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## Contagion and the beginning of the crisis - Pre-Lehman period

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JÚLIA KIRÁLY-MÁRTON NAGY-VIKTOR E. SZABÓ

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**October 2008**



The views expressed here are those of the authors and do not necessarily reflect the official view of the central bank of Hungary (Magyar Nemzeti Bank).

Occasional Papers 76.

**Contagion and the beginning of the crisis – pre-Lehman period\***

(Fertőzés és a krízis kezdete – a Lehman előtti periódus)

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# Abstract

This paper provides an overview of the antecedents, main drivers and spillover mechanisms of the turbulence emanating from the US sub-prime credit market in the summer of 2007. Its primary goal is to discuss the facts and interrelationships featured in the various analyses and statistics in a uniform, non-standard approach, to separate the ‘centre’ from the ‘periphery’ in terms of the impact of contagion, and to understand the causes and consequences in the pre-Lehman period.

The paper concludes that the primary causes of the turmoil were a persistently low international interest rate environment and financial imbalances engendered by globalisation. The combination of accelerating house price inflation and rapid financial asset price rises due to sub-prime mortgage credit securitisations (the originate-and-distribute model)\* as well as the bursting of asset price bubbles collectively were responsible for the magnitude of the distress. The spillover from the turmoil, in turn, was the consequence of increased international financial integration. One innovation of the paper is a detailed analysis of the channel of contagion within financial integration: a confidence crisis, coupled with turbulence in the interbank markets, played a major role in the centre, while on the periphery the triggers were internal vulnerability, rises in risk premia and reduced access to credit.\*\*

**JEL:** G20, G30.

**Keywords:** sub-prime, turmoil, turbulence, mortgage credit.

## Összefoglaló

2007 nyarán az Egyesült Államok másodrendű jelzáloghitel-piacáról kiinduló válság előzményeit, kiváltó okait és terjedési mechanizmusát tekintjük át. Célunk elsősorban a különböző elemzésekben és statisztikákban szereplő tények, összefüggések egy-egy és egyben újszerű keretben történő tárgyalása, az „epicentrum” és a „periféria” fertőződésének elkülönítése, a hatásmechanizmusok megértése a Lehman-krízis előtti időszakban. Megállapítjuk, hogy a válság kirobbanásához főként a tartósan alacsony globális kamatkörnyezet és a globalizáció miatt kialakuló világméretű pénzügyi egyensúlytalanságok vezettek. A válság jelentős méretét a gyors lakásár-infláció és a pénzügyi eszközök áremelkedésének a másodrendű jelzáloghitelek értékpapírosítása (a keletkeztető és szétosztó modell) miatti összekapcsolódása, valamint a buborékok kipukkanása okozta. A válság terjedése pedig a jelentős pénzügyi integráció következménye. Tanulmányunk egyik újítása a pénzügyi integráción belül a fertőzési csatorna részletes bemutatása: az epicentrumban meghatározó szerepet játszott a bizalmi válság és a bankközi piacok turbulenciája, míg a periférián a belső sérülékenység és a kockázati felárak növekedése, valamint a finanszírozási lehetőségek beszűkülése.

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\* For a list of the most frequently used terms, see the end of the paper.

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# 1 Introduction

In many respects, the series of events emanating from the US mortgage credit market in mid-summer 2007 – referred to in the US literature as the ‘sub-prime crisis’ or the ‘crisis in the sub-prime mortgage credit market’ and in Europe as ‘considerable financial turbulence’ – was not different from earlier crises of varying dimensions. A number of devastating financial crises have been documented and analysed in economic literature since the early 1990s:

- 1986-1995: United States – the Savings and Loan (S&L)<sup>1</sup> crisis,
- 1990-1991: the crisis of Norwegian, Swedish and Finnish banks – known as the Scandinavian crisis,
- 1990-1999: the Japanese banking crisis,<sup>2</sup>
- 1994-1995: the Mexican crisis – popularly referred to as the tequila or peso crisis,
- 1997-1999: the Asian financial crisis,<sup>3</sup>
- 1998: the Russian financial crisis and the LTCM incident,<sup>4</sup>
- 2001: the Turkish and Argentinean banking crises,<sup>5</sup>
- 2001-2006: the dotcom crisis and episodes of ‘creative’ accounting failures at large corporations (Enron, Worldcom and Parmalat).

Over the past year, numerous studies were devoted to analysing the series of events that began in the summer of 2007, with many analysts treating it as an extraordinary, devastating financial crisis. Although for the sake of simplicity we use the ‘crisis of 2007’ or the widely accepted phrase ‘sub-prime crisis’ in this paper, instead of the extremely complicated expression ‘the financial turbulence which started in the wake of the crisis of the US sub-prime mortgage credit market’, we do not share the apocalyptic views held by certain groups of economists (Soros, 2008; Jaksity, 2008).

The focus of the paper is the crisis of 2007, its propagation through the financial markets and its wider implications. First, we provide an overview of the underlying economic and financial developments during the ‘peaceful’ pre-crisis years, as these developments generated pressures that can be easily recognised in retrospect. Then, we take a closer look at the development of the US mortgage credit market, presenting the importance of the originate-and-distribute model and showing how a previously ‘clean’ mortgage market was polluted by the appearance of sub-prime loans and a near-crisis situation finally emerged. We also discuss the mechanism and crisis of the collateralised debt obligation (CDO) market and the ‘shadow banking system’ surrounding it (Pozsár, 2008) – an industry based on substantial embedded leverage and driven by the illusion of risk diversification, but not at all serving market integrity – which played a major role in propagating the crisis. The following two chapters deal with the spillover of the crisis in the pre-Lehman period: first, we discuss the confidence crisis that initially developed in the centre, i.e. in the countries primarily affected, and the fragility of the banking system, and then we analyse the causes and effects in the peripheral countries, i.e. in those not directly affected, with a special emphasis on Hungary. Naturally, many elements of the sub-prime crisis are not dealt with in this paper. In particular, we do not give a comparative analysis of the financial crisis, do not consider a number of regulatory and economic policy dilemmas and necessary interventions, and moreover, we do not assess the role of central banks.

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<sup>1</sup> Savings and loan institutions are US deposit-taking institutions specialising in lending to the local public. At the turn of the 1990s, several occurrences of the ‘interest rate rocket’ caused a wave of failures among S&Ls imprudently providing fixed-rate, long-term mortgage loans from short-term money market liabilities. [www.fdic.gov/bank/historical/s&l](http://www.fdic.gov/bank/historical/s&l).

<sup>2</sup> BIS (2004) provides an excellent overview of banking crises.

