (e.g. agriculture, construction and services) is generally lower than that in industry. Accepting the size of corporations and other factors (e.g. industry and region, etc.) as a given, foreign ownership is decisive in changes in export destinations. Compared with corporations in sole Hungarian ownership, wholly or partially foreign-owned corporations are more export-driven. However, significant uncertainty surrounds temporal changes in the impact of foreign ownership on the export destinations.

Klára Pintér and György Pulai present the instruments available for measuring market expectations of the key policy rate and discuss whether or not it was last year's turbulences in the financial markets that led to biases in the information content of the various market yields. They substantiate the fact that the government securities market in Hungary was where the largest and the most protracted disturbances in operation occurred. As the yield curve computed from government securities yields reflects a risk premium that was higher and more volatile than before, it is less suitable for measuring market participants' expectations than it used to

be. Recently, analysts' expectations in various surveys have been followed more closely by forward yields computed from yield curves estimated from inter-bank returns. However, liquidity in the inter-bank market has decreased tangibly and the prices of certain instruments have become biased. Since the end of 2008 BUBOR (Budapest Inter-bank Offered Rate) has been unsuitable for measuring market expectations. Fixings have lost their former flexibility and now cling to the prevailing rather than the future base rate. One of the consequences of the BUBOR losing its information content is that the yield curve estimated from the returns on inter-bank market instruments offers a somewhat more accurate measure of expectations if we do not use data on BUBOR fixings. Nevertheless, FRAs based on BUBOR remain suitable for quantifying market participants' expectations if, when interpreting them, in addition to credit and liquidity premia, we take into account the bias caused by BUBOR. Based on the above, in our interpretation the fixings of FRAs starting at various future dates directly reflect expectations concerning the central bank rate prevailing at the start of FRA maturities.

Lóránt Varga presents CDS (credit default swap) deals: they are transactions where one of the parties assumes the credit risk of a bond, i.e. if the issuer of the bond defaults, it pays the nominal value of the bond to the other party in return for the payment of a regular fee by such other party during the maturity of the transaction. The article argues that the most accurate information on the credit risk premium for Hungary's sovereign debt can be obtained through an analysis of the prices of Hungarian CDS transactions and spreads on CDS, because recently the credit risk premium for Hungary's sovereign debt has been determined primarily in the CDS market. The business turnover in and the current portfolio of the market of CDS linked to the FX-denominated bonds issued by the Hungarian government exceed the business turnover in and the current portfolio of the secondary market of Hungarian FX-denominated bonds. The marked loss in willingness to take on risks in emerging markets in the autumn of 2008 affected Hungary to a large extent. In October 2008, the level of the credit risk premium for Hungary's sovereign debt rose sharply and the international perception of Hungary's sovereign debt deteriorated significantly. An increase in the base rate in October 2008 and the agreement with the IMF contributed to preventing the already eroded confidence in investments in Hungary from deteriorating further. Markedly lower spread on CDS's linked to Hungary's sovereign debt is nearly wholly attributable to the improving international risk appetite.

Finally, we should like to mention that, consistent with the MNB's cost and environment-conscious policy, both the Hungarian language and English language versions of the MNB Bulletin are available only in an electronic format.

The Editorial Board

Dániel Homolya: The impact of the capital requirements for operational risk in the Hungarian banking system[1]

The capital adequacy regulation which came into force on 1 January 2008 for the Hungarian banking sector, in line with the Basel II directives and generally applied in the European Union, brought the novelty of distinct management of operational risk. Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, personnel and systems or from external events, which, similarly to financial risk, may result in substantial losses. The regulation allows for various methods of calculating the capital requirement. Financial institutions may opt for simpler approaches based on income indicators, or for more complex ones based on actual measures of risk. Based on the past one-year period, it appears that the Hungarian banking system's operational risk capital charge is significant compared to the total capital charge, with the operational risk capital charge for 2009 Q1 amounting to HUF 120 billion, equivalent to nearly 8% of the total capital requirements. The reported realised losses are lower than the capital requirement (approximately HUF 13 billion in 2008), but the capital charge must provide a buffer in extreme, unexpected situations, and conclusions on extreme values cannot be drawn based merely on one year of observation, therefore this discrepancy could be completely justified. Regarding institutions' choice of approach, it can be established that larger institutions prefer more complex methods in both foreign and Hungarian practice. This is due to the fact that the introduction of more advanced approaches comes with a higher fixed cost, which larger institutions can absorb more easily over the short term, and moreover, they can take better advantage of the benefits offered. Overall, the conscious management of operational risk and application of more developed methods aimed at managing such risks can contribute to the stability of the financial system.

INTRODUCTION

The European Union Capital Requirements Directive (CRD, Directives 2006/48 and 2006/49), implemented in the Hungarian legal order in 2008, introduced the so-called Basel II-based definition of banks' capital requirement[2] (BIS, 2004) to the Hungarian banking system. One of the main novelties of the regulatory change is the consideration of operational risk in the course of capital requirement allocation. Operational risk refers to the risk of loss resulting from inadequate or failed internal processes, personnel and systems or from external events (e.g. fraud, business disruption, execution and transaction errors, etc.) (BIS, 2004). The definition of this risk clearly illustrates that this type of risk goes beyond the scope of financial risks (credit and market risk) previously encompassing a capital requirement allocation obligation.

Management of operational risks has become one of the new central issues in both Hungarian and international financial institutional practice in the recent past. Substantial losses stemming from operational risk events (for instance the recently exposed cases of fraud (e.g. the fictitious transactions carried out by Jérőme Kerviel, incurring losses of several billion euros for Société Générale, or Bernard Madoff's embezzlement of clients' wealth worth tens of billions of dollars), inadequate compliance with lending standards on the subprime mortgage market, the fraud perpetrated by Nick Leeson at Barings Bank in the mid-1990s (for details on the case, see Jorion, 1999) or the 9/11 terrorist attacks against the WTC in 2001) have contributed to increased attention being focused on this topic. It is important to underline that the definition of operational risk includes legal risk, the role of which has also gained significance. On the other hand, this increased interest has

[1] The author would like to thank the participants of the internal debate which took place within the MNB for their constructive comments, especially Anikó Szombati, Tamás Czeti , Gábor P. Kiss, Márton Nagy, dr. Péter Rajczy and Róbert Szegedi, Péter Tabák for the modification recommendations on the first version of this article, furthermore for dr. Mária Móra (Hungarian Banking Association) and Gergely Szabolcs (Bankárképző Consulting and Training) on behalf of the HunOR database operating under the umbrella of Hungarian Banking Association for their suggestions and remarks. At the same time, this article reflects the author's opinion, who takes sole responsibility for any possible errors in it.

[2] Capital requirement signifies the level of regulatory capital providing adequate safety for a bank to be able to withstand possible losses while being able to fulfil its payment obligations, in other words the losses should affect those providing regulatory capital (primarily owners). Regulatory capital, a special term used by banking literature and regulation, is defined as the total of equity and Tier 2 capital.

been determined by changes in regulation, the so-called Basel II process. In Hungary, financial institutions and the groups managed by such institutions must comply with the Basel II regulation based on the new Act on Credit Institutions and Financial Enterprises (Act CXII of 1996 on Credit Institutions and Financial Enterprises), while investment companies and the groups managed by such companies must comply with the new Act on Investment Companies and Commodity Brokers (Act CXXXVIII of 2007 on Investment Companies, Commodity Brokers and the Regulations Governing their Activities). In contrast to previous practice, the new regulatory framework requires institutions to allocate capital to operational risk, in addition to credit and market risk,[3] forming a sort of "buffer" against such risks and reflecting the fact that a larger operational risk event can be fatal for an institution. The two main categories of operational risk are, on the one hand, frequent events with low impact, and rare events with extremely high impact on the other hand. The latter type of event and the combination of risks are especially dangerous. In international practice, the case of Barings bank mentioned above can be brought up as a basic case of financial and operational risks forming a fatal combination. In the case of Barings bank, a rogue trader concluded transactions considered fraudulent, then a negative turn ensued on the market which would have triggered big losses in and of itself, but coupled with the fraud, led to the collapse of Barings. Of course, operational risk may also cause damage when it is combined with credit risk, generating cases where loose lending policy is exacerbated by inadequate compliance with internal rules.

Regulation based on Basel II defines three broad methods for calculating the operational risk capital requirement:

- Basic indicator approach (BIA) – the capital charge is 15% of the average gross income of the previous three years. This method can be used without adhering to separate, precise operational risk management requirements. Gross income is defined as net interest income, net non-interest income, net profit realised on financial transactions and other incomes.

- The standardised approach (TSA) – the capital charge is 12-18% of the average gross income of the previous three years, according to business line. Data collection and risk management requirements must be fulfilled, i.e. banks must have an operational risk management function which exposes, analyses, measures, reports and manages operational risk factors.[4]

- Advanced measurement approach (AMA) – in this case, the capital charge is based on actual risk measurement: the extent of one-year 99.9% VaR[5] must be determined. Institutions authorised to use this method have to satisfy strong risk identification, risk assessment, monitoring and risk management requirements. Measurements for estimating risk are not simply based on historical data; internal controls and the business environment must also be captured, using external data as well. The capital charge of the advanced measurement approach, similar in complexity to the ratings-based approach (IRB) applying to credit risk, is the one-year 99.9% VaR. In other words, capital which is capable of covering the losses of all years, the losses of which are only exceeded every 1,000 years must be allocated, with these parameters

Due to their nature, the basic indicator and standardised approaches are considered "simpler methods". The AMA allows sophisticated risk assessment, determining a capital charge based on the actual risk profile. The method of capital requirement calculation based on gross income was determined based on the significant relationship between gross income and annual losses stemming from operational risk, demonstrated by certain studies (of which the most frequently cited is Shih et al., 2000). However, upon more careful reflection, the simpler methods do not necessarily reflect the profile of operational risk to financial institutions. Although it is logical that if an institution's gross income is higher, then the institution itself is bigger, if an institution suffers a greater loss precisely because of its greater operational risk losses, then its capital charge decreases in the opposite direction of risks. Of course, it may also decrease the available regulatory capital remaining after the appropriate accounting settlements following the claiming of losses and other items, thereby decreasing the overall level of capital adequacy. Recognising this effect, which materialises perceptibly in the current crisis environment due to falls in profitability, the authorities responsible for creating capital requirement regulations have begun to consider devising alternative indicators in order to determine capital requirement levels which reflect risks better, even under the simpler methods.

[3] The literature on risk management defines credit risk as the risk of loss stemming from a debtor's non-payment, while market risk is defined as the risk of loss stemming from a change in the market price of financial assets.

[4] The regulation enables banks with large retail and commercial banking activities to use the so-called alternative standardised approach (ASA). In this case, the authorised institution may use 3.5% of the business line's previous three years' average exposure instead of gross income in the two aforementioned business lines.

[5] VaR is the abbreviation for "value-at-risk". For example, a one-year VaR figure of 99.9% reflects the value which we cannot lose more than with a 99.9% probability in one year.

The hierarchy between the various methods for determining the capital requirement is not only reflected in the increased requirements and the one-way direction of switching method (by default, one can only progress along the spectrum of approaches from simpler methods towards the more advanced ones, and not vice versa), but also in the amount of the capital charge. The findings of impact studies introducing the new regulation (see for example CEBS, 2006) show that based on general tendencies, the observed banks are better off switching from the basic indicator approach to the standardised approach, and from the standardised approach to the advanced measurement approach, as the amount of capital charge decreases in parallel with the increasing complexity of the method chosen. In the case of certain banks, nevertheless, the capital requirement – which generally decreases as a given method's complexity increases – may show opposing change.

In the following section, I will first examine the operational risk capital charges and the available data on the operational risk losses of the Hungarian banking system, followed by an analysis of the driving forces of the choice of capital requirement method, comparing Hungarian tendencies with an overview of the operational risk method selection of large international banks.

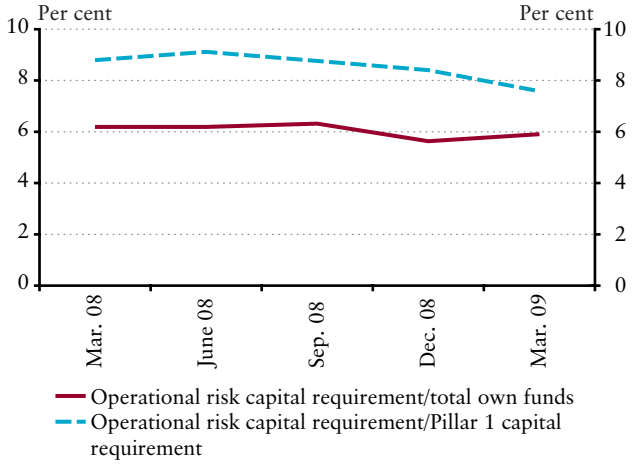
THE OPERATIONAL RISK CAPITAL CHARGES OF THE HUNGARIAN BANKING SYSTEM AND THE SIZE OF RECENT LOSSES

At the end of 2009 Q1, the banking sector's total operational risk capital charge was HUF 120 billion, which is 8.96% of the previous (year-end 2007) credit and market risk "Basel I conform" capital charge. The change in capital requirement calculation regime led to a decrease in the credit risk capital requirement, which was partly offset by the introduction of the operational risk capital requirement. The intention of regulators of maintaining the overall capital requirement at the same level, but distributing it differently among the various risks to better reflect financial institutions' risk profile is thus fulfilled. Over the past year, the proportion of the operational risk capital charge within the Basel II-based capital requirement was around 9%. Based on end-March 2009 data, this proportion has dropped to around 8% (in line with the lower level of profits compared to previous years at the end of 2008). The banking system's operational risk capital charges account for approximately 6% of the regulatory capital available for covering risks (Chart 1).

From the perspective of their choice of method, Hungarian commercial banks began to use the simpler methods in the course of implementation in 2008. Although the BIA was the most popular (60%) considering simply the number of institutions opting for it, based on the own funds available for solvency purposes, 18% of institutions introduced the BIA, 82% chose the standardised method, while the sole institution which employs the AMA accounts for 0.2%. Some of the 13 institutions which use the standardised method may switch in the future to the advanced measurement approach after acquiring sufficient experience.

Chart 1

Proportion of the Hungarian banking sector's operational risk capital charge compared to the banking system's minimal capital charge and own funds available for risk purposes



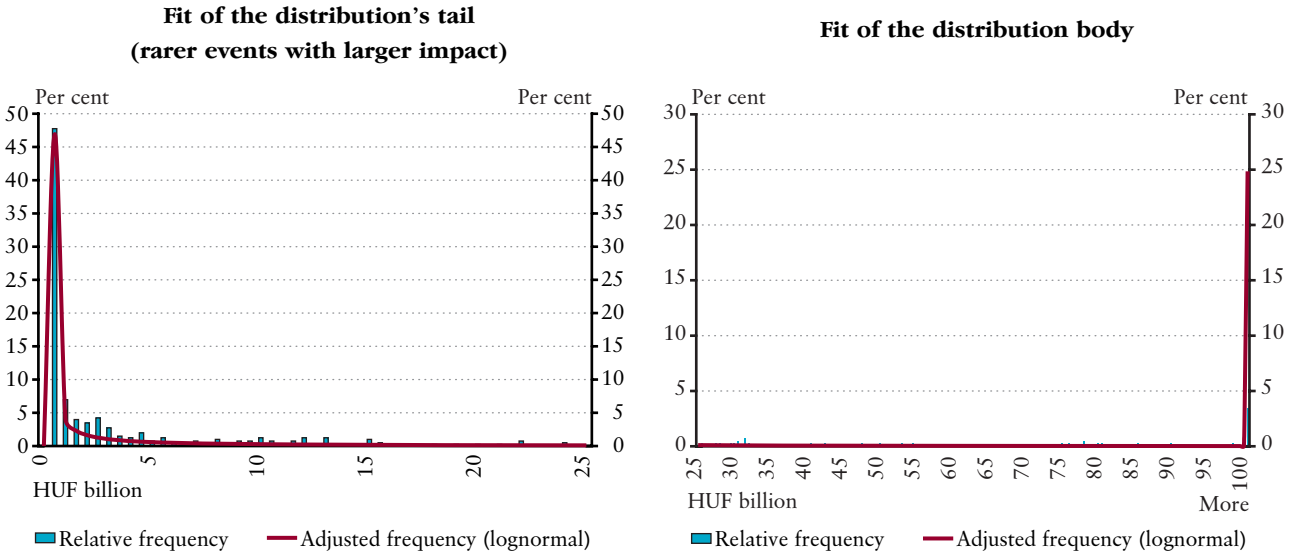
Source: MNB.

The Hungarian banking system's level of operational risk capital charge (HUF 120 billion at the end of March 2009) provides an approximation of exposure to operational risk, hence although this figure can be considered relatively low, we cannot adequately assess its level. The Hungarian banking system's operational risk potential should be assessed based on the timeline of actual losses and on scenario analyses, calculations based on international comparisons and on the basis of the extent of estimated potential losses, but there is not enough information available as yet on operational risk losses in the Hungarian banking system at the system-wide level due to a lack of systematic data collection in the past.

At the same time, the extent of operational risk can be determined based on so-called COREP reporting, based on Basel II. According to year-end 2008 data, the number of operational risk losses which affect previous years but have not yet been closed or which were recorded in the previous four quarters was 5,274 in case of banks using the standardised or advanced measurement approach, with total losses amounting to HUF 13 billion, thus the average loss was HUF 2.5 million. This level of loss accounts for 3-4% of the

2. ábra

Distribution of the main operational risk loss events of the Hungarian banking system in 2008



Note: data of banks using the standardised or advanced measurement approach. Loss events registered in 2008 or not yet closed.
Source: MNB.

entire banking system's pre-tax profits for 2008. However, when assessing significance, it must be taken into account that not every bank reports operational risk loss data based on the standardised method; furthermore, reporting biases stemming from insufficiently thorough disclosure of risk events may occur, in turn related to the fact that the practical implementation of the operational risk framework is still in its initial phase. Nearly 75% of the value of reported losses falls into the category of execution and processing errors, with the retail business line coming out on top (68%) in a business line breakdown. Examining the reported operational risk loss events which affected the previous years but have not yet been closed, or which were recorded in the preceding four quarters by quarter reveals diversity. Although the order of magnitude of aggregate losses is quasi unchanged, the internal distribution by type of event and business line varies, which is linked to the fact that the addition of one quarter can cause significant changes in short, less robust timelines. Banks only report individual loss data to the COREP database to a limited extent, reporting only 10% of the events causing the highest losses, but at least 10 events. Only limited conclusions can be drawn on the events from this censored, selected database. In any case, the analysis of the data revealed that the distribution of loss events has a fat tail, in other words the probability of losses substantially higher than the average loss is relatively high. Chart 2 shows the fat tail and that the loss distribution calculated based on the data set containing the truncated, censored data is well fitted to the lognormal distribution on the body of the distribution, although the lognormal distribution often used for operational risks which can be fitted to these same data has a slightly fatter tail. Of course, the complete distribution function could be drawn based on all the loss data, which may possibly yield a more precise fit, and a larger sample size would allow more extreme events to be included in the sample.

Stemming from the characteristics of operational risk, an institution's internal data often do not give an accurate picture of its full operational risk profile. This is why the advanced measurement approach prescribes the use of external data to disclose rare events which have a strong impact (so-called tail events). An important initiative launched by the members of the Hungarian banking system is the HunOR Hungarian Operational Risk Database, which began operation in 2007 under the auspices of the Hungarian Banking Association. Twelve banks, representing over 50% of the entire banking sector's asset portfolio, anonymously share individual loss events with a booked impact of over HUF 50,000 in the framework of the data consortium. This initiative represents a great advantage for the participating banks, allowing the disclosure of Hungary-specific operational risk events and comparison with institutions of presumably similar operational risk profile. The HunOR database began operating by registering operational risk loss events booked after 1 January 2007 in the database. A cooperation agreement was concluded between the Magyar Nemzeti Bank and the Hungarian Banking Association, pursuant to which the MNB receives data containing data aggregated from the HunOR database. The database's significance can be reinforced based on the data thus made

available, as nearly four thousand events with booking dates until end of 2009 Q1 were shared by the participating institutions, and the total registered loss for this period reached HUF 13 billion (Source: Hungarian Banking Association HunOR Hungarian Operational Risk Database).

All of this shows that recent operational risk loss events are not of determining significance in and of themselves. At the same time, an unchanged level of operational risk can, with the increased financial risks in the current crisis, further deteriorate the position of financial institutions, moreover financial institutions' employees may be more prone to error under stress. As a result, the interaction of various types of risk has intensified, with operational risk events triggering credit risk events, and vice versa (through a sort of endogeneity). Furthermore, legal risk also plays a more important role in the current environment, as clients become more sensitive in the dire economic climate, so potential legal proceedings stemming from non-compliance with the norms of fair market behaviour (for instance selling overly risky products to clients without providing them appropriate information) may lead to substantial financial losses and dent reputation, deteriorating already gloomy bank profitability prospects.

DRIVERS FOR CHOICE OF OPERATIONAL RISK APPROACH

The choice of risk management approach may be determined by several factors. A part of these factors may be related to the nature of the financial institution's activities (size, efficiency, risk exposure), while other factors – impossible or difficult to measure accurately – (organisational culture, managers' risk consciousness) may also come into play. The common traits of financial institutions using the more advanced operational risk approaches is also worth examining, i.e. whether it is attributes related to size or profitability which co-vary with the choice of method. In the following section, I will first present the data pertaining to foreign institutions, before moving on to Hungarian institutions' practices in terms of method selection.