<sup>3</sup> For an account of contagious crises, i.e. the Mexican, Asian and Russian financial crises, see Kaminsky–Reinhardt (2000) and Kaminsky–Reinhardt–Végh (2003).

<sup>4</sup> For the most comprehensive overview of the LTCM crisis, see Dunbar (2000).

<sup>5</sup> See Eichengreen (2002).



## 2 Prologue – the 2000s

The financial disturbances of 2001 brought an end to the long crisis period of the 1980s and 1990s and heralded the beginning of an unusually long economic upturn. The 2000s began with very positive developments and optimistic expectations. Emerging economies experienced more balanced and accelerating growth; India and China placed their economies on a new path of growth and modernisation, as a result of which world GDP growth picked up to close to 5 per cent in 2006. Benefiting from ‘open borders’, i.e. a liberalised world trade system, the inflow of cheap goods and the low-cost labour force were rising, which contributed to a relatively stable, low inflation environment in developed market economies as well. A number of central banks, including the US Federal Reserve, responded to the low inflation environment with an accommodating monetary policy, i.e. by reducing interest rates.

The direction of capital flows financing trade imbalances was reversed: emerging countries began to finance extra consumption in developed countries. While in the United States consumption growth picked up, other regions of the world, particularly South-East Asia, China, India and the oil exporting countries, were running current account surpluses, due mainly to the high propensity to save. Although the global saving-investment balance turning negative was a natural consequence of these developments, it was widely known that global imbalances could not be sustained over the long term.

The emergence of a new pattern of global imbalances went hand-in-hand with the integration of the world’s financial markets – financial globalisation became a commonplace idea.<sup>6</sup> Despite the crisis of 1997-1998, the removal of barriers to the free movement of capital gained momentum, financial markets became increasingly globalised, they traded similar financial products, their operational rules were compatible, new business formation was liberalised, and institutions were faced with fewer and fewer barriers in providing services across borders. Capital flows rose sharply, markets for financial products also gained momentum, and lagging regions opened up to international capital flows. After a long period of time, trade and financial globalisation<sup>7</sup> became intertwined again.

Savings arising from the strong economic growth in emerging countries sought new investment opportunities in the globalising financial markets, which, in turn, contributed to a gradual moderation in market yields. Low interest rates and the declining return on investments strengthened so-called ‘search for yield’ strategies, which was manifested in risk-based competition between investors and intermediaries. This led to increasing risk tolerance, i.e. a significant narrowing of credit spreads to their historical low and new, more risky credit product innovations. Around the middle of the decade, average spreads no longer provided adequate compensation for expected losses on assets. Diversification became increasingly sophisticated, or so it seemed, and the joint occurrence of risks appeared a distant prospect: risk managers calculated the size of potential loss in the event of default by applying low assumed correlation coefficients.

These events led to the emergence of asset price bubbles or similar phenomena in a number of sub-markets. In theory, perfectly operating financial markets possess an extremely strong, self-regulating quality, uncharacteristic of any other market: there is practically much less opportunity to manipulate prices than in ordinary product markets, as in the latter any product can be produced synthetically by ‘mixing together’ other products, and the risks can be clearly incorporated into prices.<sup>8</sup> According to empirical observations, however, in the real financial markets there are not only temporary but also permanent free lunches – arbitrage profits, difficult to interpret under conventional finance, may be generated and, simultaneously with this, irrational asset price bubbles may arise even over longer periods.

<sup>6</sup> However strange it may seem, financial globalisation was a popular concept last in the 19th century. The 20th century was not exactly about globalisation, but rather wars, fragmentation, autarchy, market protection and barriers. As Stanley Fisher wrote: ‘During the 1970’s the word ‘globalization’ was never mentioned in the pages of The New York Times. In the 1980’s the word cropped up less than once a week; in the first half of the 1990’s, less than twice a week; and in the latter half of the decade, no more than three times a week. In 2000 there were 514 stories in the paper that made reference to ‘globalization’; there were 364 stories in 2001, and 393 references in 2002. Based on stories in The New York Times, the idea of being ‘anti-globalization’ was not one that existed before about 1999.’ (Fisher, 2003)

<sup>7</sup> Financial globalisation in itself causes fear and impatience. A number of excellent papers have tried to explain the background of this animosity towards globalisation and provide a critical analysis (for example, Csontos, Király and László, 1997). These analyses deny the existence of a global conspiracy theory, and have not found tangible empirical evidence of the ‘extensive power of finance’. They demonstrate that financial markets only help private individuals solve their everyday problems, while the optimal size of markets cannot be defined; consequently, the ‘over-expansion of the financial world’ cannot be interpreted either. These analyses have not lost their relevance with the emergence of the sub-prime crisis.

<sup>8</sup> Actually, this phenomenon is described by arbitrage-free pricing, the foundation of finance, the mathematical appearance of which is axioms 1 and 2 of asset pricing (Medvedev, 2007).

Rapidly rising asset prices caused an expansion of the asset sides of investment funds, hedge funds and other financial institutions, which, in turn, increased shareholders' equity. As the majority of these institutions operate with a financial leverage which is defined to meet investors' target returns, increases in equity value led to additional fund-raising and new investments, and thus at the same time to higher leverage. The abundance of liquidity appeared in financial markets and in the funding structure all at once: banks were willing to finance their balance sheet leveraging. Virtually everything was 'cheap' in the financial markets, bid-ask spreads narrowed, the volatility of prices and yields declined and yield curves flattened. Simultaneously with this, loans became cheaper and cheaper, and banks were growing ever faster, as a reflection of an increase in funding liquidity. Many observers saw an 'over-expansion of the financial superstructure' behind the exuberance of both market and funding liquidity and the extreme growth of financial wealth, such as in funds, banks and equity capital (Soros, 2008). The 'virtuality' of the abundance of liquidity (the consequence of prices deviating from fundamentals, while 'actual' wealth or the 'real economy' is not growing) or its 'reality' (price rises contribute to introducing new financial innovations facilitating the allocation of risk and the distribution of income and, overall, raising 'net social welfare') is one of the central themes of this paper. This self-reinforcing process (financial asset price bubble) – declining yields, falling risk premia, the search for yield, rising asset prices, the abundance of both market and funding liquidity – ultimately caused an increase in the leveraging of all financial market participants.

In addition, banks' surplus funding liquidity, coupled with the low interest rate environment, led to credit booms at geographically distant locations in the world (the United States, the United Kingdom, the Baltic states, South-Eastern Europe, Spain, etc.). Above-equilibrium growth in the supply and demand of household credit prompted an increase in housing market demand and a near doubling of house prices in ten years. Rising residential property prices also pointed to the existence of an asset price bubble, but its cause can be found expressly in the dynamics of banking and credit markets (Mishkin, 2008a, 2008b). Again, an important consequence of this self-reinforcing process (real asset price bubble) – rising house prices, growing lending opportunities, credit expansion, increasing demand, even higher house prices – was a rise in the level of households' leverage.

The paper traces the interlinking (originate-and-distribute model) of financial and real asset price bubbles, and the reversal and rapid unwinding of these upward spirals.

From a regulatory perspective, the sub-prime crisis also highlighted several deficiencies of the new Basel framework. It was during this period that banking regulations were transformed from rule-based to risk-based, and the Basel II prudential regulations for banks' capital were developed and subsequently transposed into the national legislation of more than 100 countries.<sup>9</sup> The philosophy of the new regulations is to tailor capital requirements protecting depositors to the risk profile of the given institutions, but even this new regime could not provide adequate protection against regulatory arbitrage, and moreover, it could not avoid the usual risk management trap: standardised risk assessment and management cause endogenous risk and procyclicality (Danielsson, 2003).

During this upswing, several studies warned about the aforementioned risk factors (for example, Borio, 2001, 2006; Danielsson, 2003; Nouriel Roubini's blog, Calvo and Talvi, 2006; etc.). They emphasised the unreasonably narrow gaps between bid and offer prices, the asset price bubbles that were developing, the procyclical movements that reinforced each other, the necessary corrections of global imbalances and the potential drying-up of the abundant liquidity – in short, highlighting that the 'party' might soon be coming to an end.

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<sup>9</sup> Basel II is the name of recommendations issued by the BCBS set up by the Bank for International Settlements (International Convergence of Capital Measurement and Capital Standards – a Revised Framework). The countries joining the Accord must transpose these recommendations into their national laws. European legislation implemented the recommendations in 2007. The EU's Capital Requirement Directive is binding for all Member States which are required to implement it as a binding directive. US legislators have postponed implementation of the Basel II recommendations until 2009.

### 3 The spark – the US sub-prime mortgage market and the originate-and-distribute (OAD) model

As we have presented a detailed overview on the US sub-prime mortgage credit market and the typology of sub-prime loans in a separate paper (Király and Nagy, 2008), in this chapter we only discuss the operation and ‘failure’ of the originate-and-distribute model, i.e. the basic fundamentals necessary to understand the origin of the sub-prime crisis.

The mortgage credit market is a key part of the US economy: housing wealth plays a demonstrably significant role in US consumption. Consequently, from the perspective of smoothing macroeconomic cycles, the degree to which the mortgage credit market, sustaining US consumption, can be stabilised and supplied with adequate liquidity cannot be neglected. For over 30 years this system has been in operation based on securitisation, which provides the connection between borrowers and ultimate lenders, i.e. security holders. In the process, banks’ portfolios of mortgage loans are transformed into marketable securities and sold to investors. Despite very significant differences in the legal framework, technical details and market structures, in economic terms the mortgage-backed security (MBS) of the US mortgage market<sup>10</sup> and the mortgage security of the European, mainly German, market (‘Pfandbrief’) are essentially the same products: long-term savers, i.e. security investors, ensure borrowers’ long-term financing using banks as intermediate links.

The US mortgage market is one of the world’s most segmented markets, meaning that a wide variety of products are available for consumers wishing to take out a home loan as well as for investors (Csontos, Király and László, 1997). A number of specialised participants ensure that the process remains smooth and efficient:

- Mortgage brokers, either authorised private individuals or firms, are in direct contact with customers. They generally do not originate loans on their own account, but act as an intermediary. There are, however, financial enterprises which also borrow on own account and refinance the loan with the lender. And, of course, commercial banks or savings and loan associations (S&Ls) may also act as brokers in the mortgage market;
- Credit institutions and in part Federal Home Loan Banks (FHLBs) engage in refinancing loans granted to customers. As a rule, these institutions are responsible for choosing clients with good creditworthiness as well as for client monitoring;
- Numerous auxiliary institutions are involved in securitisation, including special purpose vehicles (SPVs) which issue the securities (whose activities will be discussed in detail below), and ‘mortgage servicers’ which collect interest and principal and transfer to the company issuing mortgage-backed securities, etc.;
- government-sponsored enterprises (GSEs) or agencies are very important participants in the process: Fannie Mae, Ginnie Mae and Freddie Mac are the biggest institutions.<sup>11</sup> They participate in refinancing and securitisation, or provide guarantees for mortgage securitisations and ensure the quality of mortgage-backed securities by applying tight quality standards.

Banks are the originators of securitisations. Through the process of securitisation, the long-term loans of US households are financed by long-term investors, mainly households in their saving phase, and the large institutional investors which rely on these investors, such as pension funds and life insurers. Accordingly, the lending institution passes on the credit risk, distributing it among investors. The securitisation-based originate-and-distribute (OAD) model reduces concentration risk, eases the regulatory capital burden and provides liquidity to the mortgage lender, generates fee income for the securitising firm and offers a variety of investment products to institutional and private investors. In doing so, it distributes the underlying risks to the end-investors, who actually bear the risks. The OAD is a multi-player, multi-product model of financing over the life cycle, characteristic of segmented markets. The originator of the loan is interested in maintaining loan quality, otherwise it would not be able to obtain refinancing. The distributor only accepts and repackages the risk of top quality ‘prime’ loans;

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<sup>10</sup> There are two sub-types of mortgage-backed securities: a) residential mortgage-backed security (RMBS) and b) commercial mortgage-backed security (CMBS).

<sup>11</sup> Federal National Mortgage Association (Fannie Mae), Government National Mortgage Association (Ginnie Mae or GNMA) and Federal Home Loan Mortgage Corporation (Freddie Mac).

all of its actions are focussed on maintaining investor confidence. Consequently, ensuring the quality of securitised loans and the resulting securities has always been the foundation for the smooth functioning of the system: the quality requirements of agencies forced the financing institutions to adopt stringent risk management policies and to carefully select original borrowers and, consequently, investors indeed acquired a first-class security, the riskiness and liquidity of which was comparable to that of government securities. In the classic ‘delegated monitoring’ model (Diamond, 1984), the bank’s task is to finance borrowers who do not have access to credit in the market (households, small enterprises), and in this capacity to assume the monitoring tasks of the ultimate lenders, i.e. depositors. The risk monitoring role discussed by Diamond is not damaged in the OAD model, as the originator is interested in maintaining loan quality, otherwise it could not act successfully in the market as a securitiser. The originate-and-distribute model in itself, blamed by many for the sub-prime crisis, is a financial model which efficiently serves the interests of both borrowers and investors.