Operational risk method selection practice of large, foreign institutions

I founded my analysis on data pertaining to financial institutions' choice of operational risk approach on the one hand, and on financial institutions' profitability and balance sheet data on the other. Data pertaining to the choice of operational risk approach pose the biggest problem at present, as in countries where capital allocation for operational risk has been compulsory since 1 January 2008, data on operational risk are only included in annual reports for 2008, which would have to be compiled one by one. Of course, larger institutions are much more transparent due to the reputational requirements imposed by their presence on the stock exchange and their size, so I will use operational risk data gleaned from a secondary data source containing the world's 100 largest institutions according to the banks' or bank groups' equity capital.

I used two data sources for the analysis.

- The data source for operational risk data was the article published in the October 2008 issue of the OpRisk & Compliance (OR&C) journal (OpRisk & Compliance, 2008). The referenced article obtained its data from several sources: data on equity capital from annual reports, announcements in written and non-written media, articles (e.g. The Banker magazine), the other data compiled from annual reports, supervisory publications, software company reports, while loss data was gleaned from the database containing public operational risk loss data, operated by the software company SAS. In light of the fact that OR&C magazine is the leading journal of the operational risk management profession, I considered the data published in it to be sufficiently reliable.

- Data pertaining to profitability, size and liquidity were obtained from the Bureau van Dijk "BankScope" database. BankScope is a database containing micro-level bank data, often used in academic circles and by financial institutions and central banks for comparing countries or preparing analyses based on individual bank data (Bhattacharya, 2003).

- Based on BankScope's brochure, the database contains information on 23,000 banks, with all of the relevant banks of every country worldwide included in the database (Bureau van Dijk, 2008).

Fairly detailed analyses can thus be carried out based on the available database[6], among which this article will only present the most interesting findings. Of the 100 institutions in the sample, 90 have introduced operational risk management and capital charge allocation based on Basel II. Among the largest banks, 8 employ the basic indicator approach, 43 the standardised approach and 39 the most complex advanced measurement approach. Of course, some of the institutions using simpler approaches intend to switch

[6] Even the smallest bank in the sample has equity capital of USD 5.7 million and a balance sheet total of USD 62 billion, which means that in comparison, even the smallest institutions and bank groups are slightly larger than the bank group led by the largest Hungarian bank (OTP banking group).

Table 1

Statistical correlation between size and profitability attributes and the operational risk approach used

	Correlation with the chosen operational risk methodology's code	Two-sided level of significance (p-value)	Sample size
Total tier 1 capital (USD million)	0.37	0.00	90
Balance sheet total (USD million)	0.36	0.00	90
Return on Average Assets (ROAA) (%)	–0.05	0.58	90
Return On Average Equity (ROAE) (%)	0.07	0.42	90

Note: the values of the Kendall's tau-b type correlation indicator, which can be used for ordinal data in correlation calculations, are shown. Similarly to the "traditional" linear correlation indicator, Kendall's tau-b varies between –1 and +1; the higher the absolute value of a given indicator, the stronger the correlation. A value of +1 represents perfect covariance, while –1 represents perfectly opposing variance. Significance (p-value) shows the probability of the given indicator equalling zero, i.e. there being no relation between the two timelines. The coding of the chosen operational risk methodology is the following: 1: BIA, 2: TSA, 3: AMA.

Source: own calculation based on data from OpRisk & Compliance (2008) and Bureau van Dijk (2008).

to the advanced measurement approach in the future; 13 institutions expressed such an intention. Based on the data included in the database, I examined the statistical correlation between fundamental size and profitability indicators and the choice of operational risk method among the institutions using Basel II-based approaches. The findings presented in Table 1 suggest that there is a clear, significant correlation between size indicators and the operational risk approach chosen, while no clear correlation can be established with profitability indicators. In other words, the larger an institution is, the more complex its operational risk approach, while from the aspect of profitability, more profitable financial institutions do not show an inclination towards either simpler or more advanced approaches. This leads to the conclusion that using more advanced methods yields economies of scale for larger institutions, as higher profits can be achieved with equal or comparable fixed costs.

Of the 100 institutions examined, 36 are members of the operational risk data consortium, which enables the more effective measurement of operational risk. On the international scene, there are several databases operating on a national level, similar to the one in Hungary (for instance DIPO in Italy or the Landesbanks' DAKOR database in Germany), as well as those stretching beyond national boundaries, such as the ORX database, established by the largest banks. Statistical analyses show that consortium membership is strongly correlated with the applied methodology's complexity.[7]

Hungarian banks' practice in choosing their operational risk method

Several articles have already been written on Hungarian banks' operational risk management practices (including the article published in issue 4, 2007 of the Hitelintézeti Szemle). No comprehensive analysis has yet been published on Hungarian banks' operational risk management practices, and therefore my subjective experience and Hungarian Financial Supervisory Authority (2005) represents a sort of guideline from this perspective. Hungarian banks clearly began focusing on operational risk as a part of the Basel II process, although some banks had already begun to establish special risk management practices for managing certain risks (IT security, risks related to the workout process). Internal control was a fundamental starting point in this process. Given the strong foreign presence in the Hungarian banking sector, parent banks provide strong methodological guidelines for operational risk management. This is especially important in light of the fact that in the course of the Basel II process, not only individual, but also group-level adequacy is important. When developing operational risk management practices, banks undertook efforts to develop risk identification, measurement, monitoring and management, the first step of which was the collection of data pertaining to loss events. HunOR's role from this perspective is vital, as a standardised framework was developed for the participating banks, allowing banks, sharing their experiences, to develop adequate operational risk loss data collection in line with the criteria set forth by the regulation. Overall, it can be said that

[7] A correlation value of 32% (Kendall's tau-b measuring rank correlation) exists between the external database member's proxy (1: membership, 0: no membership) and the method complexity indicator (0: Basel I, 1: BIA, 2: TSA, 3: AMA), with a rather high level of significance (p=0.02%).

Table 2

Hungarian financial institutions' choice of operational risk approach and the main attributes of the various groups

Chosen method	Number of institutions (pcs)	Balance sheet total based share (percentage)	Regulatory capital based share (percentage)	Average balance sheet total (HUF billion)	Average capital adequacy (percentage)	Average ROE (percentage)	Average ROA (percentage)
BIA	21	19.40	18.06	270	12.02	5.12	0.27
TSA	13	80.42	81.72	1805	10.84	14.34	1.02
AMA	1	0.18	0.22				

Note: non-audited, non-consolidated data from end-2008.

Source: MNB.

Hungarian banks are taking significant steps towards adopting the best international practice, although few Hungarian banks perform modelling at present, due to the lack of maturity of implementation on the one hand, and centralised modelling on the level of parent banks on the other hand. The reasons behind this could be that as there is relatively little data and experience on operational risk, developing databases of sufficient volume and methods yielding robust results can initially only be achieved at the bank group level. At the same time, an important criterion is that the calculations pertaining to subsidiary banks must reflect local idiosyncrasies, and furthermore the use of local models may become necessary as the amount of local experience grows.

Based on year-end 2008 data, the numerical majority of Hungarian banks use the method based on the basic indicator. At the same time, if we consider the proportion based on the balance sheet total or regulatory capital, about 80% of the banking system uses the standardised approach (Table 2). Only one smaller institution in the banking sector currently uses the advanced measurement approach, and some institutions currently applying simpler approaches intend to switch to the AMA in the short or medium term. The Hungarian banking system is therefore split between users of the basic indicator approach ("simpler institutions" in this perspective) and the standardised approach ("more advanced institutions" in this perspective). Considering average values, year-end 2008 data reveals that larger Hungarian banks tend to be the ones using the more complex standardised approach, which has a relatively lower capital adequacy requirement and higher profitability (Table 2). From these ostensible correspondence, correlation analyses highlight the covariance and opposing variance of balance sheet total based size and the capital adequacy indicator. At the same time, the profitability of banks using the basic indicator or the standardised approach does not differ significantly.

Twelve Hungarian financial institutions (typically commercial banks) participate in the HunOR database. From the perspective of method complexity, a pattern similar to that of foreign banks with external operational risk database membership appears. While 75% of the member banks of HunOR, falling under the scope of Basel II, and banks of which the parent bank is a member of HunOR use the standardised approach, this proportion is only 17% among non-members of HunOR. In other words, membership in an external database also indicates the choice of more complex methods in the Hungarian banking system as well, materialising in the form of the standardised approach at present, and hopefully in the use of the advanced measurement approach in future.

CONCLUSIONS

This analysis focuses on the operational risk aspects of the introduction of the capital adequacy regulation which came into force in the Hungarian banking system from 1 January 2008 in line with Basel II. The regulation allows financial institutions falling within its scope to choose their operational risk method, either opting for simpler approaches based on profitability indicators or for more complex ones based on actual measures of risk. Based on the past one-year period, the Hungarian banking system's operational risk capital charge was significant compared to the total capital charge, with the operational risk capital charge for Q1 2009 amounting to HUF 120 billion, or nearly 8% of the total capital charge. The reported realised losses are lower compared to the capital requirement (approximately HUF 13 billion in 2008), but the capital charge must provide a buffer in extreme, unexpected situations, and conclusions on extreme values cannot be drawn based merely on one year of observation, therefore this discrepancy is completely justified. Regarding institutions' choice of approach, larger institutions prefer

more complex methods in both foreign and Hungarian practice. This is due to the fact that the introduction of more complex approaches comes with higher fixed costs, which a larger institution can allocate more easily to its operational risk project, and moreover, they can take better advantage of the capital requirement benefits offered by the method's complexity. Only one smaller actor in the Hungarian banking system applied the most complex, so-called advanced measurement approach as at June 2009, presumably trying to benefit from economies of scale on a bank group level and to adopt the group-level approach locally with relatively low costs. Overall, the conscious management of operational risk and the use of developed methods aimed at managing them can contribute to the financial system's stability, which also deserves more attention given the current gloomy economic climate and the escalation of financial risk. As a continuation of this analysis, it would be worth comparing the choice of operational risk capital allocation approach with that of credit risk in future, which also allows for choice between simpler and more complex methods (standard and internal rating based approach), furthermore, country-specific factors in method selection patterns would also be worth examining.

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Erika Leszkó: Rounding is not to be feared

Nearly one and a half years have elapsed since the MNB withdrew 1- and 2-forint coins from circulation on 1 March 2008, which simultaneously saw the rule on rounding to the nearest value of 5 enter into force. While it was perfectly clear from a professional perspective that rounding would make cash payments easier on a daily basis, there was nevertheless strong concern surrounding the introduction of rounding. The actual developments, however, have not underpinned preliminary fears. The withdrawal of 1-and 2-forint coins did not bring about an inflationary effect, due to the symmetrical direction of the rounding for final amounts payable only, and the application of new rounding rules did not cause any particular difficulties. It does not come as a surprise that the use of rounding did not cause any disruption in the economy, as rounding has a more than decade-long tradition in Hungary on account of the withdrawal of the filler in the 1990s. In this article, we will present the reasons and the economic rationale behind the introduction of rounding rules with the help of Hungarian and numerous foreign practices. As Hungary's legal tender will hopefully be the euro within a few years, the experiences of euro area countries in the practice of rounding will be examined more closely.

INTRODUCTION

Due to changes in price levels and price structures, the issue of the circulation of small denomination coins emerges in almost every country from time to time. The greater tendency of small denomination coins with low purchasing power of being placed into circulation compared to higher denomination ones is a global phenomenon. The reason why they are placed into circulation significantly above average is that they do not circulate in cash payments, they have a low purchasing power, they are not used, accumulate at the bottom of drawers or are lost, and a portion of them is kept by foreign tourists.

The economic cost of using small denomination coins is comprised of several factors, among which the most obvious is production cost. In countries which decided to withdraw small denomination coins from circulation, their production cost generally exceeded their face value by far; however, this was not the sole reason behind their elimination. Other cash-related costs (circulation, transportation, processing, storage, etc.) can account for up to 0.5–0.6% of GDP on the national economy level, according to foreign studies. The lion's share of these costs is generated by coin circulation, due to the substantial weight and quantity of the coins. The introduction of measures aimed at limiting the use of small denomination coins – ceasing production, withdrawal, imposing rounding rules – can save billions on the overall social level for a country.

In our article, we examine what factors led to Hungary's decision to withdraw 1- and 2-forint coins and how the introduction of rounding rules contributed to reducing the weight of wallets and making day-to-day life easier without causing prices to creep higher. Then we will present the practice and experiences of other countries regarding this issue before drawing our general conclusions on the use of small denomination coins.

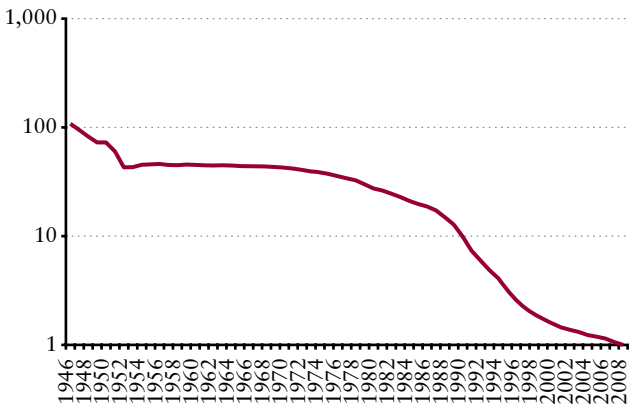
WHAT CONSIDERATIONS LED TO THE WITHDRAWAL OF SMALL DENOMINATION COINS FROM CIRCULATION IN HUNGARY?

Over recent years the purchasing power of 1- and 2-forint coins had fallen to such an extent that they were used increasingly less by people in the course of their purchases. For a long time, these coins could not be used to purchase anything and were only needed for the precise settlement of

Chart 1

Fall in the purchasing power of the 1-forint coin between 1946 and 2008

(represented on a logarithmic scale)



Source: CSO (Central Statistical Office), MNB calculation.

generally low-value cash transactions carried out in the course of daily shopping. The following chart (Chart 1) clearly illustrates that the 1-forint coin worth 1 unit in 2008 was worth 100 units at the time of its introduction in 1946, but had lost 90% of its purchasing power by 1990.

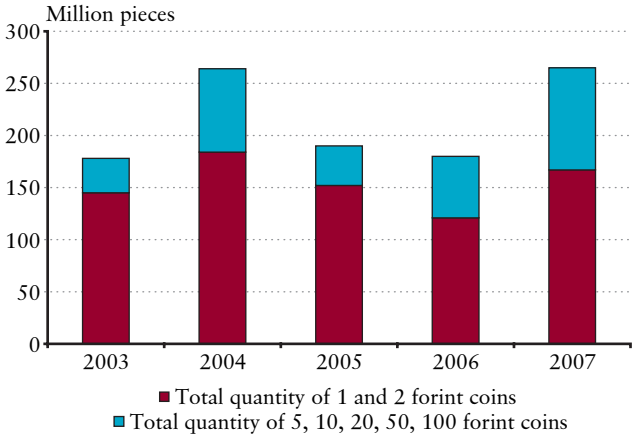
1- and 2-forint coins received as change from cash payments were then not put into circulation again by buyers due to their impractical nature (size, weight) and low purchasing power. The majority of vending machines did not accept 1- and 2-forint coins, further contributing to the lack of use of small denomination coins. The coins produced tended to become increasingly 'disposable after one use', with the majority left in wallets, piggy banks or lost after the first payment transaction following their issuance by the central bank.

On daily average, the MNB placed nearly one million 1- and 2-forint coins into circulation, replenishing their continuously dwindling quantity. The continuous production and expulsion from circulation of 1- and 2-forint coins – much like pouring water into a leaking bucket – required substantial additional outlays by the Magyar Nemzeti Bank. Given the fact that the MNB relies on public funding, this represented an additional expense for the entire country.

Chart 2 reveals that the production of 1- and 2-forint coins accounted for over 70% of annual coin production.

Chart 2

Quantity of circulation coins produced by the MNB between 2003 and 2007



Source: MNB.

The total social cost of keeping the coins in circulation is comprised of several factors. When the decision to withdraw 1- and 2-forint coins was made, the coins' production cost was five to six times higher than their face value, yet this was not the principal factor which prompted the decision, but rather the fact that the coins were not actively used in cash payments. Consequently, as 1- and 2-forint coins did not fulfil their function, keeping them in circulation would not have been economically justified, even if their production costs were lower than their face value. Spending on a coin of a denomination deemed useless by citizens is an unnecessary burden for the economy.

The social costs of keeping 1- and 2-forint coins in circulation greatly exceeded the annual production, storage, transportation and processing costs – approximately HUF 1.5 billion – incurred by the MNB. The majority of the savings stemming from the withdrawal of small denomination coins is due to the fact that there is no longer any need for their transportation, storage and processing (counting, sorting into rolls, packaging) in commerce, banks and post offices. On a social level, the profit derived from no longer having to search for small coins, count them or wait for the cashier to open a new roll of coins and hand back change during cash transactions (purchases, paying in and out in banks and post offices) is also a decisive factor. These expenses, which do not affect the central bank, may account for HUF 2-2.5 billion annually.

Therefore, due to their waning role and the increasing social costs of keeping them in circulation, the Magyar Nemzeti Bank decided to withdraw 1- and 2-forint coins as of 1 March 2008.[1]

PRELIMINARY FEARS SURROUNDING THE INTRODUCTION OF ROUNDING AND ACTUAL DEVELOPMENTS

On account of the withdrawal of 1- and 2-forint coins, legislative regulation on rounding became necessary, in order to ensure the execution of cash payments according to a unified order and the settlement of related accounting and taxation issues.[2] Prior to the entry into force of the act, many fears emerged, which later proved to be unfounded. For instance, there were fears that it would lead to an increase in the price of certain items, or the adjustment of cash registers would incur huge costs for the commercial sector, which it would pass on to households. A further fear was that unfamiliarity with rounding rules would lead to never-ending queues at tills.

Prior to the withdrawal of 1- and 2-forint coins, in 2007 the MNB examined what the inflationary effect would be if

[1] MNB Decree 10/2007 (X. 1.) on the withdrawal of 1- and 2-forint coins from circulation.
[2] Act III of 2008 on the rules of rounding required as a consequence of the withdrawal of 1- and 2-forint coins from circulation.

cashiers did not proceed according to the provisions of the rounding rule, in other words, if the price of individual articles were rounded instead of the final sum. The study revealed that if the price of every item was rounded upwards, the inflationary effect would be 0.3% at the most, and if prices were rounded downwards – i.e. if prices ending in 1 and 6 were rounded downwards, while the remainder were rounded upwards –, the effect would be 0.2%, and finally, if prices were rounded according to the rule[3], the effect would remain below 0.1%.

In practice, retail traders did not re-price articles on account of the withdrawal of 1- and 2-forint coins (which, as a matter of fact, would have been very costly), but opted instead for rounding the final sum payable on goods, in line with the stipulations of the act on rounding. Small retail outlets, as well as large supermarket chains maintained their so-called marketing prices, ending in 9. Neither the Hungarian Authority for Consumer Protection, nor the National Association for Consumer Protection in Hungary received any complaints regarding rounding. Consumer price index data for March 2008 also revealed that the withdrawal of 1- and 2-forint coins did not have an inflationary effect. (The MNB examined developments in the prices of two items which typically have low unit prices and are generally purchased alone, not in combination with other articles, expressly from this perspective. In the case of espresso coffee, a minimal price increase of 0.1% ensued compared to February. In the case of newspapers, the seasonally adjusted one-month price change did not diverge significantly from the price changes observed previously.)

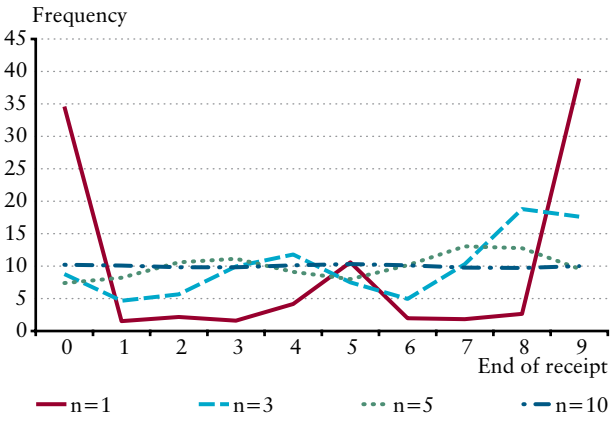
Chart 3 shows that the more items we purchase simultaneously, the more evenly the last digit of the final sum on the receipt is distributed between 0 and 9. The chart shows that in the case of purchases of 10 or more items, there is an equal probability of the cashier rounding the final sum upwards or downwards, i.e., taking the average of multiple purchases, the consumer and the seller 'wins' and 'loses' in equal proportion.

In drafting the Rounding Act, an important criterion was to avoid increasing the administrative burden on economic actors. Therefore, the Rounding Act does not prescribe the adjustment of cash registers, for example. It is up to companies' business policy whether they adjust cash registers to also display the rounded final sums on receipts or whether cashiers do the calculation themselves. For further simplification, the Rounding Act also provides the possibility to apply rounding not only for cash transactions, but for bank

Chart 3

Frequency of receipts ending in 0, 1, etc. in the case of processed foods

(n=number of items purchased)



Source: MNB.

card transactions as well; however, consumers must be notified in advance of such rounding.