The US mortgage loan market, however, has never been solely restricted to loans of agency-guaranteed quality: the market has always had more risky segments as well. One was the market of borrowers who did not have access to credit since the 1970s, because they were registered as not prime, but sub-prime customers. They constituted the sub-prime segment.

Although the public has easily taken to using the concept of sub-prime since the crisis began, it is extremely difficult for researchers to actually find a precise definition. Some simply consider all loans that involve ‘significant credit risk’ to be sub-prime loans (Gramlich, 2004), while according to other definitions, sub-prime loans include all loans that have higher interest rates. Some take the debtor and others the credit cost as a starting point. All approaches contain an element of truth, as loans collectively called sub-prime loans are indeed more risky than average, good quality loans, and moreover, they have higher interest rates. Sub-prime debtors do not have a credit history, or their existing credit history is not unblemished. And, finally, the product group collectively called sub-prime loans cannot be securitised by providing the ‘usual’ government or quasi-government guarantee, which means that sub-prime loans cannot be part of the original or the ‘old’ OAD model discussed at length.

The sub-prime mortgage credit market gained popularity from the early 1990s, as a consequence of low interest rates and acceleration of the credit assessment process. The volume of such loans quintupled between 1994 and 2000 (Gramlich, 2004), the real credit boom did not occur until after 2000. There was a sixfold increase in the volume of sub-prime mortgages between 2001 and 2007 (MBA, 2007; IMF GFSR, 2007). In 2007, sub-prime mortgages accounted for more than 15 per cent of total mortgage lending, up from 5 per cent in 2001 (Chart 1). US households had loans of USD 13,000 billion at the end of 2007 (more than 100 per cent of GDP), of which USD 10,000 billion were mortgage loans. Within mortgages, USD 1,400-1,500 billion were sub-prime, of which USD 1,000-1,100 billion were securitised loans (MBA, 2007; IMF GFSR, 2008).

Sub-prime loans were the driver behind strong lending growth: although banks maintained their tight lending criteria with ‘good’ customers, they granted credit to an increasing number of ‘bad’ customers. In the early days, various product innovations offering favourable terms (for example, adjustable-rate loans with low initial repayment amounts) were targeted mainly at such debtors: the percentage of loans extended to these clients with easier conditions, through brokers and at low initial repayment burdens, was the highest.<sup>12</sup>

One factor which contributed to the rapid growth in sub-prime lending was the simultaneous, though not accidental, occurrence of one of the most significant periods of house price inflation in US history: the Case-Shiller index, which measures house prices in the 20 largest cities, surged to 226 per cent from 2000 to June 2006.<sup>13</sup> There was a positive feedback between securitisation activity and increases in residential property prices: higher house prices acted to boost credit supply and demand, with rising loan volumes, in turn, leading to further rises in house prices.

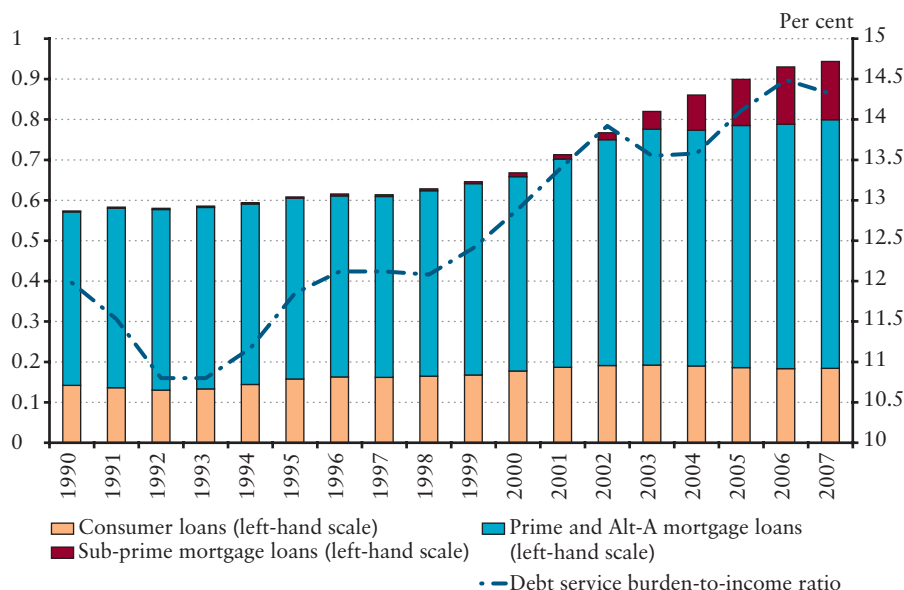
In this benign environment, not only the number of underlying products grew unusually strongly, but also the securities market that relied upon them (Chart 2). Private mortgage-backed securities had already emerged in the early 1970s, which securitised pools of loans not guaranteed by GSEs. Non-agency MBSs provided protection against credit exposure, similar to that provided by GSE-guaranteed securities through credit enhancement: issuers purchased credit insurance from specialised

<sup>12</sup> As with Gresham’s law: bad customers drive out good ones.

<sup>13</sup> The Case-Shiller index is a price index constructed from 20 regional indices of the United States housing market. For a description of the construction methodology, see Case-Shiller (2003) on housing market bubbles. Data are provided by Standard & Poor’s.

**Chart 1**

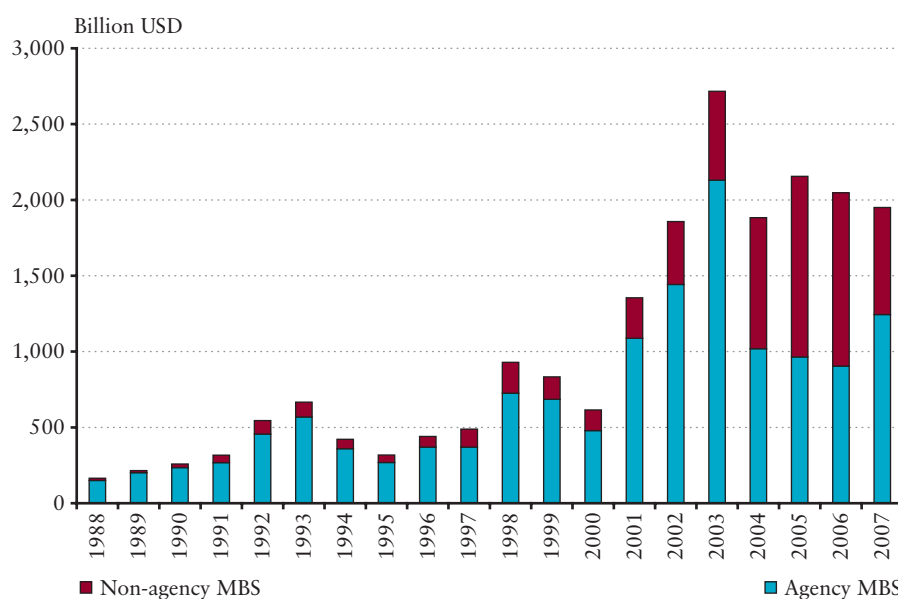
**Credit-to-GDP and debt service burden-to-income ratios of US households**



Sources: MBA (2007), Fed flow of funds statistics, 2008.

**Chart 2**

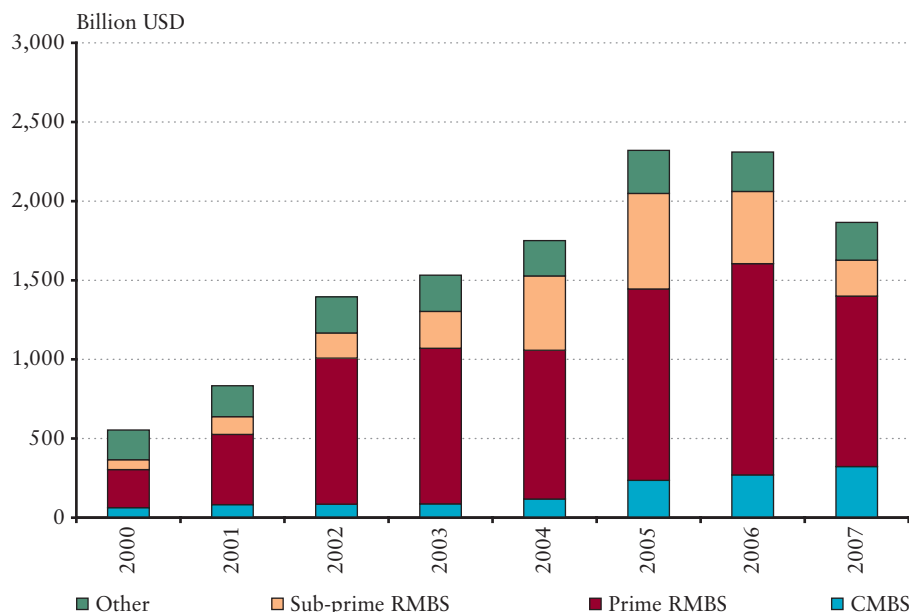
**Annual issuance of MBSs in the United States by type of issuer**



Sources: Calculated Risk (for the period 1988-2006), SIFMA (2008a) (for 2007).

insurance firms,<sup>14</sup> and they had their securities rated by large rating agencies and sold securities only of excellent quality (generally AAA-rated) to a wider range of investors. Consequently, at the outset GSE-guaranteed and non-agency mortgage-backed securities did not pollute the market: they were of equally high credit quality and low risk. The originate-and-distribute model was still undamaged. There was also a positive feedback between securitisation and credit growth:

<sup>14</sup> In the USA, these institutions engaged in bond insurance were the so-called monolines. At the time of founding, monoline insurers specialised in municipal securities, and later they switched to insuring structured finance products. The two most important insurers, severely shaken by the sub-prime crisis, are Ambac, established in 1971, and MBIA, established in 1973.

**Chart 3****Global MBS issuance by type of instrument**

Sources: Dealogic, Bank of England (2008).

securitisation made it cheaper for banks to lend, thereby increasing the supply of credit, and rising credit supply, in turn, led to further securitisations.

With the pick-up in sub-prime lending, however, there was also a change in the market. As sub-prime loans accounted for an increasing share of credit growth, non-agency, or private-labelled, MBSs securitising pools of sub-prime loans began to account for a larger and larger share of the securitised products (Chart 3). At any rate, these ‘second-rate’ securities represented higher risks and lower liquidity for investors compared with those backed by loans of good quality.

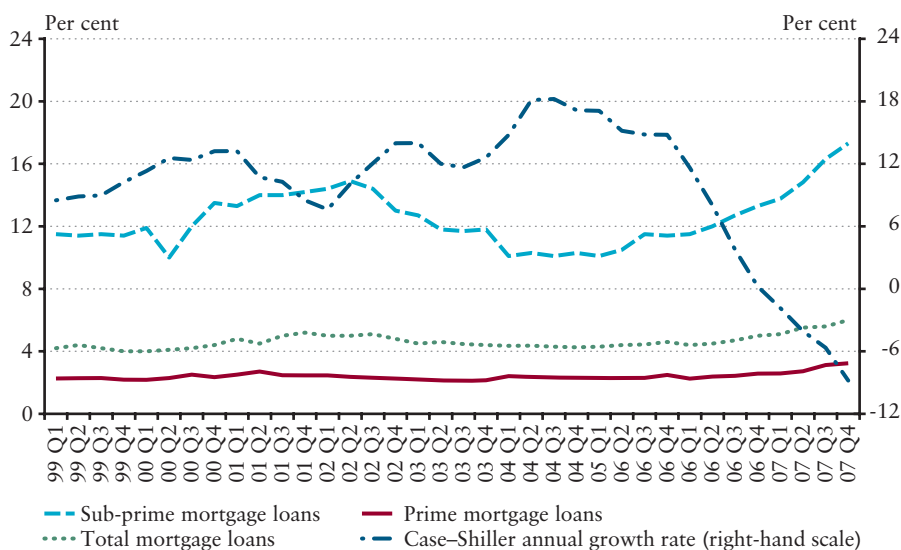
For the investment market, the vigorous growth in this sub-market meant that it became increasingly difficult to distinguish higher quality securities from lower quality securities: the market gradually became polluted, i.e. distorted. While in the early phase of growth non-prime loans also performed excellently, due to low interest rates and rising house prices, this slow pollution process only had relevance for esoteric debates among market analysts. Later, however, the upsurge in the volume of sub-prime loans, and subsequently, in sub-prime securities, meant that the OAD model was damaged: the possibility that ‘anything can be securitised’ released banks from the pressure of earlier quality requirements, and they were increasingly less interested in limiting their customers’ risks, i.e. in discharging the task that Diamond described as ‘delegated monitoring’. The originate-and-distribute model was replaced by originate-to-distribute model. The polluted security market and the damaged model naturally led to the emergence of the US mortgage crisis.

In early 2006, the rate of increase in home prices began to slow. The reasons have yet to be fully investigated, but significant factors may have included the excessive debts mainly of households, as well as a slowdown in lending due to the rise in lending rates (the Fed’s tightening cycle). With the start of a downward spiral, the decline in home prices accelerated. As a result of this reversal, default rates on mortgages, particularly on US sub-prime mortgage loans,<sup>15</sup> started to rise continuously from 2006 (Chart 4).