Prior to the withdrawal of 1- and 2-forint coins, the MNB conducted a representative nationwide survey regarding the withdrawal of the coins on two occasions, one in October and November 2007 and one in February 2008, to be repeated in April 2008 following the withdrawal. According to the survey results, the sweeping majority of respondents supported the withdrawal of the coins (88% in October and November 2007, 90% in February 2008, and 93% in April 2008). 85% of respondents in the first survey and 96% in the last survey claimed they did not fear that withdrawal would affect their financial situation.

The study also attempted to assess knowledge of rounding rules. Almost all respondents knew that the final sum had to be rounded instead of individual product prices. The majority of those surveyed rounded the numbers properly, so that they ended in 0 or 5 in line with the rules of rounding, while those rounding incorrectly mainly encountered difficulties in the case of numbers ending in 7. The MNB sought to provide colour stickers and posters showing the rules of rounding to all inquiring retailers, lending assistance to both consumers and cashiers in the initial period.

All in all, the use of rounding did not cause any disruptions in the economy despite the initial fears, which is not surprising as the practice of rounding was not a novelty. Following the withdrawal of the fillér, economic actors – by merely applying the mathematical rules of rounding

[3] In other words, prices ending in 1, 2, 6, 7 are to be rounded downwards, while those ending in 3, 4, 8, 9 are to be rounded upwards.

automatically, without any legislation regulating it – adjusted smoothly to operating without the fillér.[4] In relation to the withdrawal of 1- and 2-forint coins, the decision was made to apply the so-called Swedish rounding – which has been used successfully in many countries – thanks to which the inflationary effect could be avoided.

In the following section, we will present several countries worldwide where rounding has been successfully employed for years or decades.

FOREIGN PRACTICE RELATED TO SMALL DENOMINATION COINS

Countries which have introduced rounding rules due to the withdrawal or lack of small denomination coins, or in order to cut back on the use of such coins, apply the so-called Swedish rounding. The Swedish rounding is symmetrical both downwards and upwards, and means that the final sum has to be rounded to the nearest unit of money in circulation. Such rounding is generally used for cash payments only, as the exact amount can be paid through transfers and bank card payments, rendering rounding unnecessary.

Nordic countries are in the vanguard of employing rounding rules. In *Sweden,* 1- and 2-öre coins of the krona's subunit were withdrawn from circulation in 1972, and rounding to the nearest figure ending in 5 or 0 was applied until 1985. In 1985, the 5- and 25-öre coins were eliminated, and the 10-öre coin was scrapped in 1992. On 25 March 2009, production of the 50-öre coin was discontinued, as the denomination will be withdrawn on 30 September 2010 simultaneously to the introduction of rounding to the nearest krona for cash payments. Legislation regulates rounding rules, as a result only its amendment will be necessary. Two-thirds of the population and retail traders were in favour of the withdrawal of the 50-öre coin. The examination of the inflationary effect revealed that the withdrawal of the coins and rounding would not lead to price increases. *Norway* ceased production of the 1- and 2-öre coins in 1972, that of the 5- and 25-öre coins in 1982 and that of the 10-öre coin in 1992. *Denmark* withdrew 1- and 2-öre coins in 1973, 5- and 10-öre coins were withdrawn in 1989 and the 25-öre coin on 1 October 2008. Both countries used rounding to the nearest coin denomination in circulation, without triggering any price increases.

The term 'Swedish rounding' became widely known in 1990, when the 1- and 2-cent coins were scrapped i*n New Zealand* and rounding to the nearest sum ending in 5 or 0 was introduced. The rounding method applied in New Zealand was based on the well-functioning Swedish model, with a history of two decades. In 2006, the 5-cent coin was also removed from circulation in New Zealand, having lost its value to such an extent that people became less and less inclined to use it. The Reserve Bank of New Zealand issued 30 million new 5-cent coins on an annual basis, incurring a cost of over 1 million NZD. Prior to the withdrawal of the 5-cent denomination, the central bank commissioned a public opinion poll (AC Nielsen: Reactions to Proposed Changes to Silver Coinage, January 2004). The survey revealed that 68% of the population and 70% of retail traders were in favour of the step. The economics department of the Reserve Bank of New Zealand and the New Zealand statistical office both examined the inflationary effect of rounding, concluding that price increases in the expenditure of households would be negligible. The rounding rules governing cash payments were put forward as a recommendation by the New Zealand Retailers Association. Retailers may diverge from the rules according to their own business policy, but must notify consumers if doing so.

Australia ceased production of 1- and 2-cent coins in 1990, and has not issued such denominations since 1992. The rounding recommendation issued by the Australian Price Surveillance Authority only applies to cash payments. A surprising side-effect of the withdrawal of 1- and 2-cent coins was that large quantities of other, higher – 5- and 10-cent – denomination coins were also returned to the banks, constituting a so-called 'money box effect'. This effect could also be felt in Hungary on account of the removal of 1- and 2-forint coins, with people exchanging other coinages stored in jars and boxes at the banks and post offices.

Israel withdrew its smallest denomination, the 1-agora coin in April 1991, simultaneously introducing rounding to 5 in cash transactions. The 5-agora coin was scrapped in January 2008, thus rounding is now performed to the nearest 10-agora value. According to public opinion polls, 80% of the population supported the decision to remove the coins from circulation.

South Africa ceased production of 1- and 2-cent coins on 31 March 2002, while *Singapore* ceased production of 1-cent coins on 2 April 2002. Cents remained a legal tender in both countries, and all cash transactions are rounded to the nearest 5-cent value.

[4] The Magyar Nemzeti Bank withdrew 2- and 5-fillér coins from circulation on 30 September 1992, 10- and 20-fillér coins on 1 October 1996 and 50-fillér coins on 1 October 1999 [MNB Announcement 2/1992 (MK 30), 2/1996. (MK 22) and 1/1999 (MK 23)]. The withdrawal of fillér coins did not affect the fillér's use as an accounting unit: ME Decree 9000/1946 (VII. 28) – stating that the Hungarian legal tender is the forint, and that the forint is subdivided into 100 fillérs – was not amended, therefore the fillér could still be used in the course of calculations.

The *Czech central bank* withdrew 10- and 20-heller subunits of the Czech koruna on 31 October 2003, and consumer protection legislation stipulated that for cash payments, the final sum of purchases had to be rounded to the nearest denomination in circulation. On 31 August 2008, the 50-heller coin was also withdrawn, making rounding to the nearest 1-koruna value necessary. According to the Czech central bank's study, rounding did not trigger an inflationary effect.

Malaysia introduced rounding to the nearest 5-sen value on 1 April 2008, while maintaining 1-sen coins as a legal tender which must be accepted as a means of payment in amounts up to RM 2 (Malaysian ringgit, 1 ringgit=100 sens). All payments are subjected to rounding irrespective of their mode, be it cash or non-cash (bank card, electronic payments, cheque).

In conclusion, small denomination coins did not fulfil their function in cash payments, due to their weak purchasing power in all of the countries presented above, prompting the decision to withdraw them and/or to round to the nearest higher coinage in circulation.

In the following section (Chart 4), we will present the countries included in our study together, listing them in the order of the value at purchasing power parity of the coin denomination based on which rounding is performed according to the country's effective rounding rules. Canada and the USA (which will be examined further in the article) were only included in the chart as a point of interest, as they have not yet introduced rounding, with 1-cent coins still in circulation. The international comparison reveals that Hungary has not 'overdone it' with the introduction of rounding to the nearest 5-forint value.

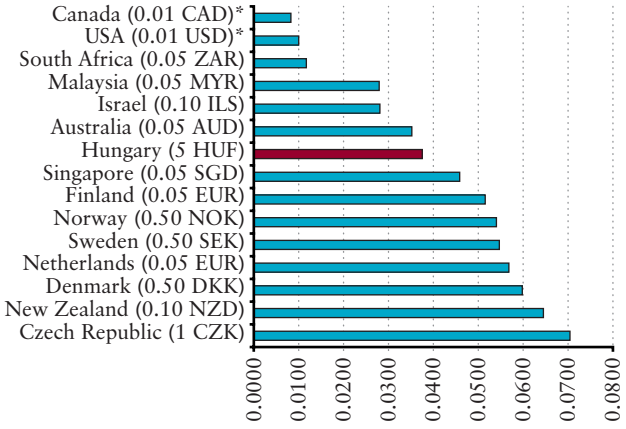
USE OF 1- AND 2-CENT COINS IN THE EURO AREA

The purchasing power of 1- and 2-eurocent coins is quite low given European price levels, thus people tend to use them increasingly less for payments, and the small denomination coins regularly emptied from wallets are not reintegrated into active cash circulation. This is the reason why following the introduction of 1- and 2-cent coins on 1 January 2002, the release into circulation of these coinages greatly exceeds that of other coin denominations.

Currently, there are approximately 19 billion 1-cent coins and 16 billion 2-cent coins in circulation, accounting for over 40% of the stock of coins in circulation. Chart 4 shows that following the introduction of the euro, the release into circulation of 1- and 2-cent coins increased for one and a half years, then stagnated at a relatively stable level following a slight decline until 2005. This means that 10% of 1- and 2-cent coins, i.e. 1.9 and 1.6 billion pieces are ejected from

Chart 4

Value at purchasing power parity (PPP) of the smallest coin denomination actively used in countries applying rounding in 2007[5]



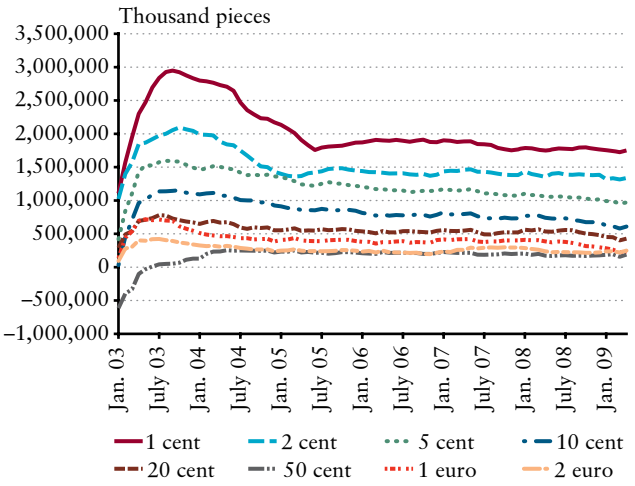
** There is no rounding in Canada or the US; the two countries are only included in the chart for the sake of comparison.*

Source: rounding – websites of national issuing authorities; PPP values – IMF website.

Chart 5

Changes in the stocks of coins in circulation between 2003 and 2009, in units

(differences between the stock during the given month of each year and the stock during the same month of the previous year)



Source: ECB.

[5] Purchasing power parity measures the quantity of goods and services which can be purchased in a given currency (USD) compared to another currency, reflecting diverging prices between various countries.

circulation annually, a quantity which then has to be replaced every year.

Finland and the Netherlands do not produce 1- and 2-cent euro coins for cash circulation, as these coinages are not used for cash payments, with the final amount of retail payments being rounded to the nearest 5 cent value.

Finland introduced an act in 2000 which stipulates rounding for cash payments as of 1 January 2002. As payment by bank card is rather widespread in Finland, the legislation was amended in June 2002 in order to allow rounding to be applied to bank card payments as well.[6] The legislation on rounding was based on previous experiences with the Finnish mark, when the smallest denomination was the 10 penny, which accounted for 70% of the coin quantity in circulation. In order to rein in the use of 10-penny coins, broad consultation with the affected economic actors preceded the entry into force of the rounding rule in 1980.

The decision on 1- and 2-cent coins also took into account the argument that it would be irrational to issue coins worth less than the smallest national coinage (10 penny=1.7 eurocents), furthermore, it would be easier and cheaper for retail outlets to handle only six coin denominations instead of eight. As a result of obligatory rounding, 1- and 2-cent coin subunits are therefore not needed in Finland.[7] Similarly to other euro area countries, 1- and 2-cent coins are legal tender, so the remaining 1- and 2-cent coins can be used for payment. The rounding of final sums, however, strongly limits their use. The position of the Finnish consumer protection is that retailers in Finland may refuse to accept 1- and 2-cent coins on condition that this policy is visibly and clearly indicated at the outlet's entrance.

Upon the recommendation of the social forum (MOB)[8] created for rationalising the payment system in *the Netherlands,* rounding the final sum of cash payments to the nearest 5-cent value is possible since 1 September 2004. The procedure is chosen and applied freely by retail traders based on the principle of 'freedom of contract', on condition that they notify consumers of their policy (at the outlet's entrance and at cash registers). According to the rule, only the final sum, and not the individual articles purchased is rounded. The rounding rule does not apply to electronic transactions and does not affect the status of 1- and 2-cent coins as legal tender. Experience shows that rounding has simplified purchases and has reduced the total cost of cash circulation. Rounding did not and does not increase the price level due to the fact that rounding up and down occurs in equal proportions.

Prior to the introduction of the euro in the form of cash, the Netherlands already applied the rounding rule from 1983 for the guilder, therefore it already had experience in rounding. A one and a half month test period preceded the introduction of the rounding rule applying to 1- and 2-cent coins in April 2004, in the context of which 150 retail traders began to apply rounding in the Dutch city of Woerden. The aim of this test period was to assess the level of support for the reintroduction of rounding among consumers, retailers and banks. The outcome of the study revealed that retail traders and banks strongly supported the rounding rule (95%), the majority of consumers also supported the step (83%), while the initial proportion of those against the introduction of rounding – 32% – fell to 16% by the end of the one and a half month test period. According to estimates, the cost of cash management incurred on traders in the Netherlands was slashed by EUR 30 million annually, thanks to the comprehensive application of the rounding rule, further complemented by the savings derived from ceasing production, storage and processing of 1- and 2-cent coins for circulation, which was implemented in 2004.[9]

The European Commission commissioned a survey in November 2006[10] on the level of satisfaction regarding the use of euro coins and banknotes. According to the survey, 36% of respondents found the number of euro coin denominations too high. This value – over one third of those surveyed – represents the average of the 12 euro area countries; there are substantial divergences between the level of satisfaction of the populations of various countries. Regarding the number of denominations, Finland's population is the least dissatisfied (9%) (however, there are no 1- and 2-cent coins in circulation there), followed by Germany with 14%. It should be noted regarding Germany that the 1-pfennig coin – despite its purchasing power having been eroded by inflation – remained a legal tender until the introduction of the euro. The majority in Italy (64%), Belgium (61%) and Luxemburg (59%) think that there are too many coin denominations in circulation. Among respondents who deem the number of euro denominations excessive, 87% are in favour of removing the 1-cent denomination, while 82% favour removal of the 2-cent

[6] Act on rounding of euro payments No. 890/2000 (27 October 2000), amended by No. 496/2000 (14 June 2002).

[7] 1.5 million pieces per denomination are therefore minted for collectors.

[8] The Social Forum on the Payment systems (MOB) was created in January 2003 with the aim of examining how the payment system's effectiveness could be improved. Members of the MOB include representatives of retail traders, the banking sector and consumers.

[9] The Netherlands only mints 150-200 thousand 1-2 cent coins for collectors, for the series of annual circulation coins (year-set) and the roll-set.

[10] The eurozone, 5 years after the introduction of euro coins and banknotes. Analytical report, November 2006. *Eurobarometer.*

denomination. Among the new members of the euro area, the Slovakian population is also dissatisfied with the use of 1- and 2-cent coins, as the smallest denomination coin prior to the introduction of the euro (50 hal =0,5 SK) was worth 1.7 cents. Consequently, the recommendation – also discussed by Parliament – to introduce a rounding rule in order to rein in the use of 1- and 2-cent coins was formulated.

Although the possibility of introducing rounding rules to limit the use 1- and 2-cent coins was brought up in several other euro area countries as well, so far none of them have joined the ranks of those not using 1- and 2-cent coins, besides Finland and the Netherlands. The main reason behind this is that decision-makers are afraid to bring any measures which may weaken the population's confidence in the euro, despite the fact that rounding did not lead to an inflationary effect in countries (including those outside the euro area) where the rounding rule was introduced. The fears can be understood in part; suffice to recall the so-called 'teuro debate'[11] surrounding the transition to the euro, when the inflation perceived by the population was higher than reality. The main concern of countries introducing rounding was that retailers would round the price of products – especially those ending in 8 or 9 – upwards. This fear, however, proved unfounded. A study carried out in 2005 (El Hehity, Hoezl, Kirchler) revealed that after the initial shock following transition to the euro, retail traders are just as willing to use marketing prices as before the transition, which in certain cases required them to actually decrease prices.

The Finnish and Dutch examples prove that the use of 1- and 2-cent coins, representing a futile burden for cash circulation can be reduced without any disruptions and to the satisfaction of all economic actors with the introduction of rounding. Possible fears in connection with rounding can be managed with proper communication and consultation with stakeholders.

TWO COUNTRIES WHERE THE WITHDRAWAL OF SMALL DENOMINATION COINS HAS BEEN THE SUBJECT OF DISPUTE FOR DECADES

The series of positive examples presented in the previous section begs the question why two such developed countries as the USA and Canada have not yet withdrawn the 1-cent coin, which is practically of no value. For a long time now, there has been a debate surrounding the withdrawal of small denomination coins in these countries, with a plethora of articles and studies both in favour and against it.

The bill on halting the production of 1-cent coins (the penny) and implementing rounding to 5-cent values has been brought before US legislation on numerous occasions since 1989,[12] to no avail thus far. The penny, celebrating its 100th anniversary this year, has lost all of its value and is not accepted by vending machines, therefore consumers regularly empty their wallets of pennies received as change. The production and processing of pennies, the cost of which is substantially higher than their face value, represents a loss of approximately USD 900 million for the United States each year. The major concern of opponents of scrapping the penny is that rounding would push prices up. However, university professor of economics Robert M. Whaples presented in a study examining 200,000 purchase transactions that this fear is completely unfounded, with no price increase in case of products purchased by socially less advantaged groups. The penny represents Abraham Lincoln, the first Republican president, thus advocates of the preserving the penny are mainly motivated by emotional factors. The other major lobbying force is the zinc mining industry, as the penny contains 97.5% zinc.

The situation in Canada is similar to the USA: pennies have lost their value over the past century, therefore they are continuously expelled from circulation. The study carried by researchers from the Desjardins Group revealed that preserving pennies in circulation costs Canada 150 million dollars on an annual level. The study also takes into account that fact that handling pennies generates a loss of 2 seconds on average during every cash purchase, and taking into account average Canadian wages, the study concluded that the big winners of eliminating the penny would be consumers. The study furthermore reveals that giving more publicity to research corroborating that rounding does not go hand in hand with an inflationary effect would increase the social acceptance of scrapping the 1-cent coin.

For both countries, it can be thus asserted that attachment to national traditions and various lobby interests are what keep the penny alive, rather than rational economic arguments.

CONCLUSIONS

The withdrawal of 1- and 2-forint coins in 2008, and that of the fillér in the 1990s, as well as the experience in rounding

[11] Teuro: amalgamating the terms 'teuer' (expensive) and 'euro', expressing the fact that in Germany, the population perceived that the price of goods and services increased in excess of official figures.

[12] Legal Tender Modernisation Act.

in Hungary bear a strong resemblance to foreign experiences. Economic actors did not use small denomination coins due to their low purchasing power, so their withdrawal was widely supported by both the population and the retail sector.

The rounding rule, made necessary for cash payments by the withdrawal, ensured a smooth transition for economies to operating without small denomination coins. Despite preliminary fears in connection with rounding, actual inflationary figures corroborated the findings of previous studies, claiming that the symmetrical rounding of the final sums to be paid on purchases would not trigger any price increases. By applying rounding rules – which can be learned easily – the social costs of ensuring uninterrupted payments can be reduced, and day-to-day operation becomes easier.

The success of the withdrawal of small denomination coins and the application of rounding rules can be considerably improved by engaging the affected economic actors – households, retail traders and the financial sector – as soon and as broadly as possible in preparing the decision, and by informing them adequately. Moreover, an important lesson to be drawn from the practice of the two euro countries presented in our article is that the earlier positive experience gained through the rounding of their national coins substantially contributed to the smooth elimination of 1- and 2-cent coins in their economies, and to both sides – consumers and retailers – emerging as the winners of simpler, faster payments.

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Zsuzsa Munkácsi: Who exports in Hungary? Export concentration by corporate size and foreign ownership, and the effect of foreign ownership on export orientation[1]

In the United States and most European countries, the majority of export is concentrated in a small number of firms. The Hungarian Tax and Financial Control Administration's data (APEH-panel)[2] indicate that Hungarian industrial export is highly concentrated by firm size; export concentration is even higher in terms of foreign ownership, and both concentrations have increased considerably in recent years. Export concentration in other sectors of the Hungarian economy (agriculture, construction industry and services) is generally lower than in industry. Taking firm size and other factors (industry, region, etc.) as given attributes, foreign ownership has a predominant role in export orientation: in comparison to fully Hungarian-owned firms, businesses partially or fully owned by foreigners are more export-oriented. However, the effects of foreign ownership on export orientation over time are highly uncertain.

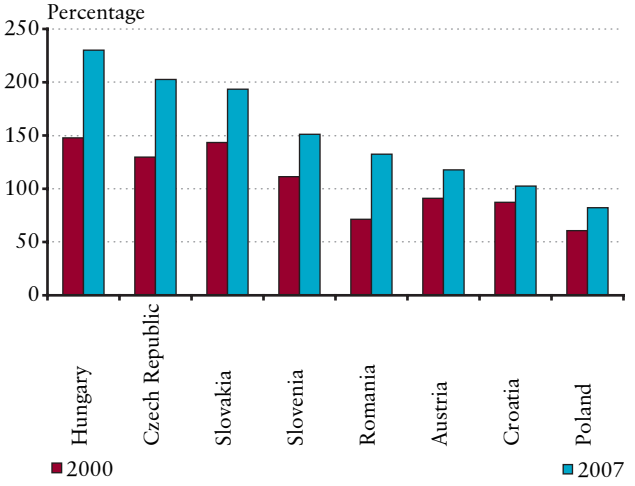
INTRODUCTION

Central and Eastern European countries are small and open economies, i.e. foreign trade turnover plays a significant role in gross domestic product. At the turn of the millennium, Hungary was the most open country in the region, and although openness has increased in every country since then, Hungary's openness remains still one of the highest (Chart 1).