<sup>15</sup> In the paper, delinquency ratio and default ratio are used as synonyms. In US terminology, delinquency refers to debts at least 60 days in arrears. Default criteria is laid down in Basel II, including loans past due for more than 90 days, winding-up procedure or bankruptcy proceedings. Ratios are calculated in percentage of total existing loans.

## Chart 4

## Percentage share of households facing payment difficulties in the US mortgage credit market and annual house price inflation



Sources: Mortgage Banking Association Delinquency Survey, S&P.

Increasingly unfavourable news on the mortgage credit market began to appear from early 2007. In February 2007, a major sub-prime lender, ResMAE Mortgage filed for bankruptcy, while another 'star' institution of the market, Nova Star Financial revealed huge losses.<sup>16</sup> The second largest sub-prime mortgage lender, New Century Financial stopped accepting new loan applications from 8 March 2007, and on 2 April it filed for bankruptcy.<sup>17</sup> On 6 August 2007, American Home Mortgage also filed for bankruptcy. Countrywide Financial, the largest US mortgage lending institution, wrote off several billion dollars in losses on its residential loan portfolio.<sup>18</sup>

Once a crisis hits, the question arises as to what early signs of the problem there were and whether the consequences could have been accurately anticipated.<sup>19</sup> As in the case of all crises, it must be said straightaway that nobody knew exactly what was going to happen. According to the assessment in the June 2007 issue of the ECB's Financial Stability Report, 'given the limited size of the market segment, the aggregate impact should be relatively contained' (ECB, 2007, June, p. 23). At the Federal Reserve Bank of Chicago's 43rd Annual Conference, Fed Chairman Ben Bernanke said he had not expected sub-prime delinquencies to have a significant impact on the rest of the economy (Bernanke, 2007). Former Fed Governor Edward Gramlich, who has since passed away, has been cited extensively as he continuously warned Alan Greenspan about the dangers of irrational lending practices. In his warning (Gramlich, 2004), he famously said that the rising rates of delinquencies might call into question the positive impact of the credit boom, but even he was not able to completely detach himself from the euphoria, and emphasised that the resulting 'net social benefits' should be welcome, which, among others, meant '9 million new homeowners'.

<sup>16</sup> ResMAE Mortgage was acquired first by Credit Suisse and from Credit Suisse by Citadel Investment, a hedge fund firm. In November 2007, ResMAE went bankrupt. Nova Star also filed for bankruptcy in the autumn of 2007 and ceased operations.

<sup>17</sup> Simultaneously with this, various bailout efforts were made. On 18 April 2007, Freddie Mac took a step: it indicated that it would refinance those sub-prime debtors by USD 20 billion who would not be able to repay their debts. On 3 May 2007, some members of the US Senate announced their USD 300 million plan to rescue homeowners under foreclosure proceedings. In June, Ben Bernanke supported this proposal.

<sup>18</sup> Of the large investment banks, HSBC was the first that announced on 22 February 2007, that it had suffered losses of around USD 11 billion and that it was going to fire the head of mortgages credit line.

<sup>19</sup> In the United States, a couple of small banks went bankrupt in the late 1990s, due to sub-prime losses: Best Bank, an institution specialising in the issuance of sub-prime credit cards, and Keystone and Pacific, which were involved in mortgage lending and, moreover, in securitising sub-prime loans; however, these cases remained fairly isolated, and no conclusions were drawn from them (BIS, 2004).

This episode was not the first significant banking sector crisis in the United States – barely a decade earlier, the protracted S&L crisis caused a general upheaval in the economy. We need to understand the parallel development on the mortgage credit market and financial markets, particularly on structured finance markets, in order to understand why the sub-prime crisis spilled over from the US, why we do not limit the scope of this analysis to the spillover effects of the slowdown in the US economy caused by the crisis, why we consider the first quick analysis by Reinhart and Rogoff, the two most renowned analysts, as ‘narrow’ (Reinhart and Rogoff, 2008),<sup>20</sup> and why we believe the damage to the OAD model and its role in the crisis to be of the utmost importance.

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<sup>20</sup> The excellent authors, while demonstrating that the sub-prime crisis was not at all different from similar crises in the past, make no mention of the fact that the crisis emerged from the US mortgage credit market, moreover from US financial system.



## 4 The spillover. Structured finance markets – collateralised debt obligations (CDO) and their counterparts

Securitisation is a new innovation, as the first pass-through mortgage-backed security was issued by Ginnie Mae in 1970, and the first structured security was issued by Salomon Brothers in 1977. The previous chapter discussed the merits and drawbacks of the originate-and-distribute model: we saw that mortgage-backed securities played a dominant role in promoting the rapid growth of the US mortgage market, maintaining its liquidity, creating a link between borrowers and lenders, but also in the ratio of loan approvals for sub-prime borrowers increasing, bank's risk management standards weakening, and, through this, in the securities market being damaged.

The originate-and-distribute model allows investors and lenders (the depositors) of a bank to distribute risks across market investors. The development of securitisation is a special story of repackaging credit risk, which will be presented in this chapter.

### 4.1 DEVELOPMENT OF SECURITISATION FROM PASS-THROUGH TO STRUCTURED FINANCE

The securitisation process involves the isolation of future cash flows from loans and repackaging them into new products that offer different cash flows.<sup>21</sup> At the beginning, there is an asset which generates a regular cash flow,<sup>22</sup> and at the end a product with a regular cash flow stream, albeit different from the original, is sold by a bank to an investor. Not incidentally, securitisation has its roots in illiquid bank loans, and its primary objective is to create a liquid security.

For a long time, securitisation meant nothing more than removing assets from banks' balance sheets, i.e. the creation of marketable bank loans under specific, well-defined conditions. Accordingly, for quite a while securitisation was also about transforming an illiquid asset into a liquid asset: long-term mortgage loans, difficult to convert into cash, were transformed into marketable, i.e. easily transferable, securities with a liquid, deep market. In the early days, government or quasi-government guarantees greatly contributed to the liquidity of the securities, i.e. that they could be sold without incurring significant capital losses. Consequently, as discussed in the previous chapter, it was not accidental that for investors 'security', 'low credit risk' and 'liquidity' were linked. For over two decades, a bond created through securitisation was synonymous with liquid securities providing secure income, guaranteed by the government.