Since the political changeover, with the gradual removal of trade barriers, foreign trade in the countries of the region has quickly integrated the global economy and Western Europe.[3] Jakab et al. (2000) found that, in terms of its integration into the world economy, by 1997 Hungary's foreign trade had approached equilibrium, while the export and import convergence was slower in Czech and Polish foreign trade. According to Bussiere et al. (2005), in 2003 Central and Eastern European countries had already been integrated in the euro area to an extent that exceeded even certain Baltic and Southern European countries, although there is still room for further integration. Based on the country-specific structure of exports in the Czech Republic and Hungary, the question arises whether these countries have not converged towards the euro area in excess of the equilibrium, as the ratio of euro area exports in total exports has decreased in recent years.

Chart 1

Openness of Central and Eastern European countries



Note: based on volume data (reference year 2000), openness was calculated as follows: (export of goods and services + import of goods and services)/GDP. Current price data show that Hungary was the most open in 2000. In 2007 it was second to Slovakia in the order of openness.

Source: Eurostat.

As Central and Eastern European countries are open and their foreign trade quickly integrates into Western Europe, their export performance strongly affects their economies.

[1] The author would like to thank Ádám Martonosi (MNB) and Péter Gál (Tinbergen Institute) for cleansing the panel data of the Hungarian Tax and Financial Control Administration (APEH) and their assistance in data management, as well as Gábor Kátay (MNB) and Cecília Hornok (MNB) for their valuable remarks. The author takes sole responsibility for any remaining errors.

[2] The APEH-panel contains data compiled from the tax returns filed by firms registered in Hungary and made available to me (individual corporate data are unidentifiable for data protection reasons).

[3] The literature uses the gravity model to analyse this by giving an estimate of the potential level of foreign trade and a comparison of the actual and potential levels.

Relying on APEH-panel data for the period between 1995 and 2006, corporate export performances are analysed below in order to give a picture of the features of exporting firms, an activity which plays a significant role in Hungary.

The analysis of export firms is relevant for several reasons. First, it is well-known that Hungary is extremely open, but we have less information on the firms actually exporting. Second, it is important to stress that the high export concentration in Hungary[4] is not a country-specific phenomenon. Third, export concentration can differ by sectors. Finally, as most large firms are partly or fully foreign-owned, is it worth estimating the effects of foreign ownership on export orientation[5].

This study is composed of the following parts. Export orientation is analysed i*n the first part*. Export concentration in various European countries is compared according to corporate size. Then, export concentration is analysed in Hungarian industry and other private sectors (agriculture, services and construction industry) by corporate size and ownership structure. *In the second half of the study*, the effect of foreign ownership on export orientation is estimated with other variables taken as given. I would like to address the question of whether the firms in partial or complete foreign ownership are more export-oriented than Hungarian-owned ones, and how the effect of foreign ownership on export orientation has changed in recent years.

EXPORT CONCENTRATION IS HIGH IN DEVELOPED COUNTRIES

As databases containing corporate data are becoming increasingly available, more and more researchers are interested in the nature of firms actually transacting export turnover and the features that determine export performance.

Mayaer and Ottaviano (2007) compare firms with a significant role in exports in several European countries. They conclude that the aggregate export turnover is transacted by a few firms, extremely different from the others, as they are larger in size, produce higher added value and are more productive. Exports are controlled by a few firms, and few firms are genuinely export-oriented. Exporters are often foreign-owned firms. They see close correlation between the relative export performance of firms and their productivity.

Bernard et al. (2007) analyse export concentration in the United States. Only a few firms are engaged in exporting: in 2000, for example, the ratio of exporters to the total number of firms was merely 4%, although there are significant differences between the ratios of export firms in individual sectors.[6] Manufacturing export firms in the United States differ considerably from non-export firms: export firms are generally larger, more productive and more capital intensive. Export concentration in the United States is highlighted: in 2000 the top 1% transacted 80% of exports. Several alternative explanations are given for this high concentration. These phenomena are explained partly by the extreme differences between firms in productivity, and partly by high flexibility.

Görg et al. (2008) analyse Hungarian data in the period between 1992 and 2003 to identify the factors that determine how long a particular firm exports a particular product. Firms change their export product structures considerably from one year to the next. They conclude that more productive firms usually export products which are present in international markets for a longer time. The longer a firm has been exporting a particular product, the more likely it is to go on exporting the particular product.

In most developed countries, exports are highly concentrated. Concentration is also high in Central and Eastern Europe: small-sized firms predominate in terms of proportion (with a share of 80–90%) (Chart 2). Nevertheless, the overwhelming majority of exports is transacted by large firms employing more than 250 persons. Although similarly to other Central and Eastern European countries, export concentration is high in Hungary, the ratio is not exceptional. For this reason, this phenomenon cannot be termed Hungary-specific.

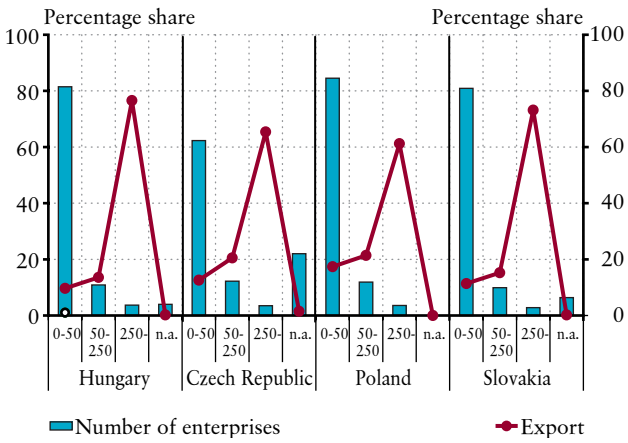
[4] The share of firms of different sizes (small, medium and large) and various ownership structures (owned exclusively by Hungarians, exclusively by foreigners, in Hungarian majority or foreign majority ownership) in exports is surveyed. The lower the number of firms (of a particular size and ownership structure) involved in export, the higher export concentration is.

[5] "Export orientation" means the ratio of export revenues within total sales revenues. The higher this ratio, the more export-oriented a particular company is.

[6] Various trade theories discuss the role of firms and provide an explanation to the concentration phenomena observed to various extents. Traditional trade theory presumes that countries with a relatively highly qualified labour force – such as the United States – are more likely to export in the sectors where such labour is employed in large numbers. However, there is no explanation to why certain firms export while others do not. More recent theories are consistent with the fact that overall, few firms are engaged in export and every sector has export firms. However, even more recent theories fail to provide reasons for the fact that only a few firms are engaged in exporting in each sector, while the majority of the firms avoid do not engage in this activity. The most recent heterogeneous theories stress the role of corporate diversity in foreign trade. For more information see Bernard et al. (2007).

Chart 2

Number of export firms and their export activities in a breakdown by size in Central and Eastern Europe



Note: 2003 data of all firms engaged in the national export of goods. The horizontal axis indicates the number of people employed. The ratio of small-sized firms is likely to exceed 60% in the Czech Republic, however, no data are available on 20% of the firms.

Source: External Trade by Enterprise Characteristics. Eurostat (2006).

STRONG EXPORT CONCENTRATION IN HUNGARIAN INDUSTRY

In an international comparison, the aggregate export concentration in Hungary is not exceptional. I wish to know how export concentration in the individual sectors of the economy changes and if there are sector-specific idiosyncrasies. In this chapter, concentration in the Hungarian industry is analysed on the basis of the APEH-panel data for 1995, 2000 and 2006.[7] The range of firms analysed is limited to non quasi-fiscal firms.[8]

In Hungary, merely 6.8% of the firms were engaged in exporting in 2006, while the majority of Hungarian firms steered clear of international markets. (Moreover, in 2006 nearly two-thirds of exports were transacted by the 100 leading export firms in the private sector.) For this reason, I focus only on export firms, as I wish to map the idiosyncrasies of firms actually transacting exports, but the stylised facts of all Hungarian firms and the panel estimates compiled on the basis of such data obviously would yield a different picture.

The following three firm sizes are distinguished for the purposes of the analysis:[9]

- small business: with less than 50 people employed;
- medium-sized business: with 50 to 250 people employed;
- large business: with at least 250 people employed;

and four ownership categories are used (as a ratio of the subscribed capital):

- a firm in 100% Hungarian ownership;
- a firm in 100% foreign ownership;
- foreign ownership is between 0 and 50%;
- foreign ownership is at least 50 but less than 100%.

In 2006, two-thirds of industrial export firms were small in size, about 20% were medium-sized and less than 10% were large firms.[10] The ratio of small businesses has increased in the past ten years. At the same time, the majority of exports is carried out by firms of over 250 employees. There is therefore strong concentration among industrial export firms, which has increased since 1995 (Chart 3).

In the period under review, approximately 55-70% of industrial export firms were in exclusively Hungarian ownership, and 20% were completely foreign-owned. Two-thirds of exports was transacted by firms exclusively owned by foreigners. Concentration by ownership is even higher than concentration by corporate size, and it increases faster (Chart 4).

Concentration is also significant according to the number of employees: although the ratio of large firms has decreased somewhat in recent years, it was around 60% even in 2006. The proportion of those employed by exclusively foreign-owned firms has increased significantly, with 40% of employees employed by such firms in 2006.

Overall, it can be concluded that concentration in the Hungarian industrial export is significant in terms of both corporate size and ownership, and has increased considerably

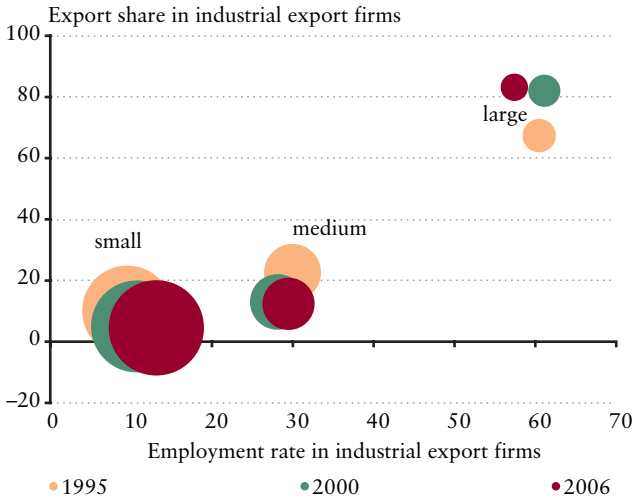
[7] Notes: 1. The methodologies applied in the APEH-panel and the GDP and foreign trade statistics published by the Central Statistical Office differ, as the former provides information on the accounting category termed "export sales revenues". 2. For firms which have not reported data on their subscribed capital in foreign ownership, I presume zero foreign ownership, as in the overwhelming majority of cases the subscribed capital without foreign ownership amounts to the total subscribed capital.

[8] Quasi-fiscal firms mean firms with the aggregate ratio of state and municipal ownership no less than 25% of the subscribed capital, ratio of quasi-fiscal firms within export was the highest in 1995, while in 2006 they had far less significance.

[9] Eurostat distinguishes the following four company sizes (with the number of employees in brackets): micro-business (1-9), small business (10-49), medium-sized business (50-249) and large business (more than 250) (Schiemann, 2008). In this study "small business" includes both micro- and small businesses in the sense of the Eurostat classification.

Chart 3

Concentration of Hungarian industrial export firms by corporate size

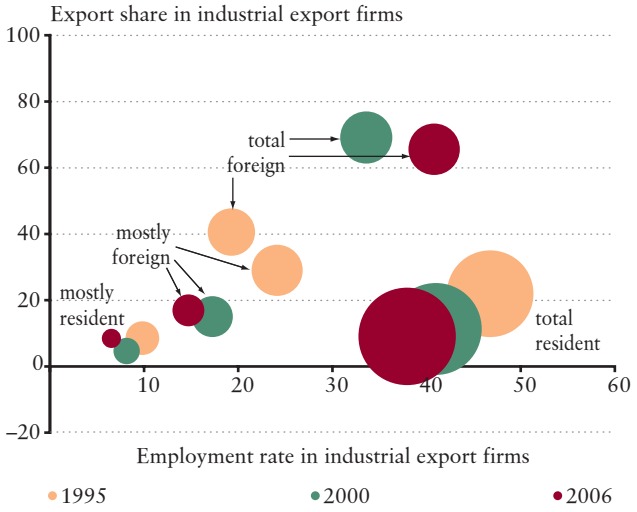


Note: the horizontal axis shows the ratio of people employed by certain firm types to the industry total. The vertical axis depicts the ratio of these firm types within exports. Circle size is proportionate to the number of firms of that particular type.

Source: APEH-panel.

Chart 4

Concentration of Hungarian industrial export firms by foreign ownership[11]



Note: the horizontal axis shows the ratio of people employed by certain firm types to the industry total. The vertical axis depicts the ratio of these firm types within export. Circle size is proportionate to the number of firms in the particular type.

Source: APEH-panel.

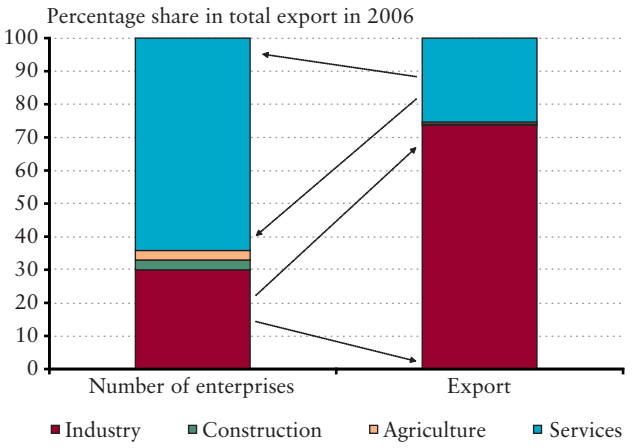
in recent years. The reason for this is that large and foreign-owned firms, which represent a relatively low ratio, generate approximately 70-80% of all export sales revenues.

CONCENTRATION IS LOWER IN OTHER PRIVATE SECTORS THAN IN INDUSTRY

Hungarian industrial exports are highly concentrated. While no more than about one-third of export firms are active in industry, more than half of them provide services (trade, transportation, business services, etc.) (Chart 5).[12] By contrast, two-thirds of the exports transacted in the private sector is performed by industrial firms and 25% by service providers.

Chart 5

Number of firms and exports in the private sector in a breakdown by sector



Source: APEH-panel.

In agriculture, the construction and the service sector, the ratio of small-sized firms is higher than in industry (about 80-90%), nevertheless they transact a relatively higher portion of exports (40% in agriculture and construction and two-thirds in services). Thus, in these sectors the ratio of large firms is lower than in industry, but their share in exports is far lower (for instance, in services it is merely 10%).[13]

Similarly to concentration by corporate size, concentration by ownership is generally lower in the other industries of the private sector than in industry. The ratio of 100% Hungarian

[10] For more information on industrial export firms, see Table 1 in the Appendix.

[11] The reason why fully Hungarian-owned firms employ far more people than small businesses is that there are about 200 large firms in 100% Hungarian ownership with a large number of people (about 100,000) employed.

[12] Similarly to the above, in sectors excluding industry, export firms other than quasi-fiscal businesses are analysed. Let me note that taking account of tourism is not unambiguous. In national accounts, tourism is recognised among the export of services, while in the APEH-panel the export revenues raised by the firms classified as accommodation service providers and caterers is insignificant in comparison to the total sales revenues, which means that the export of services is probably underestimated.

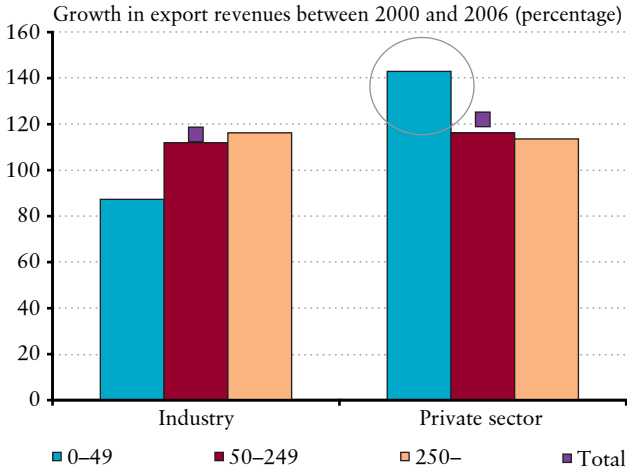
[13] For more information on other sectors of the national economy, see Tables 2, 3, 4 and 5 in the Appendix.

firms is roughly the same in all four business sectors analysed (70-80%), however they transact 10% of exports in industry and 60-80% in agriculture and the construction industry. Firms in exclusively foreign ownership have a significant weight in industry and service sector exports, but they are far less significant in agriculture and even less important in the construction industry.

In addition to the difference between export concentration in the individual sectors, export dynamics also varies from sector to sector. Between 1995 and 2000 large firms achieved the most rapid growth in export revenues, however, after the turn of the millennium, small businesses increased their export sales revenues at the fastest pace within the private sector (Chart 6). This is mostly due to the services, primarily commerce, repair, real estate transactions and business services.[14]

Chart 6

Growth in export revenues in industry and the private sector by size



Source: APEH-panel.

FOREIGN OWNERSHIP HAS A DETERMINANT ROLE IN THE EXPORT ORIENTATION OF INDUSTRIAL FIRMS

In addition to the high concentration of industrial exports by both foreign ownership and size, there is considerable overlap between large and foreign firms. The question is the effect of foreign ownership – separately from other effects – on export orientation. Let me take two firms of identical size, efficiency, industry classification, site, etc., the only difference being that one of them is fully Hungarian owned while the other is in foreign ownership. We expect the foreign firm to be more export-oriented as it may have more or better relationships, increased market power and more perfect information than the Hungarian one.

Relying on manufacturing firms data in Estonia between 1995–1998 and Slovenia between 1994–1998, Rojec et al. (2001)[15] conclude that foreign and resident firms[16] differ significantly in terms of export orientation: If all other conditions are identical, export orientation is on average 5-7 and 12-14 percentage points higher in Estonia and Slovenia, respectively, in the case of a foreign firm over a resident one.

Analysing Hungarian data resulted in a conclusion similar to the one for Estonia, but over a longer time horizon and using more ownership categories. The analysis relies on the corporate data of the APEH-panel for the period between 1995 and 2006, quasi-fiscal industrial export firms and the above specified four ownership categories are distinguished.[17] Overall, completely or partially foreign-owned firms are significantly more export-oriented than resident ones. Moreover, the higher the ratio of foreign ownership, the stronger this effect is. However, the estimated effects do not differ significantly. All other conditions unchanged, in terms of export orientation completely foreign-owned firms exceed completely resident firms by 5-7% on average.[18]

[14] This study relies on the 2003 TEÁOR (Nomenclature of Economic Activities) classification.

[15] Rojec et al. (2001) deduct the estimated regression and the control variables from a Cobb–Douglas type production function. For more details see pages 9-10 of the referenced study.

[16] A company is considered to be foreign if foreigners own at least 10% of it, otherwise it is resident.

[17] The main results are summed up in brief. More information on the applied methodology is given in the Appendix.

[18] The difference between the average export orientation of large firms in 100% foreign ownership and completely resident-owned firms is about 20-30 percentage points. For this reason the 5-7 percentage point partial effect may explain about 20%. Size has a similar explanatory effect.

The effects over time of foreign ownership on export orientation are highly uncertain. Overall, the effect is estimated to increase over time for exclusively foreign-owned firms and decline over time for predominantly resident-owned firms. After controlling for several variables, change over time becomes insignificant in the various ownership types, i.e. no time path could be demonstrated for the effect on export orientation on the analysed data over the period surveyed.[19]

In summary, firms in exclusively or partially foreign ownership are more export-oriented than completely Hungarian-owned ones, however, the differences in the effect on export orientation between the individual ownership categories are nonrobust. As the APEH-panel does not offer import turnover data, import ratios could not be considered. For this reason and due to the uncertainty related to the time path, further research is considered necessary on the effects of foreign ownership.

CONCLUSIONS

The purpose of this study was to map the corporate features of exports, which are significant in Hungary at the aggregate level. The 1995-2006 data included in the APEH-panel were analysed to reveal the concentration of export firms by size and foreign ownership, and an estimate was made on the effect of the ratio of foreign ownership on export orientation.

In developed and Central and Eastern European countries, export concentration is generally considerable. Although export concentration by size in Hungarian industry is already extremely high, concentration by foreign ownership is even higher. In other sectors, concentration is generally lower. Small and/or resident firms play a more significant role in construction and agriculture.

With regard to the effect of foreign ownership on export orientation, partially or completely foreign-owned firms are, *ceteris paribus,* more export oriented than fully Hungarian-owned firms, on average. Due partly to the lack of data, changes in this effect over time remain uncertain and require further research. In addition, other possible fields of research include the relationship between corporate profits and export orientation on the one hand, and ownership structure and productivity on the other hand.[20]

[19] In an alternative model, the export orientation surplus of firms in majority resident ownership (in comparison to exclusively resident-owned firms) was lower between 1999–2001 than before or after, however, it is not a robust finding.