The cash flow from an underlying asset, forming the basis for a securitisation transaction, has three basic characteristics which are worth transforming, in order for the end-investors to obtain a product that meets their preferences: maturity, interest rate and credit risk. The transformation of interest on and maturity of cash flows was the first step towards structured finance. During the conversion process, fixed and floating rate notes and even reverse floating rate notes were equally created from the originally fixed-rate mortgage loans, which either ran the prepayment risk of the original loans or not (Fabozzi, 2001). Mortgage-backed securities, secured by a portfolio of mortgage loans, and asset-backed securities, securitising wider pools of loans, were real financial innovations at the time.

Securities issued to transfer credit risk, i.e. the radical repackaging of credit exposure, constituted the next step, representing a huge quality improvement from the perspective of distributing risks. The credit risk of the original assets with an average default rate and expected loss were allocated to three different tranches:

<sup>21</sup> Today securitisation is often characterised by two words: 'slice and dice'. During the process, the available cash flow on a pool of assets is sliced into very small parts and packaged in a different form. If the bank cannot sell the packaged security, then they repackage it and try again.

<sup>22</sup> Naturally, absurd securitisations were also born as the market developed, for example, CDOs backed by commodity as collateral; however, in the end these did not come into widespread use, and are not considered as securitisation, given that commodities do not have regular cash flows.

- a) High-quality securities issued in senior tranches are almost (!) completely protected from losses potentially arising from the original loans. The notes issued have at least investment-grade credit ratings, but are predominantly AAA-rated investment vehicles. Accordingly, their default rates and expected losses are low and are identical to the default probabilities and/or expected losses of corporate bonds of similar credit ratings.
- b) Mezzanine tranches have lower credit ratings. Here, the percentage of losses incurred through defaults on the repayment of loans is higher. If losses on loans led to a total loss of principal, holders of mezzanine tranches would also incur a loss. In terms of expected losses and default probabilities, credit rating agencies also rate mezzanine tranches identically to corporate bonds.
- c) The unrated, equity tranche is the first to bear any losses on the underlying loan portfolio. It is therefore frequently retained by the underwriting bank.

The essence of structured finance products is to understand the role of the equity tranche: it plays the same role as the bank's capital, i.e. in a prudent case it has to absorb losses in asset portfolio in its entirety. Traditional logic would suggest that the equity tranche should be at least as large as to provide adequate protection for the other security tranches against loss on the loans: for example, its value should exceed a 99.9% VaR of the loan portfolio. However, the main difference from traditional banking practices is that equity tranches created during the securitisation process do not guarantee a repayment at nominal value, unlike deposits, i.e. if the amount of loss incurred on loans is higher than the principal value, then highly rated securities will also suffer a loss. This spurred underwriters to undertake a higher leverage, i.e. to hold a lower equity than the adequate VaR.

Consequently, should there be any default on the underlying loan, it is the equity tranche that first suffers a loss, followed by the mezzanine and senior tranches. So, compared with traditional banking products, the loss function of structured products is not linear and the probability of so-called tail events is higher, due to the so-called waterfall mechanism presented above.

The transfer of credit risk leaves investors greater freedom to choose, i.e. to select the credit risk, while the risk of the original loan portfolio is shared across more investors willing to undertake higher risks than depositors. So, an essential difference is that in the intermediation process banks spread the credit risk across their depositors, whereas during securitisation risks are distributed among security-holders.

The decisive step in the development of structured finance was re-bundling cash flows already repackaged. With the development of a uniform terminology, these genuine structured securities were called collateralised debt obligations (backed by pools of loans, bonds or ABSs). CDOs are created by repackaging various assets generating cash flows: cash flows on high-yield bonds, investment-grade bonds, high-risk loans or securities created through securitisation – mortgage or other asset-backed bonds – are sliced and repackaged. In the beginning, only homogenous cash flows – either mortgage loans (CMOs) or high-risk corporate bonds (CBOs) – were repackaged; however, CDOs bundling together heterogeneous cash flows or claims for cash flows appeared in the 1980s.

The CDO<sup>23</sup> repackaging structured finance products based on securitised loans was somewhat of a financial miracle: for bond investors exposure to assets ensuring the original cash flow diminished, while the same risk ensured higher returns; aggregate exposure fell, i.e. the financing of assets ensuring the original cash flow became lower, and, meanwhile, the underwriter of the securitisation deal reaped the profits of packaging. To illustrate the credibility of the 'falling risk – rising income' thesis, we show the operations of the 'CDO factory' on a simple example (Table 1). Let a package of BBB-rated residential mortgage-backed securities of 100,000 units, the expected loss of which is 3 per cent, consistent with its credit rating, be the starting point. The total value and expected loss of securities packaged into the CDO will be equal to the parameters of the underlying package.

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<sup>23</sup> In a narrower sense, these were called arbitrage CDOs, but because these products accounted for a dominant share of the CDO market, their characteristic features equally apply to the entire market.

**Table 1****Stylised example of a CDO factory – distribution of expected loss**

Original	Amount	Expected loss		Sliced	Amount	Expected loss	
		Per cent	US dollar			Per cent	US dollar
BBB-rated RMBS	100,000	3	3,000	Senior	70,000	0.3	210
				Mezzanine	20,000	2.8	560
				Equity	10,000		2,230
Total loss			3,000				3,000

From the original BBB quality a ‘70 per cent’ highly rated senior tranche is created: the share of the mezzanine tranche is 20 per cent and the rest is accounted for by the equity tranche. Let the expected loss on the issued securities be 0.3 per cent, which corresponds to a triple-A rating, that of the mezzanine slightly better on average than that on the BBB-rated (with a 2.8 per cent expected loss) and, consequently, a large part of the expected loss on the original cash flow will be borne by the unrated equity tranche. In our example, the leverage is 10:1; however, in reality funds with much higher leverages have been created, i.e. the equity tranche is likely to absorb a much higher share of the expected loss.

Let us assume that the market benchmark rate (LIBOR) is 4 per cent and the risk premium on the BBB-rated pool is equal to its expected loss, i.e. 3 per cent; consequently, the total distributable cash flow of a 100,000 unit starting investment is 7,000 units. In distributing, a higher premium will be ensured for bond investors that the expected loss (and also higher than the risk premium on similarly rated bonds), i.e. the premium is 0.4 per cent for the senior tranche, and a total 4.4 per cent return (2,080 units of annual income); investors in the mezzanine tranche will be ensured a 3.2 per cent premium, i.e. they will realise a 7.2 per cent return (140 units of annual income). It can be seen that in the given interest rate environment an additional nearly 100 basis point bonus income (980 units annually) is generated for participants of the securitisation process, over a high, 15 per cent capital income (which, of course, does not provide a cover for expected loss). This redistribution of incomes – the way in which incoming cash flow on assets underlying the securitisation is repackaged – is also based on the waterfall mechanism (Table 2).