[20] The relationship between privatisation and productivity is analysed among others by: Brown–Earle–Telegdy (2008), Brown–Earle (2007), Brown–Earle–Telegdy (2005), Earle–Telegdy (2002).

APPENDIX: TABLES

Table 1

Stylised facts of industrial export firms, 1995, 2000 and 2006

1995

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size	Foreign ownership share (percentage)	Export share (percentage)	Export revenue/ employment (thousand HUF)
Small	65.1	9.6	14	32.8	10.1	2,278
Medium	26.0	30.0	111	34.1	22.6	1,630
Large	9.0	60.5	650	39.2	67.3	2,408

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size		Export share (percentage)	Export revenue/ employment (thousand HUF)
Total resident	55.5	46.8	81		21.9	1,014
Total foreign	16.6	19.3	112		40.6	4,549
Mostly resident	8.5	9.8	112		8.5	1,878
Mostly foreing	19.4	24.1	120		29.0	2,596

2000

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size	Foreign ownership share (percentage)	Export share (percentage)	Export revenue/ employment (thousand HUF)
Small	67.1	10.7	15	26.1	5.0	4,397
Medium	24.6	28.1	110	37.2	13.0	4,386
Large	8.3	61.1	707	54.1	82.0	12,743

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size		Export share (percentage)	Export revenue/ employment (thousand HUF)
Total resident	62.2	41.0	63		11.3	2,614
Total foreign	20.2	33.6	160		69.1	19,528
Mostly resident	5.2	8.2	150		4.6	5,387
Mostly foreing	12.4	17.3	134		15.0	8,260

2006

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size	Foreign ownership share (percentage)	Export share (percentage)	Export revenue/ employment (thousand HUF)
Small	72.2	13.1	14	19.4	4.5	7,939
Medium	21.7	29.5	107	37.5	12.3	9,683
Large	6.1	57.4	744	67.0	83.1	33,483

	Number of enterprises (percentage)	Employment (percentage)	Average enterprise size		Export share (percentage)	Export revenue/ employment (thousand HUF)
Total resident	70.0	37.9	43		9.1	5,520
Total foreign	19.6	40.8	163		65.6	37,131
Mostly resident	2.8	6.5	185		8.5	29,939
Mostly foreing	7.6	14.7	152		16.9	26,593

Note: exporting non quasi-fiscal firms.

Source: APEH-panel.

Table 2

Stylised facts of private sector export firms, 2006

Private sector					
	Number of enterprises (percentage)	Export (percentage)	Average foreign ownership share (percentage)	Employment (percentage)	Export revenue/ employment (thousand HUF)
Small	86.5	20.9	21.5	21.1	19,152
Medium	11.0	15.1	36.3	29.4	9,902
Large	2.4	64.0	62.6	49.5	25,006

	Number of enterprises (percentage)	Export (percentage)		Employment (percentage)	Export revenue/ employment (thousand HUF)
Total resident	72.4	13.6		44.2	5,932
Total foreign	18.3	63.9		36.5	33,863
Mostly resident	2.4	7.0		4.9	27,337
Mostly foreign	7.0	15.6		14.4	20,976

Note: exporting non quasi-fiscal firms.

Source: APEH-panel.

Table 3

Stylised facts of agricultural export firms, 2006

Agriculture, hunting, foresting, fishing					
	Number of enterprises (percentage)	Export (percentage)	Average foreign ownership share (percentage)	Employment (percentage)	Export revenue/ employment (thousand HUF)
Small	83.5	40.9	29.3	24.7	7,397
Medium	14.8	53.1	10.8	51.4	4,615
Large	1.7	6.0	0.0	23.9	1,125

	Number of enterprises (percentage)	Export (percentage)		Employment (percentage)	Export revenue/ employment (thousand HUF)
Total resident	71.3	57.0		86.3	2,951
Total foreign	20.5	35.3		8.3	19,110
Mostly resident	2.1	1.1		1.6	3,136
Mostly foreign	6.1	6.6		3.8	7,694

Note: exporting non quasi-fiscal firms.

Source: APEH-panel.

Table 4

Stylised facts of construction export firms, 2006

Construction					
	Number of enterprises (percentage)	Export (percentage)	Average foreign ownership share (percentage)	Employment (percentage)	Export revenue/ employment (thousand HUF)
Small	84.6	41.2	10.2	29.1	4,126
Medium	13.3	50.6	12.3	35.2	4,186
Large	2.1	8.2	28.6	35.7	670

	Number of enterprises (percentage)	Export (percentage)		Employment (percentage)	Export revenue/ employment (thousand HUF)
Total resident	86.6	79.5		69.2	3,342
Total foreign	7.6	6.4		20.4	920
Mostly resident	1.8	10.3		4.3	7,052
Mostly foreign	4.0	3.7		6.1	1,783

Note: exporting non quasi-fiscal firms.

Source: APEH-panel.

Table 5

Stylised facts of service sector export firms, 2006

Services					
	Number of enterprises (percentage)	Export (percentage)	Average foreign ownership share (percentage)	Employment (percentage)	Export revenue/ employment (thousand HUF)
Small	93.5	67.7	22.4	34.9	28,592
Medium	5.8	21.5	39.7	27.2	11,674
Large	0.8	10.8	56.5	37.9	4,193

	Number of enterprises (percentage)	Export (percentage)		Employment (percentage)	Export revenue/ employment (thousand HUF)
Total resident	72.9	24.7		50.8	7,161
Total foreign	18.0	60.5		31.7	28,097
Mostly resident	2.3	2.7		2.3	17,805
Mostly foreign	6.9	12.2		15.2	11,791

Note: exporting non quasi-fiscal firms.

Source: APEH-panel.

APPENDIX: THE MODEL

A fixed-effects model is built on the panel data.[21] As numerous firms failed to report data on their subscribed capital in foreign ownership, if the subscribed capital owned by the other owners amount to the total amount of subscribed capital, the ratio of foreign ownership is presumed to be zero for these firms.

As I am looking for the partial effect of foreign ownership, in order to avoid endogeneity I control for numerous variables. These variables correlate both with foreign ownership and export performance.

1. I control for the corporate size. As foreigners presumably purchase larger firms, there is a positive correlation between corporate size and foreign ownership, and large

[21] For more information on panel data, fixed effects estimation, endogeneity, control and biased parameter estimations, see *Wooldridge: Econometric Analysis of Cross Section and Panel Data.*

firms may be more export-oriented. If I did not control for size, the coefficient of foreign ownership would be biased upwards.

2. The ratio of foreign firms may vary by industry, as foreign investors are interested in the different individual industries to various degrees. I do not control for industries, however, as the industry classification of firms rarely changes, the model can manage this problem.

3. As foreign investors may prefer certain regions to others, the coefficients of foreign ownership dummies may be biased if the regions are not included in the model. However, for the reasons mentioned in connection with industries, we do not control regions either.[22]

4. I control for the per capita profit after taxes in order to capture efficiency. I presume that efficiency has a beneficial effect on export orientation and foreign firms may be more efficient.

5. I also control for the average export orientation in the industry (due to the firms predominant in a particular industry, an average is calculated disregarding the particular observation). I expect that if an industry is more export-oriented, the specific firm may also be more export-oriented.[23]

Despite control variables, the coefficients may still be somewhat biased. First, export orientation and foreign ownership may influence each other simultaneously (simultaneous bias). Second, omitted variables (e.g. import) may also bias the estimation, as a firm that exports more is also likely to import more (omitted variable bias).

Thus, the following model is run (compared to firms in 100 per cent domestic ownership and small businesses):

$$\exp share_{it} = c + \beta_1 onlyforeign_{it} + \beta_2 mostlyforeign_{it} + \beta_3 mostlypresident_{it} + \\ + \beta_4 \exp share\_ind_{it} + \beta_5 medium_{it} + \beta_6 large_{it} + \beta_7 profit_{it} + \\ + yeardummies + trend / trendsquare / yearcrossproducts + a_i + u_{it}, \text{ where}$$

– onlyforeign = 1 if the firm is in 100% foreign ownership, and 0 otherwise;

– mostlyforeign=1 if the firm is in 50-100% foreign ownership, and 0 otherwise;

– mostlyresident = 1 if the firm is in 0-50% foreign ownership, and 0 otherwise;

– expshare_ind is the average export orientation of the industry in the particular year (in average the particular observation is disregarded);

– medium = 1 if the firm is medium-sized, and 0 otherwise;

– large = 1 if the firm is large, and 0 otherwise;

– profit is the logarithm of the per capita corporate profit;

– yeardummies represent the cyclical conditions of the given year and the extent of foreign trade liberalisation (openness);

– yearcrossproducts capture changes in foreign ownership over time.

– a_i is an unobserved cross section constant; while u_{it} is an unobserved variable element.

[22] Industry and region dummies have been incorporated in the model for verification purposes, however, most of them turned out to be insignificant. This supports the presumption that this estimation method manages industries and regions as corporate invariables.

[23] More detailed: Rojec et at. (2001).

Table 6

Estimation results

	1. model		2. model		3. model		4. model		5. model		6. model		7. model		8. model	
	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error	Coeffi-cient	Standard error
onlyforeign	**0.070**	0.009	**0.069**	0.009	**0.059**	0.011	**0.059**	0.011	**0.049**	0.011	**0.051**	0.013	**0.053**	0.015	**0.059**	0.016
mostlyresident	**0.032**	0.008	**0.030**	0.008	**0.035**	0.009	**0.051**	0.011	**0.039**	0.012	**0.041**	0.013	**0.053**	0.016	**0.053**	0.016
mostlyforeign	**0.041**	0.007	**0.038**	0.008	**0.035**	0.009	**0.041**	0.009	**0.032**	0.010	**0.036**	0.012	**0.038**	0.013	**0.039**	0.013
onlyforeign*trend	-	-	-	-	-	-	**0.002**	0.001	**0.003**	0.001	0.001	0.001	0.000	0.003	-	-
mostlyresident*trend	-	-	-	-	-	-	**-0.004**	0.002	**-0.002**	0.002	-0.001	0.002	-0.009	0.005	-	-
mostlyforeign*trend	-	-	-	-	-	-	-0.000	0.001	**0.002**	0.001	-0.000	0.001	-0.001	0.004	-	-
onlyforeign*trend*trend	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	-	-
mostlyresident*trend* *trend	-	-	-	-	-	-	-	-	-	-	-	-	0.001	0.000	-	-
mostlyforeign*trend* *trend	-	-	-	-	-	-	-	-	-	-	-	-	0.000	0.000	-	-
expshare_ind	-	-	-	-	**0.141**	0.033	-	-	-	-	**0.139**	0.033	**0.139**	0.035	**0.138**	0.033
medium	-	-	-	-	**0.036**	0.006	-	-	-	-	**0.035**	0.006	**0.035**	0.006	**0.035**	0.006
large	-	-	-	-	**0.052**	0.013	-	-	-	-	**0.051**	0.013	**0.051**	0.014	**0.051**	0.013
profit	-	-	-	-	**0.005**	0.001	-	-	-	-	**0.005**	0.001	**0.005**	0.001	**0.005**	0.001
R^2	0.127		0.122		0.181		0.126		0.122		0.181		0.180		0.179	
Number of observations	71,303		71,303		52,318		71,303		71,303		52,318		52,318		52,318	
F(mostlyresident-mostlyforeign)	0.343		0.390		0.951		0.468		0.459		0.748		0.388		0.424	
F(onlyforeign-mostlyresident-mostlyforeign)	0.000		0.000		0.011		0.225		0.203		0.453		0.476		0.361	
Other control variables	-		év dummyk		év dummyk		-		év dummyk		év dummyk		év dummyk		év dummyk és tulajdon-év kereszszorzatok	

Note: 1. Interpretation of the trend variables in 1995 the trend is 0, in successive years the figure increases by 1. 2. Variables significant at 5% are in bold characters. 3. Although in the case of uncensored estimation, the estimated export orientation may be less than 0 and more than 1, in this case it was primarily between 0 and 1. Nevertheless, a censored estimation was also made, however, without any significantly different outcome. 4. In the fixed effects model, the foreign ownership dummy on the right side, adjusted for fixed effects, often turned out to be 0 (due to the fact that many firms change their ownership structure infrequently or not at all), as however, a large number of observations remain with values other than zero, so the identification is working. Moreover, no significant change was seen in the partial effect when the observations with zero for the above value were excluded from the model. 5. If the firms not engaged in exports are not excluded, a tobit model or a Heckeman method could be applied. In this case the results would not only refer to export firms. This is a possible field of research. 6. Robust standard errors were applied in the estimation.

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Klára Pintér and György Pulai: Measuring interest rate expectations from market yields: topical issues

Learning market participants' policy rate expectations is a major issue for central banks. The underlying reason for this is that the interest rate expectations of market participants may themselves contain information on market participants' perceptions of the economic prospects, which decision-makers might want to incorporate into their own assessment of the outlook. Market participants' expectations, however, cannot be observed directly and are difficult to quantify. Of the two most common approaches, we will discuss in detail the one where we infer market expectations from the prices of the financial instruments which are closely related to expectations. In properly functioning, liquid markets we can infer market participants' expectations of future interest rates from the prices of and returns on government securities and inter-bank transactions. Before the onset of the financial crisis, BUBOR (Budapest Inter-bank Offered Rate) reflected market participants' expectations of the interest rate relatively reliably, but since the deepening of the crisis, this has changed for a number of reasons, which we will also seek to pinpoint. The fact that BUBOR no longer reflects real market expectations, i.e. it distorts them, is all the more important as this measure serves as a benchmark rate for other financial products, among other things, for corporate loans. The loss of the information content of BUBOR means that the yield curve derived from returns on inter-bank market instruments provides a more accurate measure of market expectations if we exclude data on BUBOR fixings. Nevertheless, forward rate agreements (FRAs) settled on BUBOR remain suitable for the quantification of market participants' expectations. However, in interpreting these, it is important that, in addition to credit and liquidity risk premia, the bias caused by BUBOR should also be taken into consideration.

INTRODUCTION

Knowing market participants' expectations of the key policy rate is of key importance for central banks for a number of reasons. One is that monetary policy works properly if it can influence market participants' expectations efficiently, and if the interest rate path that market participants expect to materialise is in line with the steps planned to be taken by central banks. Therefore, it is important that monetary policymakers monitor how their decisions and communications affect these expectations. Moreover, market participants' interest rate expectations may themselves contain useful information about market participants' perceptions of economic developments, which decision-makers may want to incorporate into their own assessment of the outlook.

As market participants' expectations cannot be observed directly, quantification of these expectations is not any easy task. The most common approaches used to identify future policy rate expectations fall into two main categories. One is surveys conducted among market participants (traders and analysts). Respondents are regularly asked about their future policy rate expectations for various specific points in time (e.g. the end of the following month, the given year and the one following it). Their answers contain direct information on the expected path of the key policy rate. If respondents attempt to offer the most accurate forecast of central bank rates, their answers will indeed reflect their actual interest rate expectations. But there is no absolute guarantee for this, as there is no stake involved in the opinion that respondents express, i.e. they do not incur any losses if they fail to forecast the actual interest rate accurately, and they gain nothing if they do not. Consequently, answers may reflect a number of other underlying motivations: it may, for instance, be the case that a rate of interest assumed to be the most likely rather than the one actually expected is provided as a forecast, or some analysts may want to provide accurate projections when most err significantly, and thus they provide a less likely value as the expected rate. If such is the case, surveys can provide a skewed measure of market participants' actual expectations. Another possible approach is that we infer market participants' expectations from the prices of the financial instruments which are closely related to interest rate expectations. There are a number of instruments whose returns depend strongly on the current and future base rate; it should be noted, however, that their liquidity and credit risk may vary. Accordingly, returns on these instruments embody, in addition to the interest rate expectations, the premium demanded as compensation for these risks, which are difficult to identify and measure when expectations are interpreted. Relying on two different data

sources, our earlier analysis presented both approaches. We concluded that the yield curve computed from government securities yields and Reuters surveys were both good approximations of market participants' expectations. Nevertheless, neither provides a direct, unbiased measure, and expectations derived from the two data sources may often vary significantly.[1] Thus, consistent with central bank practice, it seems reasonable to use several possible approaches and interpret them together when monitoring developments in expectations. Supplementing our earlier study, this time we offer a more in-depth analysis of recent changes in interest rate expectations computed from market instruments. We will present the instruments whose returns may serve as a starting point for measuring expectations, the bias they may contain and the ways in which the recent turbulences in the financial markets have affected their information content.

MEASURING INTEREST RATE EXPECTATIONS WITH THE PRICES OF MARKET INSTRUMENTS

Forward yields computed from returns on a financial instrument with various maturities are equal to the sum of the expected future interest rate and the risk premium usually charged for the given instrument or group of instruments. The most important risk factors facing investors in the market of these instruments that reflect policy rate expectations are credit – counterparty – and liquidity risks. Credit or counterparty risk is the risk run by investors that the counterparties to which they extend credit will default. Liquidity risk means the risk that markets may vary according to how easy and affordable trading is in them, which costs the trading involves. If, for any reason, market participants consider an instrument to be riskier than lending to the central bank, they demand a premium in return for taking on risks, which, in turn, means returns higher than the base rate.

As we can compute the sum of only these two components (i.e. the expected interest rate and the premium expected in return for the perceived risk) from market returns, in order to be able to identify expectations of the future path of interest rates, we must make some assumption on risk premia. The conventional assumption used when determining the expected path of the interest rate is that risk premia are constant over time. If this condition is fulfilled, both premia and the expected path of the interest rate can be estimated over a longer horizon, or we may make inferences about changes in expectations directly from changes in returns.

WHAT YIELDS HELP US MAKE INFERENCES ABOUT INTEREST RATE EXPECTATIONS?

Government securities are the most obvious choice for measuring expectations. Relative to the credit risk posed by the central bank policy instrument, they are close to being risk free in terms of credit risks, and the deviation of forward yields from the expected path of interest rates is due mainly to liquidity premia. Therefore, forward yields computed from yield curves comprising the information content of government securities with various maturities offer a good approximation of the future path of central bank rates as long as the government securities market is sufficiently liquid.

Alternatively, we may infer market participants' expectations of interest rates from the prices of certain inter-bank transactions (unsecured lending and deposit transactions, forward rate agreements and interest rate swap deals) or from estimated yield curves comprising the information content of various instruments.[2] In order to be able to measure short-term expectations (i.e. those over a time horizon for up to 1 year), we use BUBOR or forward rate agreements (FRAs).

BUBOR (Budapest Inter-bank Offered Rate) denotes the rate at which commercial banks are willing, for various maturities, to provide unsecured loans to each other. The MNB collects – from the domestic commercial banks – quotes for a maturity range of 1 day to 1 year, which serve as a basis for setting BUBOR, daily, at a pre-set point of time. Pursuant to the regulations of the Hungarian FOREX Association, quoting banks participating in the setting of BUBOR undertake to quote real inter-bank lending interest rates valid at the time of fixing. BUBOR depends fundamentally on the interest rate expectations of banks; however, as it is a rate charged for unsecured lending, it also contains a credit risk premium demanded in return for counterparty default. Furthermore, as the liquidity situation of the banking system also affects the terms and conditions under which banks lend each other, interest rates also contain a liquidity premium.[3] Accordingly, BUBOR reflects the interest rate expectations of banks along with a credit risk and liquidity premium.

[1] Gábriel and Pintér (2006).

[2] For a detailed presentation of how inter-bank transactions are used for estimating the yield curve, see Reppa (2008).

[3] Changes in very short-term interest rates are due to short-term fluctuations in liquidity; in order to measure interest rate expectations we only take into consideration BUBOR with a two-week or longer maturity.

Forward rate agreements (FRAs) are arrangements in which two parties agree on a notional interest rate to be paid, at a specified settlement date, on a notional amount of principal that is never exchanged; the only payment (the payment of the settlement amount) that takes place relates to the difference between the agreed FRA rate and the prevailing market rate (or benchmark rate) at the time of settlement. Transactions are settled when their maturity period actually begins, i.e. after the conclusion of an FRA with a 3-month maturity starting 3 months later, the parties to the agreement will exchange fixed interest rate payments for floating interest rate payments in three months. In HUF FRAs the benchmark rate is BUBOR, thus, the two rates correlate strongly. Similar to inter-bank lending transactions, FRAs also contain a liquidity premium and one compensating the credit risk run by the counterparty. But as only the interest due is exchanged, and the principal is not, the credit risk premium may be lower than in standard lending transactions.

FRAs with a maturity of 3 months 1 to 12 months ahead are traded in the inter-bank market. In order for longer-term interest rate expectations to be quantified, *interest rate swap (IRS)* transactions[4] can be used. Parties to IRS transactions exchange interest rate payments on amounts denominated in the same currency. In the most common and most widely used form of IRS transactions one party receives floating interest rate payments during the term of the swap transaction, in exchange for which the other party receives fixed interest rate payments. As a rule, the term of the transaction is over 1 year. The most important difference between IRS and FRA transactions is that in the former the floating rate is fixed at the start of the successive interest periods, while in the latter the market interest rate prevailing at the date of interest payment applies. In addition, IRS transactions are usually longer maturity transactions and interest rate payments are exchanged several times. The two products are similar, and so are risks and expected premia; albeit as interest rate payments are exchanged several times, credit risk premia in IRS transactions are likely to be higher.

WHICH MARKET INSTRUMENT TO CHOOSE TO MEASURE INTEREST RATE EXPECTATIONS?

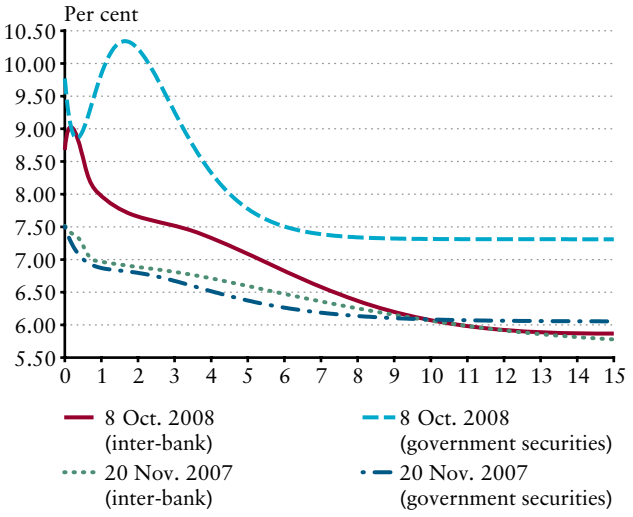
If financial markets operate properly, interest rate expectations computed from various instruments will be similar, taking into account the diversity of the risk characteristics of the instruments. That is, if forward yields are adjusted for the premium corresponding to the risk implied in an instrument or changes in yields are analysed, they will reflect similar expectations. The conditions for the above are that the market must be sufficiently deep and liquid for information on expectations to be reflected in returns and for changes in risk premia not to be the major drivers of changes in returns.

Initially, central banks used forward yields computed from government securities market yields to quantify expectations, because government securities markets were liquid and operated properly in most countries, and the direct link between yields and expectations was the most important consideration when selecting instruments. The development of financial markets and the emergence of new instruments have increased the liquidity and importance of the inter-bank markets significantly over the past decade. This has led to inter-bank yields playing an increasingly central role in measuring interest rate expectations. Although, due to credit risks, the linkage between yields and expectations is less direct than in the government securities market, this is counterbalanced by the depth of the market which allows for more information to be gathered. As a result, the number of the central banks that place a great emphasis on information derived from inter-bank returns has been rising, with yield curves estimated with these returns becoming increasingly common as a tool for measuring market participants' expectations.

In 2008, however, disturbances in the financial markets raised both the risk premia and their volatility, rendering the assumption about stability untenable. Growth in risk premia led to yields higher and more volatile than they used to be.

Chart 1

Two-week forward yields computed from government securities market and inter-bank yield curves



[4] For a detailed discussion of the HUF IRS market, see Balogh et al. (2007).

Consequently, if we adjusted forward yields for former average risk premia, we would provide a biased estimate of interest rate expectations, concluding that they will increase and become uncertain. The difference could be especially striking in the case of short-term expectations, because if markets function properly, risk premia are lower at shorter maturities; thus, our measure of the expectations is also more accurate.

Disturbances and tensions affected the individual market segments and risk factors to a varying extent and at different points in time. Accordingly, the extent to which the information content of the expectations measured with different instruments has become distorted and uncertain varies.

Chart 1 reveals that in November 2007 the path of 2-week forward yields computed from the yield curves estimated from government securities market yields and inter-bank returns reflected rate cut expectations that were steep over the short run and moderate over the medium term. In contrast, both the shape and the level of the forward interest rate path derived from the yield curves of October 2008 were markedly different: inter-bank yields follow a steep path over the very short term and a declining path beyond a 6-month horizon; as regards the path settled on yields on government securities, they first decline, then rise steeply over a horizon of up to 2-2.5 years.

Box: International experiences

Significant differences between expectations computed from various data sources are not an isolated occurrence. In August 2007, a sharp rise in the size and the volatility of risk premia triggered by disturbances in the financial markets prompted several central banks to check whether the conventional instruments and methods used for the quantification of interest rate expectations still suited that purpose. The issue was particularly important for the Bank of England (BoE) and the European Central Bank (ECB) as they make their macro-economic projections on the basis of market participants' interest rate expectations rather than the assumption of an unchanged central bank rate path. In their case, market disturbances hit inter-bank markets rather than the government securities market hard and permanently.

Between November 2004 and August 2007, the Bank of England used forward yields computed from the yield curve settled on unsecured inter-bank transactions to determine the path of interest rate expectations. The reason why unsecured inter-bank transactions was selected was market liquidity. Liquidity in both the secured inter-bank market and the government securities market was tighter and the number of the available instruments was lower especially at short maturities. Implied forward yields were adjusted for credit risk premia measured with the historical average difference between returns on secured (repo) transactions and those on unsecured deals as well as the average differential between returns on repo transactions and the central bank base rate. But in August 2007, inter-bank returns and government securities market yields diverged, which was attributable to banks' mistrust of each other and a steep rise in credit risk premia. As a result, the adjustment made earlier no longer reflected credit risk premia properly. Therefore, the group of the instruments used for measuring short-term expectations was changed, and until May 2008 the Inflation Report was settled on the path of expectations calculated from repo yields, which, although it was previously less liquid, did not reflect credit risks. Later, repo yields were replaced by OIS[5] transactions because liquidity in this market segment rose significantly. No similar difficulty was experienced in respect of longer-term expectations; the disturbances thought to be temporary first of all markedly raised returns on short-term instruments. Therefore, the data source used to predict the yield curve at a horizon of over 1 year remained the same.[6]

Nearly a year later, the ECB also changed the group of instruments that it used for measuring market expectations. Prior to September 2008, it used the forward yield curve estimated from inter-bank market data (swap returns) to approximate the market expectations of the policy rate. As an alternative, the use of EURIBOR futures was also considered, but this market was sufficiently liquid only for contracts with a maturity of up to 3 years, and the models that it used required the quantification of a longer path of expectations.[7] By September 2008 the gap between the expectations computed from one data source and those computed from the other had grown wide, and in the opinion of the ECB, the path derived from EURIBOR futures better reflected actual expectations in the short run and their information content was less distorted by market disturbances.[8]

Difference in the expectations measured with the prices of the various instruments does not offer any guidance as to which path is the "right" one, the one better reflecting actual expectations. In order to be able to make the right decision, we must analyse the extent to which turbulences in the financial markets affected the individual market

[5] Overnight index swap: a short-term interest rate swap whose underlying product (the benchmark yield of a leg changing daily) is SONIA, the Sterling Overnight Interbank Average Rate.

[6] *Inflation Report,* November 2007, Bank of England and Inflation Report Conditioning Path for Interest Rates.

[7] *ECB Monthly Bulletin,* March 2007.

[8] *ECB Monthly Bulletin,* September 2008.

segments and identify the impacts in play in the markets of the individual instruments. In order to measure expectations, we would like to use returns on the instruments which contain the largest possible amount of information; therefore, our primary concern is trends in liquidity in the individual markets. Furthermore, we can compare the forward yields obtained from various data sources with the expectations expressed in surveys. Expectations in analyst surveys, however, may not necessarily reflect market participants' expectations accurately, as possible biases originate from respondents' motivations rather than market disturbances. Accordingly, the expected interest rate path may serve as a benchmark that is left unaffected by market turbulences.

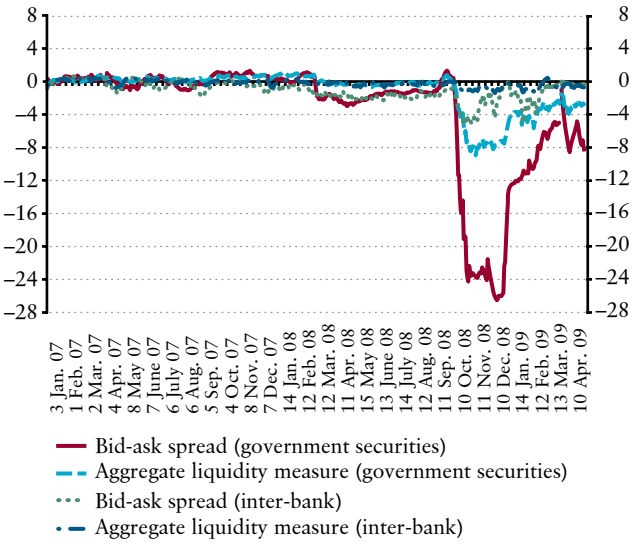
LIQUIDITY AND THE INFORMATION CONTENT OF PRICES IN THE INDIVIDUAL MARKET SEGMENTS DURING MARKET TURBULENCES

Indicators[9] describing changes in the liquidity of the individual market segments (Chart 2) suggest that, in respect of the Hungarian financial markets, it is the government securities market where strong and permanent disturbances in operation emerged. In particular, liquidity indicators related to the behaviour of prices suggest disturbances in both the government securities and the unsecured inter-bank credit markets.[10] The widening of the bid-ask spread is especially significant, which compromises the information content of the observed prices, and, even if we exclude risk premia, significant errors materialise in measuring expectations.

During the period of turbulence on the government securities market in March 2008 liquidity risk rose sharply and its fluctuation was also stronger than before. The increased volatility of the liquidity premium leads to considerable uncertainty in estimating its size. Furthermore, there were dry spells in the market during certain periods, so much so

Chart 2

Liquidity indicators in unsecured inter-bank and the government securities markets



that quoting banks had to suspend quoting for some time, or there were quotes only for limited volumes. As a result, the information content of benchmark yields concerning expectations is highly questionable, which renders 2-week forward yields derived from the yield curve estimated from yields on government securities useless as a tool for the quantification of policy rate expectations.

There were also disturbances in the Hungarian inter-bank market in the autumn of 2008: a confidence crisis led to a rise in perceived counterparty risks and inter-bank trading came to a standstill with transactions concluded with the central bank replacing the inter-bank market. This led to a rise in both credit risk and liquidity premia. Nevertheless, according to the liquidity measures tension seemed to be lower than in the government securities market and wore off faster. Only estimates and aggregate data are available on the liquidity of FRA and IRS markets prior to 2009 (Table 1). From 2008

Table 1

Liquidity of the HUF FRA and IRS markets

(an estimate for the London inter-bank market)

	Average daily traded volume (HUF billion)	Bid-ask spread (basis point)	
		FRA	IRS
2006–2007	100	8	5
2007–2008	40	20	10

Source: JPMorgan.

[9] For the calculation and interpretation of liquidity indicators, see Páles and Varga (2008).

[10] The chart contains indicators of overnight maturity.

Chart 3

2-week forward yields beginning at various points in time estimated from the government securities market yield curve and the inter-bank yield curve

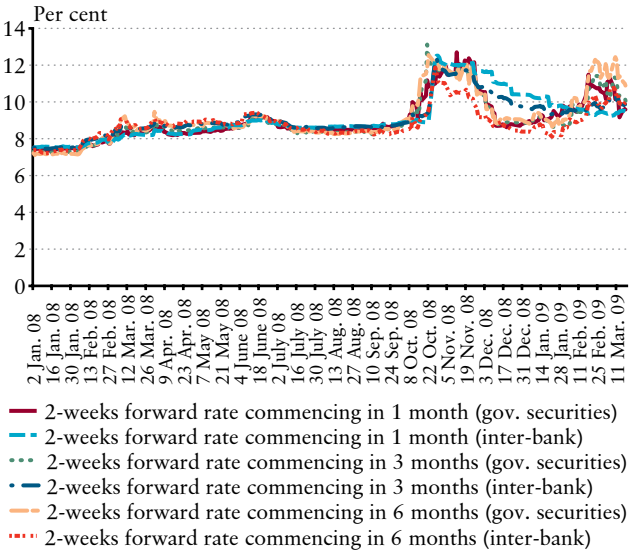


Chart 4

Base rate expected to be set at the next rate-setting meeting of the central bank

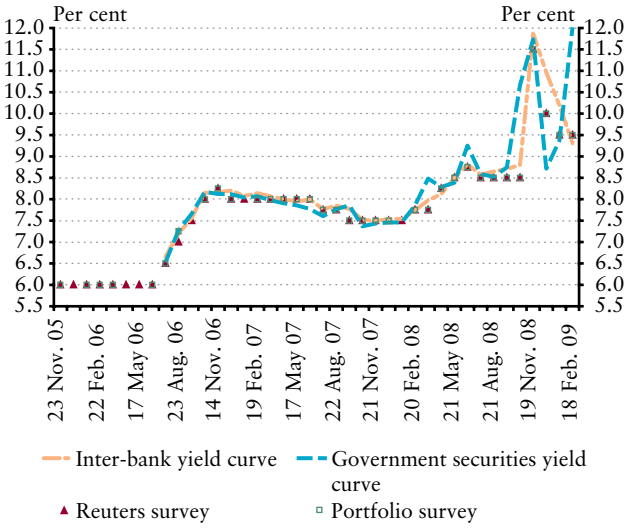
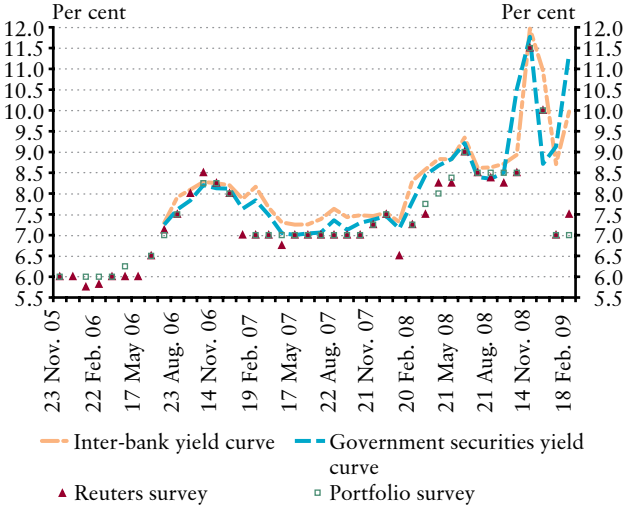


Chart 5

Expected end-year central bank base rate



onwards, they all point to liquidity constraints. At the same time, however, despite its widening, the bid-ask spread is roughly what can be regarded as average in the government securities market and lower than what was experienced there in turbulent times.

Based on liquidity indicators, it seems reasonable to say that forward yields computed from the yield curve estimated from inter-bank yields better approximate actual short-term policy rate expectations than those derived from the government securities market curve.

Increased volatility of forward yields computed from the yield curve (Chart 3) also suggests that disturbances leave a stronger footprint in the government securities market. The volatility of forward yields reflecting interest rate expectations for various points in time used to be similar in the case of both yield curves. Since the second half of October 2008, however, the volatility of government securities market yields has grown significantly. This means that we face considerably higher uncertainty regarding the information content of our measures of expectations if we rely on government securities yields rather than on inter-bank returns.

WHAT DID ANALYST EXPECTATIONS SUGGEST DURING THIS PERIOD?

Comparing data on implied forward yields obtained from the two different data sources with the results of the surveys conducted by Reuters and portfolio.hu among analysts, we arrive at a similar conclusion (Charts 4 and 5). Prior to the spring of 2008, forward yields computed from the two data sources reflect similar interest rate expectations. The government securities market curve was generally below the curve estimated from inter-bank returns, reflecting a lower credit risk premium. In the first half of 2008 we detected the first major divergence between the two curves. The government securities market curve reflected 50-100-basis point higher short-term expectations than surveys and the curve computed from inter-bank returns did. The difference became even more conspicuous after September 2008 and emerged even in longer-term expectations. The gap that became narrower temporarily widened significantly in February 2009. Based on the above, it seems that, overall, in

turbulent times it was forward yields computed from inter-bank returns that approximated short-term rate expectations better.

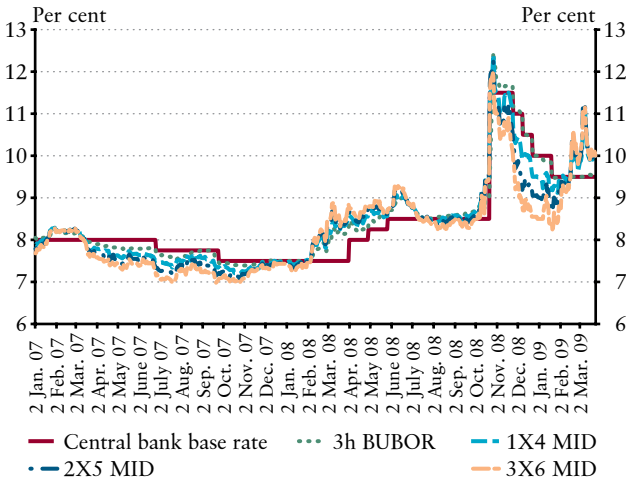
THE INTER-BANK YIELD CURVE IN PERIODS OF TURBULENCE: WHAT DOES BUBOR REFLECT?

Based on the above, it is safe to say that since the spring of 2008, the forward yield curve for inter-bank market yields has predicted interest rate expectations more reliably. However, disturbances also emerged in the inter-bank market in the autumn of 2008, with liquidity ebbing away. This may lead to distortions also in BUBOR and FRA fixings, on which the yield curve estimates are based, and thus to erroneous conclusions about expectations. In the following, we will examine possible biases in detail, and describe how – taking these factors into consideration – we can measure and interpret expectations more reliably. In doing so, we will focus on developments in the 3-month BUBOR. The reason for this is that this maturity is of key importance for two reasons. One is that the 3-month BUBOR is the underlying product of other market instruments (e.g. FRAs), and the other is that it serves as a benchmark interest rate for several types of corporate loans.

In addition to the fact that lower liquidity caused by a confidence crisis and the temporary drying-up of the inter-bank market distorted the information content of returns, the question which also arises in connection with BUBOR is how well the quotes provided by quoting banks reflect actual expectations. As no actual transaction is concluded at BUBOR, no costs are incurred if the interest rates provided by quoting banks reflect neither expectations of the base rate, nor the rate to be applied to possible transactions reliably. This type of bias does not necessarily originate from a lack of interest on the banks' part. Rather, lower liquidity in the unsecured inter-bank market is very likely to play a role during market turbulences. This particularly affected the market segment of transactions with longer maturities where business turnover is far lower than that in the market segment of overnight transactions. Since December 2008, loan transactions with a maturity of 3 months or longer have practically disappeared from the inter-bank market. As the market is illiquid, banks quoting BUBOR have no benchmark with which to compare their quotes. They cannot adjust their fixings to the interest rates of actual transactions. Although the adoption of BUBOR as a benchmark rate for corporate loans may mean that banks do have a stake at risk and bet on the accuracy of their expectations, this does not necessarily guarantee that quotes are in line with interest rate expectations.

Chart 6

Movements in the 3-month BUBOR and FRA returns



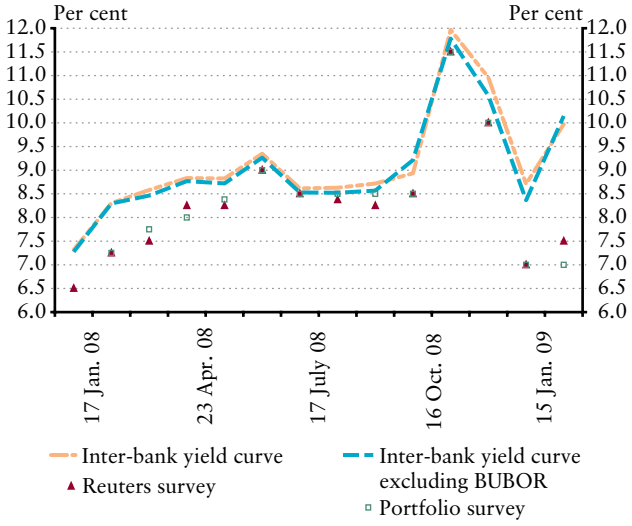
This concern seems to be justified by the recent rigidity of BUBOR fixings. Since December 2008 the 3-month BUBOR has practically been identical with the current base rate despite the fact that until mid-February FRAs and, occasionally, analyst projections had reflected significant rate cut expectations (Chart 6).

Theoretically, a higher BUBOR may reflect either the fact that, in the case of inter-bank lending, relative to FRA transactions and lending to the central bank, banks expect higher premia compensating counterparty risks or a higher liquidity premium due to market frictions. During easing cycles and corresponding expectations of rate cuts, it is particularly difficult to decide whether the fact that the level of BUBOR exceeds FRA returns is attributable to credit risk premia or a bias in fixings. There are two phenomena suggesting that BUBOR has recently reflected market participants' expectations to a lesser extent and banks simply give the prevailing base rate as their quotes. One is that, if a higher BUBOR were attributable to risk premia, there would be more or less continuous fluctuations in BUBOR, as market participants would revise their expectations in response to new incoming information. Sudden changes after rate-setting meetings occur only if the new base rate differs from expectations, it came as a surprise. Furthermore, fluctuations in risk premia may also lead to volatility in the level of BUBOR rates. However, fluctuations in BUBOR are minimal, in fact, much lower than those in FRAs; changes occur in a step-wise manner, coinciding with rate cuts.

Furthermore, BUBOR remained unchanged when, between mid-February and end of March 2009, FRA returns, consistent with analyst expectations, reflected the pricing-out of rate cut expectations and the emergence of expectations of

Chart 7

Expected end-year central bank rate



a base rate increase. If the explanation concerning the risk premium were valid, BUBOR fixings should be substantially higher than the prevailing policy rate since early March. The above notwithstanding, BUBOR has stayed close to the policy rate and has hardly followed the rise or the volatility experienced in FRAs since late January. However, as Chart 6 clearly shows, this was not always the case over the past two years. Subject to the prevailing market situation, BUBOR has changed nearly as dynamically as FRAs have.[11]

One of the consequences of BUBOR losing its information content is that the yield curve estimated from the returns on inter-bank instruments offers a somewhat more accurate picture of expectations if we do not use data on BUBOR fixings (Chart 7).

HOW ARE FRA RETURNS TO BE TREATED?

The question now arises whether FRA fixings, even if they change dynamically in response to changes in market sentiment, contain any bias caused by the fact that they are settled against a "sticky" BUBOR that fails to reflect expectations over the following 3-month period. In this case, FRA transactions can be regarded as if their underlying product (the benchmark rate) were a 3-month interest rate identical with the central bank base rate prevailing at the due date. In this case, FRA deals reflect expectations in relation to this instrument, i.e. expectations of the central bank base rate prevailing at the due date. In interpreting expectations, this represents a significant difference: FRA returns show expectations regarding the central bank base rate prevailing at the start of the transaction rather than the average base rate during the maturity period of the transaction. Thus, if the 3-month BUBOR reflected market participants' average interest rate expectations for the coming 3 months, then the 3-month FRA 1 month ahead would reflect expectations of a BUBOR prevailing 1 month later, which comprises the expectations of the average of the central bank rates during the 3-month period 1 month ahead. If, however, BUBOR is identical with the base rate, then it reflects the expectations prevailing at the start of the transaction, i.e. expectations of the following month's base rate. In this case, FRA returns commencing at various points in time directly indicate the expected central bank rate path. This would also mean that FRA returns have a characteristic gradual pattern, because expectations of rate cuts are reflected in prices when the period leading up to the settlement of the transaction contains the day, immediately following the rate-setting meeting, on which change is expected to occur.[12] If BUBOR did not get stuck at all, no calendar effects of this type, only expectations of future policy rates and the difference in BUBOR relative to them should be reflected in FRA returns.

There are sharp falls in FRA returns on some days, especially on rate-setting days or on the days immediately preceding them, which might lead to the conclusion that this is because of the 'cave-in' of future BUBOR fixings related to expected rate cuts. This hypothesis has also been confirmed by anecdotal information. Nevertheless, examining the dates closely reveals that such major falls do not occur exactly on the day of rate cuts at the beginning of the relevant future period (i.e. the day when a fall in BUBOR serving as a benchmark rate is expected to materialise).[13] Furthermore, significant changes in returns on FRAs with various maturities (e.g. 1 v 4, 2 v 5, etc.) occur on the same day despite the fact that the period intervening between two rate-setting meetings is not exactly one month. It follows that the data do not fully prove our assumption that FRA returns reflect expectations of the base rate directly. This is due, in part, to the fact that recent lower liquidity is manifest in a less efficient FRA market, and it may be the case that some banks fail to change fixings on these 'cut off dates'.

[11] As during the initial period the benchmark rate for BUBOR is fixed, its volatility should be lower than that of FRAs.

[12] Except for extraordinary cases, a new base rate enters into force on the day immediately *following* rather than *on* the rate-setting day. Thus, under our assumption, it will be reflected in the following day's BUBOR fixings.

[13] For instance, conventionally, the value date of a 1 v 4 FRA transaction concluded on 7 April 2009 is 9 April (T+2); the start date of the forward period would thus be 9 May. As, however, it falls on a weekend, it is the first working day following it (i.e. 11 May). BUBOR, which forms the basis for settlement, is the 7 May fixing for this day (T-2).

At the same time, however, the very fact that, in addition to expectations reflecting a declining interest rate path, FRA rates fall before rate-setting meetings without either fundamentals or market sentiments changing significantly suggests that market participants take into consideration the rigidity of BUBOR and its adherence to the base rate in their pricing.

CONCLUSIONS

In August 2007, a sharp rise in the level and the volatility of risk premia triggered by disturbances in the financial markets prompted several central banks to check whether the conventional instruments and methods used for measuring interest rate expectations still suited that purpose. Our analysis argued that it was in the government securities market that market turbulences caused the largest and the lengthiest disturbances in Hungary. Therefore, the yield curve computed from yields in the government securities market is less suitable for measuring market participants' expectations than it used to be. Recently, analyst expectations in various surveys have been followed more closely by forward yields computed from yield curves estimated from inter-bank returns. However, liquidity in the inter-bank market has decreased tangibly and the prices of certain instruments have become distorted. Since the end of 2008 BUBOR has been unsuitable for measuring market expectations. Fixings have lost their former flexibility and now cling to the prevailing rather than the future base rate. One of the consequences of BUBOR losing its information content is that the yield curve estimated from the returns on inter-bank market instruments offers a somewhat more accurate measure of expectations if we do not use data on BUBOR fixings. Nevertheless, FRAs based on BUBOR remain suitable for quantifying market participants' expectations provided that, when interpreting them, in addition to credit and liquidity premia we take into account the bias caused by BUBOR. If BUBOR is basically identical with the prevailing base rate, FRA returns reflect expectations of the central bank base rate prevailing at the start of their maturity period rather than expectations of the average central bank base rate during their maturity.

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Lóránt Varga: Hungarian sovereign credit risk premium in international comparison during the financial crisis

As the CDS market has been the primary market for the price discovery of Hungarian sovereign credit risk in recent years, we can gain the most reliable information about Hungarian sovereign credit risk premia by analysing the price of Hungarian CDS contracts, in other words, the CDS spread. Credit default swaps are contractual agreements between two parties, whereby one party assumes the credit risk associated with a bond held by another party by undertaking to pay the other party the nominal value of the bond in the case that the issuer of the bond defaults, in exchange for which it receives a series of periodic payments from the other party during the term of the contract. The turnover and outstanding amount of CDS contracts related to Hungarian sovereign foreign currency bonds exceed the secondary market turnover and outstanding stock of Hungarian foreign currency bonds. Last autumn, Hungary was hit particularly hard by the significant decline in risk appetite observed in relation to emerging markets, and in October 2008 both the level and the relative international position of the Hungarian sovereign credit risk spread deteriorated substantially. Raising the key policy rate in October 2008, combined with the IMF credit facility, contributed largely to stopping the profound loss of confidence in Hungarian investment opportunities. The substantial decline in Hungarian sovereign CDS spreads observed in March-May 2009 can be almost entirely attributed to improving global risk appetite.

INTRODUCTION

The deepening of the global financial crisis in the autumn of 2008 was accompanied by a drastic decline in global risk appetite combined with a general, substantial increase in credit risk premia. Consequently, the Hungarian sovereign credit spread – the compensation which investors expect to receive in exchange for assuming the credit risk associated with Hungary – has also been higher in recent months than in previous periods. However, given that the various prices indicating new developments in the Hungarian sovereign credit spread have, to a certain degree, departed from one another during the period under review, defining the actual value of the Hungarian credit spread is currently a challenge in its own right. Along with identifying the precise changes that the credit spread has been subject to, another important issue is to determine the extent to which the growth in the spread can be attributed to a global decline in risk appetite – which equally affected all emerging markets – and to unique, country-specific factors. This article is intended to answer these questions.

The first part of the paper presents the alternative price data that capture developments in the Hungarian sovereign credit risk spread; the Hungarian sovereign foreign currency bond spread; and the Hungarian sovereign CDS – credit default swap – spread. Because of their relative unfamiliarity and ostensible complexity, we provide a detailed account of the characteristics of credit derivatives and CDS contracts, as well as the functioning of the CDS market in general, and the Hungarian sovereign CDS market in particular. The next section contains a brief description of the findings based on which the CDS market, rather than the Hungarian sovereign foreign currency bond market, should be considered the most reliable measure of the Hungarian sovereign credit spread. The last section of the paper proceeds to identify the global and country-specific factors which have contributed to the changes in the Hungarian credit spread in recent months.

MEASURING THE SOVEREIGN CREDIT RISK OF HUNGARY

Several sources are available to provide information on developments affecting Hungarian sovereign credit risk. For example, we can monitor the assessment of major international credit rating agencies (Moody's, S&P, Fitch, etc.) of Hungary's credit rating as well as their revisions of Hungary's rating. While these ratings are typically reliable indicators of changes in the credit risk associated with a country in the long run, the credit ratings of individual rating agencies may differ from one another in the short term, and the decision to upgrade or downgrade a certain country often lags behind market perceptions. For this reason, in order to analyse the changes in Hungary's sovereign credit risk with higher frequency – for example, on a daily basis – we must seek a different source of information. The accuracy of the information can also be improved by relying on price data

obtained from financial markets, which reflect the actual financial investments of market agents.

One possible solution is to quantify the exact portion of the yield on *Hungarian foreign currency bonds,* which investors expect to receive in exchange for assuming the credit risk associated with the Hungarian government. If investors' perception of Hungary's sovereign credit risk changes, the credit spread they expect to receive will increase or decrease accordingly. The credit spread on a euro-denominated Hungarian foreign currency bond can be estimated by deducting from its yield the yield of a corresponding risk-free bond, the other parameters (maturity, denomination, interest rate, secondary market liquidity, etc.) of which are completely identical with the first bond. Since all parameters of the two bonds – other than credit risk – are identical, we can assume that their yields contain the same amount of other (interest rate, liquidity, exchange rate, reinvestment, etc.) risk premium, and thus any difference between the two yields should purely reflect the credit spread associated with the Hungarian foreign exchange bond. In line with the prevailing market practice, for the purposes of this paper we used the euro-denominated German government bond yield to approximate the value of the risk-free euro yield. However, our estimate of the yield spread on Hungarian foreign currency bonds may not be entirely accurate, due to the following reasons: one, even German government bonds are not completely risk-free; two, Hungarian and German foreign currency bonds cannot have precisely identical parameters; three, the liquidity of the Hungarian foreign currency market is much lower than that of the German government bond market. Consequently, Hungarian foreign currency bond yields should definitely contain a higher liquidity premium. Nevertheless, some of these imperfections can be eliminated, and empirical experiences suggest that the overall distortion they create is not as significant as to render analyses based on the thus estimated yield spreads unreliable.

Thanks to the development of financial markets, by the middle of the 2000s an alternative source of determining the price of Hungarian sovereign credit risk emerged: the price of *credit default swap (CDS) deals,* a derivative product used explicitly for the pricing and transferring of credit risk.

CDS CONTRACTS AND THE HUNGARIAN SOVEREIGN CDS MARKET

Considering their success and steady development, *credit derivative products* are by far the most prominent financial innovation of the last decade. A common feature of these financial contracts is that they are used to transfer the credit risks associated with bonds or loans from one party to another without transferring any other risks (such as exchange rate, interest rate, reinvestment risks, etc.) associated with these loans or bonds. The borrower or the issuer of the bond does not typically participate in the deal, which is made between two counterparties independently of the borrower or issuer.

Credit default swap (CDS) contracts constitute the basis for credit derivative markets. According to the semi-annual survey conducted by BIS in the derivative market (2008) and to the data provided by ISDA (2008), at the end of 2007 the total nominal value of outstanding CDS contracts reached USD 30 trillion. Credit default swaps are contractual agreements made between two parties for a pre-determined term, in order to transfer the credit risk associated with a third party (the entity that issued the bond or the borrower, hereinafter the reference entity) from one party to the other. The term CDS refers to this credit risk swap. However, when we look at the functioning of these contracts and the pattern of the related cash flow, we find that CDS transactions are in fact much closer to insurance or option deals in content than to traditional *swap* transactions.[1]

According to market terminology, the buyer of the CDS buys protection, while the seller of the CDS is obligated to compensate the protection buyer by paying the nominal value of the bond or the loan if the reference entity defaults. The protection buyer makes a series of periodic payments to the protection seller, and does not realise a profit on the deal unless the reference entity defaults or the market's collective assessment of the credit rating of the reference entity deteriorates during the term of the CDS. By contrast, the protection seller receives periodic payments, and profits from the deal if no default takes place during the term of the CDS, or the credit rating of the reference entity improves. The CDS buyer or seller can take advantage of the deterioration or improvement of the reference entity's credit rating if – rather than locking in their positions until maturity – they enter into an offsetting contract to close the deal as soon as the prevailing fees change to their advantage. In this case, the profit they realise will be the difference between the fees collected on the two opposing deals.

The regularly paid fee is commonly known as the *CDS spread* in international terminology. The term 'spread' usually refers to a type of interest rate margin or interest rate premium. On the one hand, the premium paid regularly under CDS contracts is called a spread because its amount is determined in basis points. The regularly paid premium is the product of

[1] See Csávás–Varga–Balogh (2007) for details on the characteristic features and classification of traditional swap transactions.

this amount defined in basis points and the total nominal value of the underlying bonds or loans of the CDS contract between the parties. On the other hand, we may look at the regularly paid premium as a portion of the regular interest income paid by the reference entity to the party holding the bond or loan instrument, which the latter passes on to the protection seller in exchange for the seller's assumption of the credit risk associated with the reference entity. Thus, in this sense, the regularly paid premium is a portion of the received interest payable in exchange for taking on credit exposure (credit risk premium).

There are two major groups of *driving forces* behind participation in CDS contracts (and essentially in any other credit derivative transaction). First, by means of CDS deals the credit risk associated with the holding of loan or bond portfolios can be reduced or completely eliminated. Second, the application of credit derivatives allows the investor to take up and switch positions easily and flexibly, betting on positive or negative future changes in the creditworthiness of an economic agent. To achieve this latter goal, it is not even necessary for the investor taking up a position in the credit derivative market to have any exposure vis-à-vis the specific economic agent. Speculating on changes in an entity's creditworthiness and taking up positions accordingly has substantially contributed to the surge in credit derivatives in recent years, as credit derivatives allow investors to take such positions with an ease and flexibility that would not be possible by means of the underlying loan or bond instruments alone.

Based on the sector of reference entities, global CDS markets can be divided into two major groups: CDS markets linked to corporate bonds (including bank-issued bonds) and sovereign bonds. CDS deals with underlying corporate bonds are by far the more dominant of the two. Even though recent years have seen a considerable turnover growth in *sovereign CDS deals* – as has been the case in the global market overall – data provided by the large credit derivative brokers which we interviewed indicate that their market share is only around 5-6%, and the nominal value of outstanding sovereign CDS contracts was probably around USD 1.5-1.8 trillion at the end of 2007. CDS contracts with the underlying foreign currency bonds of emerging countries accounted for the vast majority of sovereign CDS turnover, representing over 90%.

Most features of sovereign CDS deals are identical with those of corporate bonds except, naturally, that under a sovereign CDS contract it is a country's credit risk that is transferred between market participants. A sovereign CDS contract may have any maturity. However, the most favourable terms are between 1 and 10 years, of which the 5-year-term tends to be the most liquid according to market participants. In case of a default event on the part of the specific sovereign reference entity (typically a failure to pay, debt restructuring or moratorium), the protection buyer delivers to the protection seller any bond under the terms of the contract issued by the reference entity in the face value equal to the nominal value specified in the CDS, in return for which the protection seller pays the buyer the par value of the bond. Rather than physically delivering the bonds affected by the default event, using a cash settlement for the conclusion of CDS contracts has become an increasingly popular practice in sovereign CDS markets. In this case, the protection buyer does not have to deliver the bonds; instead, the protection seller pays the buyer the difference between the par value and the post-default market value of the affected bonds. Under the terms of sovereign CDS contracts, in the case of a default event, government bonds issued by the specific sovereign can be generally delivered denominated in any accepted foreign currency listed in the ISDA Master Agreement (euro, US dollar, pound sterling, Japanese yen, Swiss franc, and Canadian dollar). In sovereign CDS trades, the CDS spread is also quoted as an annual premium payable by the protection buyer, but as is the case in other CDS markets, it is typically paid in quarterly instalments, and the nominal amount of the payment is the specific par value multiplied by the specific portion of the CDS spread computed for the length of the given quarter (length of the quarter in days/360).

Under Hungarian sovereign CDS contracts, the counterparties can transfer the credit risks of foreign currency bonds issued by the Hungarian government denominated in any standard, accepted foreign currency. Reliable information regarding the Hungarian sovereign CDS market is scarce. Similarly to other credit derivatives markets, the Hungarian sovereign CDS market is a typical OTC (over-the-counter, unregulated) market where the scope of market participants and their trading motives are hard to grasp. There are no real dealers; trading takes place through credit derivative brokers, who are responsible for pairing up the anonymous, nevertheless binding bids of market participants, typically submitted by electronic mail. The majority of credit derivative brokers are based in London or New York. According to the triennial BIS survey on global foreign currency and derivatives market activity (2007) and based on the information provided by domestic credit institutions, Hungarian market participants do not enter into Hungarian sovereign CDS contracts. Active market participants include global investment banks, hedge funds and other non-resident fund managers, typically motivated by the possibility of taking flexible positions, which allows them to take advantage of any changes in the credit risk premium of the Hungarian government. Trading is based on the terms of the ISDA Master Agreement, a standard form

widely used in credit derivatives markets; price quotes typically refer to nominal values of EUR 5-10 million. In line with global trends, contracts with a 5-year maturity are the most liquid in the Hungarian sovereign CDS market as well. According to the information provided by credit derivative brokers, the Hungarian sovereign CDS market achieved an adequate level of liquidity around the end of 2005 and early 2006, which marked the beginning of a gradual turnover growth; particularly remarkable liquidity growth was observed from early 2008.

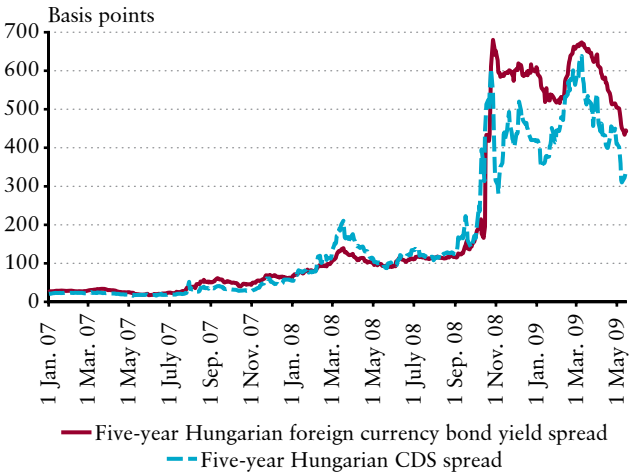
Based on the survey we conducted in 2008 with the participation of the largest global credit derivative brokers (see Varga, 2008), the Hungarian sovereign CDS market has low liquidity compared to the average liquidity of credit derivatives markets. In terms of the number of quotes it is in the lowest quarter of sovereign CDS markets. Nevertheless, *in 2008 brokers typically received 30-40 binding price quotes on a daily basis from an average of ten banks,* accounting for 1-3% of all sovereign CDS quotes, while the daily turnover of actual trades is estimated to be at least EUR 10-20 million. While these values significantly fall behind the turnover of the most liquid CDS markets, the Hungarian sovereign CDS market is considerably more liquid than the secondary market of the underlying Hungarian sovereign foreign currency bonds, where no daily trades are performed according to market participants. Based on our estimate, *the outstanding stock of Hungarian sovereign CDS contracts at the end of 2007 amounted to around USD 10-30 billion or around EUR 7-20 billion.* Based on the CDS stock data published following our survey[2] by the clearing house *Depository Trust & Clearing Corporation (DTCC)* at the end of October 2008, the above estimate – particularly its upper limit – was in the correct range. According to the information provided by DTCC, on 31 October 2008 the gross outstanding stock of Hungarian sovereign CDS contracts amounted to nearly USD 33 billion, or over EUR 25 billion. Comparing these values to USD 21 billion – the total amount outstanding of foreign currency bonds issued by the Hungarian government as of the end of 2007 – it is evident that despite its daily turnover falling far short of the average turnover of the more liquid credit derivatives markets, the Hungarian sovereign CDS market should still be considered a significant market from the perspective of pricing Hungarian sovereign credit risk.

PRIMARY MARKET OF THE PRICE DISCOVERY OF HUNGARY'S SOVEREIGN CREDIT RISK

As the previous section indicated, the price of Hungary's sovereign credit risk can be defined both as the Hungarian sovereign foreign currency bond yield spread over the corresponding risk-free bond yields, or as the CDS spread. If these two prices are the same, we can rely equally on either one and draw the same conclusion, in other words, the price discovery that took place in two different markets will not pose a problem. If the opposite is true, i.e. the two prices are not identical, in order to achieve a reliable analysis, as a first step we need to decide which price provides more – as well as more accurate – information about the changes in the credit spread.

Chart 1

Developments in the five-year Hungarian CDS spread and the five-year Hungarian foreign currency bond yield spread[3]



Source: Datastream, Bloomberg, own calculations.

Until the final quarter of 2007, the two five-year Hungarian sovereign credit spreads moved together; fluctuating around 20-30 basis points (see Chart 1). However, from the end of 2007 they deviated from one another several times. Initially, in 2008 the CDS spread was typically higher than the foreign currency bond yield spread, but at the end of 2008 they reversed directions. While both the CDS spread and the bond yield spread started to soar, the difference between them

[2] http://www.dtcc.com/products/derivserv/data/index.php.

[3] On the computation of five-year Hungarian sovereign foreign currency bond yield spreads, see Varga (2008). In view of the fact that credit spreads were subject to a significant increase in the autumn of 2008 even in countries previously considered risk-free – including Germany – we deviated from the method applied for the purposes of that study in that we deducted the prevailing German CDS spread from the euro-denominated benchmark German government bond yield in order to calculate the risk-free yield.

increased significantly as well, at times reaching or even exceeding 200 basis points, and in any case, staying consistently over 100 basis points. Cointegration analyses examining the relationship between the two time series over different periods arrived at similar conclusions.[4] They confirm that while the two time series cointegrate in the long run, they may temporarily deviate from one another due to microstructural factors (for example, the different liquidity situation of the two markets, the small proportion of participants that are active in both markets, transaction costs, which are capable of persistently preventing market arbitrage forces from coming into effect). Thus, the Hungarian CDS spread and the foreign currency bond yield spread may contain strongly conflicting information about the changes in the credit spread in different periods, and therefore we need to decide which of the two has the most reliable information content.

In the case of financial markets, the concept of market effectiveness can be used to determine how relevant and reliable the information content of market pricing is. To put it simply, the more available information is captured in the prices of a market, the faster, the more effective the given market should be. On the other hand, the more liquid a financial market is, the information is captured in the prices to a greater extent and faster. Consequently, of two markets sharing the same parameters, the more liquid one is probably more effective. Despite the lack of precisely verifiable data, we have suggested before that according to information obtained from market participants, the Hungarian sovereign CDS market is more liquid than the secondary market of Hungarian sovereign foreign currency bond market. Based on this, the CDS market is probably the more effective market of the two, in other words, the CDS spreads contain more relevant information about the developments in the Hungarian sovereign credit risk.

Furthermore, effective markets tend to be the first to capture changes in prices, while price changes in the less effective, albeit similar markets, will lag behind. This further supports our assumption that the CDS market is more effective than the foreign currency bond market. Indeed, as Chart 1 clearly indicates, in recent years the five-year foreign currency bond yield spread has typically adjusted to changes in the five-year CDS spread with a lag. To put it differently: Chart 1 suggests that the CDS market, rather than the foreign currency bond market, is the primary market where the price discovery of the Hungarian sovereign credit spread takes place, as new information regarding the credit spread is first captured in the CDS spreads.

However, anecdotal information obtained from market participants and the correlation suggested by the chart should not be considered irrefutable evidence. Thus, as it is suitable in the case of cointegrating time series, we have conducted a number of error correction analyses for the purpose of identifying the primary market of price discovery.[5] Based on the results, for the periods of both 2006–2008 and 2008–2009 *the CDS market was undoubtedly the primary market of the price discovery of the Hungarian sovereign credit spread,* while the foreign currency bond market did not prove to be an effective market, in that the foreign currency band yield spread merely adjusted to changes in CDS spreads. As we have seen, an analysis of Hungarian CDS spreads can provide the most accurate information about the Hungarian sovereign credit spread. This result characterises countries other than Hungary as well: in the majority of emerging countries examined in 2008 by Varga (2008), the CDS market, rather than the foreign currency bond market, was the leader in the price discovery process of the sovereign credit spread. Consequently, including the period that has elapsed in 2009 to date, the CDS spread was a more reliable measure of the actual level of the sovereign credit spread, which also implies that the foreign currency band yield spread – which exceeds the CDS spread by an average of 100-200 basis points according to Chart 1 – should not be considered realistic as a *credit spread*. Nevertheless, we cannot conclude that the level of Hungarian sovereign foreign currency bond yields is unjustified from an *economic perspective*. Indeed, the fact that the foreign currency bond yield spread has been persistently higher than the CDS spread probably reflects a significant increase in the level of the liquidity premium on Hungarian foreign currency bonds since late October 2008. As we have stated above, the method we applied to estimate the credit spread of foreign currency bond yields cannot separate the liquidity premium from the foreign currency bond yield spread.

DEVELOPMENTS IN HUNGARIAN SOVEREIGN CDS SPREADS IN INTERNATIONAL COMPARISON

As Chart 1 indicates, the CDS spread, a reliable measure of the Hungarian sovereign credit spread, increased slightly in March-April 2008, and significantly in the autumn of 2008. In the rest of this paper, our primary goal is to assess the

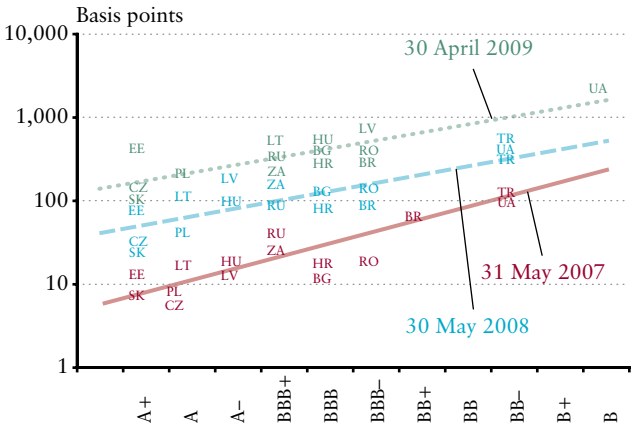
[4] The exact method and the results of the periods preceding 2008 are presented in Varga (2008), while the results of the period between 2008 and 2009 are included in the Annex.

[5] The exact method and the results of the periods preceding 2008 are presented in Varga (2008), while the results of the period between 2008 and 2009 are included in the Annex.

Chart 2

Credit ratings and five-year CDS spreads of emerging countries

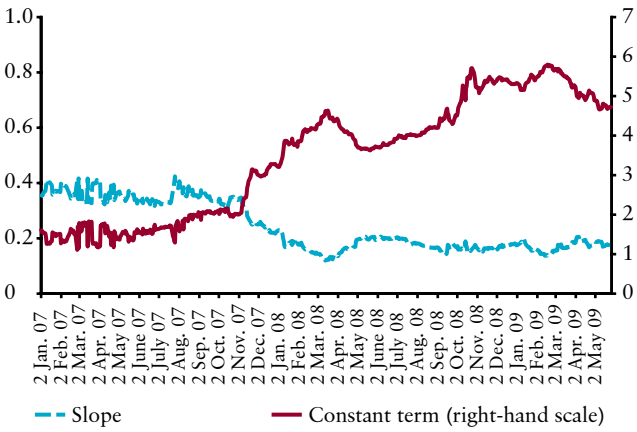
(on a logarithmic scale, on specific days)



Source: Datastream, own calculations.

Chart 3

Daily changes of the slope and the constant term of the linear regression between the credit ratings and the logarithms of five-year CDS spreads of emerging countries



Source: Own calculations.

extent to which the above changes in the Hungarian credit spread can be attributed to a substantial, global decline in risk appetite observed in the second half of 2008 – i.e. a general increase in global credit spreads – and the extent to which country-specific factors contributed to these developments. To answer this question, we conducted a comparative analysis of the five-year Hungarian sovereign CDS spreads versus CDS spreads observed in different other countries in the period of January 2007 and May 2009, taking into account the credit ratings of the sample countries as well. Besides Hungary, we used the 5-year CDS spreads and the average credit rating – the average rating of Moody's and S&P – of 14 additional emerging countries[6] relevant from the perspective of the relative development of the Hungarian economy and Hungarian financial markets for our calculations.

Our goal was to grasp, at each point in time across the sample period, the common information we can gain from the relationship between the CDS spread and credit ratings of different emerging countries, and examine how the specific values of Hungary compare to that common information. In order to achieve this – in the same way as illustrated by the three randomly selected days on Chart 2 – we estimated a regression for each day of the sample period between the five-year CDS spreads and the credit ratings of the emerging countries in our sample.[7]

The slope of the daily regression lines was positive across the sample period (Chart 3).[8] This means that the five-year sovereign CDS spread levels of the emerging countries in our sample were broadly consistent with the credit rating of individual countries, as the expected CDS spread of lower-rated countries is wider than that of countries with a better credit rating. The slope of the regression lines remained steady until the end of 2007; however, from the end of 2007 the slope began to flatten and the constant term of the regressions began to rise. Since – in consideration of the non-linear relationship between credit quality and the expected credit spread – we ran the regression on the logarithm of CDS spreads, this change indicates an overall, significant widening of credit spreads across all credit rating categories from the end of 2007, which further escalated in the autumn of 2008.

As regards Hungary, based on the parameters of the daily regressions between the credit ratings and five-year CDS spreads of emerging countries, we estimated what would have been the value of the five-year Hungarian sovereign

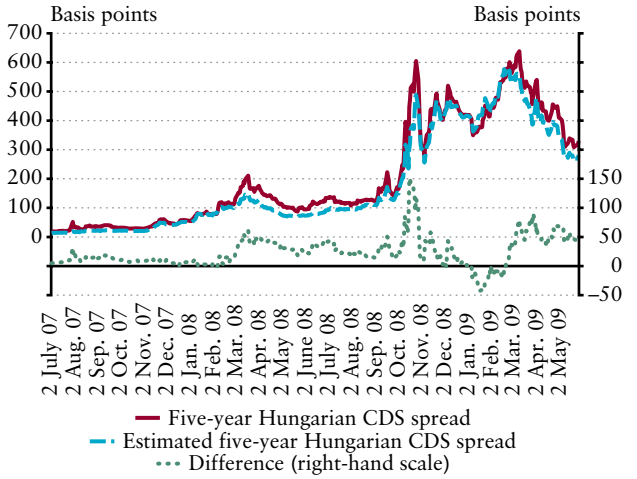
[6] Brazil, Bulgaria, Croatia, the Czech Republic, Estonia, Latvia, Lithuania, Poland, the Republic of South Africa, Romania, Russia, Slovakia, Turkey and Ukraine.

[7] For a more detailed description of the method, see Varga (2008). While regression analysis is in theory used to examine the relationship between two ratio variables, general market experience suggests a linear relationship between the logarithms of credit spreads and the credit ratings measured on an ordinal scale. We used the logarithm of credit spreads because according to general market experience, the change in credit spreads that follows the deterioration of the credit rating between categories is usually not linear but exponential, as market participants demand increasing expansion in risk premia when credit quality declines, especially as the credit rating approaches non-investment grade categories.

[8] On 13 March 2008 the slope of the estimated regression line reached 0.12, its flattest position in the sample period, however, with a p value of 0.009 even this figure implies a statistically significant positive slope at all standard significance levels.

Chart 4

Deviation of the five-year Hungarian CDS spread from the regression line between the credit ratings and five-year CDS spreads of emerging countries



Source: Datastream, own calculations.

CDS spread on each day of the sample period (see Chart 4). While the estimated and actual values of the CDS spreads broadly cointegrated during the sample period, from 2007 we could identify three periods when the actual value of the CDS spread exceeded – by more than 50 basis points – the regression line between the credit ratings and five-year CDS spreads of emerging countries. Thus in these periods (in March 2008, in October 2008 and starting from March 2009) the value of the Hungarian sovereign CDS spread was not consistent with the correlation we observed between the sovereign credit ratings and the level of sovereign CDS spreads across the group of emerging countries.

The increase of the Hungarian sovereign CDS spread to 150 basis points in *March 2008* was justified by the overall surge observed in the CDS spreads of emerging countries across all credit rating categories. However, exceeding this value of 150 basis points – which was justified by global developments – by around 60 basis points, the Hungarian sovereign CDS spread increased to 210 basis points. Thus, this 60-basis-point increase should be considered a country-specific factor, which cannot be attributed to the general growth of credit spreads observed in global markets. Although this country-specific growth in March 2008 was neither significant nor lasting, it was rather exceptional because, in addition to *fundamental reasons* (i.e. investors' more negative perceptions about the credit risk of Hungary than would have been justified by the official assessment of credit rating agencies) *technical factors* contributed to it as well, as market participants reported a significant decline in the liquidity status of the secondary market of forint government securities and an increase in liquidity premia during the same period.[9]

Parallel to the gradually decreasing Hungarian sovereign CDS spread, the difference declined as well from April 2008, but even until late August it was unable to drop below 20 basis points for a longer period of time. This suggests that even after March 2008 investors had a slightly worse perception of Hungary's credit risk than the average of other emerging countries with similar credit rating. This assumption is supported by the fact that the growth of the Hungarian CDS spread following the default of Lehman Brothers in September 2008 surpassed the level justified by the general, global growths of CDS spreads, and the difference once again reached 50 basis points.

As the credit spread of emerging countries temporarily decreased after the default of Lehman Brothers, a significant decline in risk appetite was observed *in early October 2008,* indicating that the government and central bank measures announced in developed markets failed to alleviate investors' fears in the long run. Considering the average credit rating of Hungary at the time, until the middle of October global developments justified growth of the Hungarian CDS spread up to nearly 500 basis points, which is more than twice as high as the highest value observed in the past. At that point, it became apparent that investors' perceptions of the credit risk of Hungary was significantly more unfavourable than their assessment of the credit risk of other emerging countries. Indeed, on 16 October 2008 the Hungarian sovereign CDS spread surpassed the regression line between the credit ratings and five-year CDS spreads of emerging countries by 150 basis points, a historical high. *In conclusion, the significant decline in risk appetite triggered by the financial crisis, which affected all emerging markets, was particularly severe for Hungary,* because the perceptions of market participants of Hungary's credit risk was significantly poorer – by several rating categories – than its prevailing average credit rating. *The emergency interest rate increase on 22 October 2008 followed by the announcement of the IMF credit facility agreement on 26 October largely contributed to stopping the profound loss of confidence in Hungarian investments.* In the days that followed, parallel to a general global improvement of credit spreads, the difference between

[9] Indeed, investors who were unable to reduce their Hungarian credit risk exposure because the shrinking liquidity of the domestic government bond market did not allow them to sell their government bonds to the extent they had wished to suddenly created an immense demand for Hungarian sovereign CDS contracts. As they were seeking protection with respect to their credit exposure vis-à-vis the Hungarian government, their behaviour triggered an abrupt and substantial increase in the Hungarian CDS spread. For more details see Varga (2008).

the actual and the estimated Hungarian CDS spreads dropped to nearly zero from the previously observed historical high.

However, the decline of the Hungarian sovereign CDS spread proved to be temporary: as early as the middle of November 2008 its growth surpassed, once again, the extent justified by the regression line between the credit ratings and five-year CDS spreads of emerging countries. Although the difference, which exceeded 50 basis points again, returned close to zero by the end of November, this time the narrowing reflected the downgrading of Hungary's credit rating that was first announced by Moody's and then by S&P in November, rather than new developments that improved Hungary's risk perception. While the difference widened again in the first few days of December, between late November 2008 and late February 2009 the value of the Hungarian CDS spread was broadly consistent with the global changes in credit spreads. In fact, as evidenced by the negative difference between the actual and estimated CDS spreads, in January 2009 investors' perceptions regarding Hungary's credit risk was more positive than the average credit rating of the country at the time.

These positive developments came to a halt in *March 2009,* when – reflecting a substantial weakening of the forint exchange rate – the Hungarian sovereign CDS spread significantly surpassed the level justified by global developments once again. Fluctuating around 500 basis points, at the end of March the Hungarian CDS spread exceeded the level warranted by Hungary's prevailing credit rating by nearly 100 basis points. Again, the widening of the gap was halted by Moody's and S&P's announcement in the last days of March about further downgrading Hungary's credit rating, each by one category. However, contrary to November 2008, the gap between the actual and estimated Hungarian CDS spreads did not narrow to close to zero in the wake of the downgrades; in fact it continued to fluctuate at around 50 basis points until the end of May 2009 (the end of the sample period). *Thus, the substantial decline in Hungarian sovereign CDS spreads that exceeded 300 basis points in the period of March-May 2009 can be almost entirely attributed to improving global risk appetite,* rather than an improvement in Hungary's relative global credit risk position.

CONCLUSIONS

The price of Hungary's sovereign credit risk can be defined both as the Hungarian sovereign foreign currency bond yield spread over the corresponding risk-free bond yields, or as the price of Hungarian sovereign CDS contracts, the CDS spread. Credit default swaps are contractual agreements made between two parties for a pre-determined term to transfer the credit risk associated with the issuer of a bond. During the term of the CDS contract the party transferring the credit risk pays the protection seller a series of periodic payments, commonly known as the CDS spread. If the reference entity defaults, the protection seller will pay the protection buyer the nominal value of the bond. The turnover and outstanding amount of the CDS contracts related to Hungarian sovereign foreign currency bonds exceed the secondary market turnover and outstanding stock of Hungarian foreign currency bonds.

In recent years, the CDS market was undoubtedly the primary market of the price discovery of the Hungarian sovereign credit spread, while the foreign currency bond market did not prove to be an effective market, in that the foreign currency yield spread merely adjusted to changes in CDS spreads. Therefore, an analysis of Hungarian CDS spreads can provide the most accurate information about the Hungarian sovereign credit spread. In the period of 2009 that has elapsed to date, foreign currency bond yield spreads have been remarkably high, significantly exceeding the level of the CDS spread, probably reflecting the increased liquidity premium on Hungarian foreign currency bonds.

The beginning of October 2008 saw a dramatic increase in the credit spreads of emerging markets, and at the same time it became apparent that investors' perceptions of the credit risk of Hungary was significantly more unfavourable than their assessment of the credit risk of other emerging countries. Indeed, the extent to which the Hungarian sovereign CDS spread surpassed the level justified by global developments reached a historical high during this period. In conclusion, the significant decline in risk appetite triggered by the financial crisis, which affected all emerging markets, was particularly severe for Hungary, because the perceptions of market participants of Hungary's credit risk was significantly poorer – by several rating categories – than its prevailing average credit rating. The emergency interest rate increase on 22 October 2008 followed by the announcement of the IMF credit facility agreement on 26 October largely contributed to stopping the profound loss of confidence in Hungarian investments. In the days that followed, parallel to a general global improvement of credit spreads, the relative disadvantage of Hungary vis-à-vis other emerging countries diminished. In contrast, the substantial decline in Hungarian sovereign CDS spreads that exceeded 300 basis points in the period of March-May 2009 can be almost entirely attributed to improving global risk appetite, rather than an improvement in Hungary's relative global credit risk position.

ANNEX

Long-term relationship between the Hungarian sovereign foreign currency bond market and the Hungarian sovereign CDS market, and the primary market of the price discovery of credit risk (2008–2009)

Since the foreign currency bond yield spreads and CDS spreads subject to our examination tend to follow a unit root process, we applied a cointegration method to analyse the long-term relation between the two markets. To determine the contribution of each market to price discovery, we estimated the following vector error correction model:

$$\Delta p_{CDS,t} = \lambda_1 \left(p_{CDS,t-1} - \alpha - \beta p_{CS,t-1} \right) + \sum_{j=1}^{p} \gamma_{1j} \Delta p_{CDS,t-j} + \sum_{j=1}^{p} \delta_{1j} \Delta p_{CS,t-j} + \varepsilon_{1t} \quad (1a)$$

$$\Delta p_{CS,t} = \lambda_2 \left(p_{CDS,t-1} - \alpha - \beta p_{CS,t-1} \right) + \sum_{j=1}^{p} \gamma_{2j} \Delta p_{CDS,t-j} + \sum_{j=1}^{p} \delta_{2j} \Delta p_{CS,t-j} + \varepsilon_{2t} \quad (1b)$$

where $p_{CDS,t}$ implies the sovereign CDS spread and $p_{CS,t}$ implies the sovereign foreign currency bond yield spread at date t. The first, parenthetical expression on the right side of equations (1a)–(1b) implies the error correction mechanism through which the sovereign credit spread evolving in the two markets cointegrate in the long run. Parameters α and β of the error correction coefficient are the equivalent of the cointegration parameters.[10] The cointegration and error correction analysis was performed by using the most liquid, five-year Hungarian CDS spreads and five-year Hungarian foreign currency yield spreads for the period of 2 January 2008–15 May 2009 (359 observations).

Based on the results of the Johansen cointegration analysis, there is evidence of cointegration between the five-year Hungarian sovereign CDS spread and the five-year Hungarian sovereign foreign currency bond yield spread in the sample period (At the 5% significance level, we reject the null hypothesis suggesting the opposite, as indicated by Table 1). On the other hand, based on the test statistics indicated in the second row, we also reject the null hypothesis of value [1, –1] for the cointegrating vector. As noted above, our results indicate that the Hungarian sovereign CDS spread and foreign currency bond yield spread cointegrate over the long run. However, the two prices may deviate from one another over the short term due to transaction costs, a difference in market liquidity and additional microstructural factors. Taking also into account the results suggested by Varga (2008), the cointegration parameter β exceeded 1 in the sample period 2006–2008, and dropped below 1 in 2008-2009. This implies that in 2006–2008 the CDS spread, while in 2008-2009 the foreign currency bond yield spread was more volatile.

As for the parameters of the error correction model, the value of parameter 2 was significantly positive in the sample period, while the value of parameter 1 was not significant. This means that in the sample period it was primarily in the Hungarian sovereign CDS market where the price discovery of Hungary's credit spread took place, i.e. new information regarding the credit risk of Hungary was first captured in the CDS spreads. By contrast, the foreign currency bond market was not an effective market considering that foreign currency bond yield spreads merely followed the changes in CDS spreads. If we

Table 1

Estimation results

	January 2008–May 2009
Null hypotheses	
No cointegration	33.59*
β=1	25.86*
Estimated β	0.80
λ_1	–0.005
λ_2	0.083*

Note: the first row of the table presents Johansen trace test statistics for the five-year Hungarian CDS spread and foreign currency bond yield spread. The number of lags in the underlying vector auto regression is defined by means of the Akaike Information Criterion (AIC). The second row displays test statistics for restrictions on the cointegration parameter β. The third row indicates the estimated value of parameter β. The fourth and fifth rows contain the estimated values of parameters λ_1 and λ_2 of equations (1a)–(1b).

*For the null hypotheses displayed in the first two rows, the * sign indicates the rejection of the specific null hypothesis, while the * sign in the last two rows indicates the significant parameters, at a 5% significance level in all cases.*

[10] For a more detailed description of the methods see Varga (2008).

compare the values of the recently computed parameters to the results of Varga (2008), we see that this trend in fact intensified in 2008-2009 relative to the period of 2006–2008.

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