This financial innovation offering ‘higher return at lower risk’ was associated with such strong marketing that investors and analysts accepted it almost unconditionally. For all that, the process could be created synthetically by the use of credit derivatives, such as credit default swaps (CDSs), i.e. the asset underlying the cash flow did not have to be bought, it was enough to repackaged claims for the cash flow at almost zero cash investment and to earn the income.

However, some analysts raised some doubts about CDOs even in their heyday, as did, we believe, the careful reader who followed the above example.

– *The importance of leverage.* The more highly leveraged a fund and the higher the expected loss on assets that it repackages, the higher burden the equity tranche will have to absorb and the less cover a relatively attractive double-digit return will provide for the expected loss on capital (in our example, the risk premium on a 22 per cent expected loss is only 15 per cent). This is a headache for investors, but it should be borne in mind that holders of better-rated tranches are not given a

**Table 2****Stylised example of a CDO factory – distribution of income**

Original	Amount	Premium (per cent)	Income	Sliced	Amount	Premium (per cent)	Income
BBB-rated RMBS	100,000	3	7,000	Senior	70,000	0.4	3,080
				Mezzanine	20,000	3.2	1,440
				Capital income	10,000		1,500
				Fee income			980

guarantee for the nominal value of the bonds they hold – rising loss will not leave them unaffected. For capital investors, this investment appeared very attractive in a seemingly ‘risk-free’ world.

- *The importance of illiquidity.* Often banks pursued the following strategy: if you cannot sell, repackage it and try to sell once more. As a consequence, the CDOs issued were no longer simple products. Assessing the underlying cash flow required serious analytical work, and the facilities (the ‘mixes’) were unique. Consequently, a CDO has a rather complex structure: it cannot be standardised and, consequently, it is an investment with an illiquid secondary market.<sup>24</sup> For a long period, ‘investor illusion’ did not take into account the illiquidity of these securities. Investors ‘became accustomed’ that a AAA-rated investment is at the same time liquid, which contributed to the survival of the ‘false perception’. This was indeed the case with government or corporate bonds, as high quality not only implied low risk, but also low liquidity risk; however, in the case of structured securities good credit rating did not imply low liquidity risk. Nevertheless, bond investors considered their highly rated securities as liquid, and they treated them as quasi deposits, which represented another trap of the ‘investor illusion’.
- *The credit rating trap, or the effect of tail events.* Ratings did not take into account that a CDO is a secondary security, i.e. the expected loss (or probability of default) being the same as in the case of similarly rated bonds is of no use: because of its very design it reacts non-linearly to tail events. Consequently, while the BBB-rated tranche of bonds secured by a mortgage on an ‘ordinary’ residential property (RMBS) will be only slightly damaged in case of a 10 per cent loss on the original loans, the same loss will cause a loss to investment-grade securities in the case of CDOs of RMBSs, as a result of repackaging. In the meantime, numerous analysts have demonstrated the non-linear reaction to tail events (Blundell and Wigmal, 2007; Fender, Tarashev and Zhu, 2008). At the outset of the financial market turbulence, the major credit rating agencies – S&P, Moody’s and Fitch – insisted on the soundness of their methods, then one after the other (Moody’s at the end of 2007, Fitch in early 2008) they recognised that the series of letters expressing default risk on government bonds and structured securities could not be interpreted in the same way. The different meanings confused investors considerably. This phenomenon is known in the literature as rating confusion. The inadequate incentive system (conflicts of interest) also contributed to raters’ inadequate assessments. In the ‘rating competition’, half of the rating agencies’ revenue was related to securitisation activity (Calomiris, 2007). And it was the issuers, rather than the investors, who paid for ratings. All this led to a loss of confidence in rating agencies.

So, the ‘great miracle’ did not occur: no additional income was generated at lower risk – additional income resulted from inadequate assessments of risk. In our opinion, the competitive advantage offered by collateralised debt obligations is clearly offset by the additional disadvantages of the facility. CDOs are highly unlikely to determine the future course of financial innovation.

## 4.2 MAJOR AND MINOR CHARACTERS OF THE SECURITISATION PROCESS

Slicing the original cash flows into tranches and transferring them into cash flows with different characteristics are the task of the parties to the securitisation process. The more segmented, deeper and sophisticated the market, the higher the number of parties involved in the process: as in a giant factory, every participant is responsible for a small phase, but they are able to accomplish their duties with increasing sophistication. But the three basic participants have remained unchanged: the originator selling the cash flow of the underlying asset, the special purpose vehicle dividing and repackaging the cash flow and, finally, the investor purchasing the repackaged cash flow.

Initially (the first securitisation transactions date back to the 1970s), only banks transferred their assets, particularly large retail banks selling their mortgage loan portfolios. The mortgage-backed repackaged cash flows were mainly secured by residential property. Through securitisation, banks were able to increase their profitability, lower their regulatory capital burden (which also involved some regulatory arbitrage), and reduce the overall costs of financing (Nádasdy, 2004). Generally, the loans backing securities were homogenous and of good quality.

<sup>24</sup> Some important investment funds managing CDOs also undertook to issue ‘auction-rate’ securities. For example, between 2003-2006 Merrill Lynch issued large volumes of this sort of securities designated as liquid, which were sold at auctions organised by the issuer – except when there was no liquidity in the market. Due to this practice, in 2007 a number of unfortunate investors brought a lawsuit against Merrill Lynch (Mollenkamp and Ng, 2007).

In the beginning, the dominant investors in the securities market were large institutional players active in the retail market: life insurers and pension funds. These institutions are less exposed to liquidity risk, i.e. they have time to wait until the periods of market turbulence are over. In the early phase of securitisation, loan-backed securities represented safety, liquidity and quality. Market development could not easily erase the image held by investors, while the products created in the development process were increasingly less liquid, became more risky and had no government guarantee. The ‘investor illusion’ arising though traditional securitisation contributed to misunderstanding the new products and, consequently, to the emergence of crisis. With the transformation of the securitisation process, end-investors also changed: the role of life insurers and pension funds was taken over in part by hedge funds and in part by banks themselves.

The major parties to securitisation are the institutional units that ‘slice and dice’ pools of loans, and stand between originators and end-investors. The first SPVs were established by commercial banks. A special purpose vehicle is a legal person, functioning independently from the asset-transferor, as a ‘bankruptcy-remote’ entity and with limited tax liability, set up by the securitising firm to conduct the transaction. In the beginning, these entities functioned as pass-through companies, but today they more closely resemble asset transforming ‘mini-banks’ or ‘shadow banks’. The development of special purpose vehicles – which coincides with the development of ‘tranching and repackaging’ – closely followed the major transformation of the link between underlying cash flows and final cash flows.

From the moment of birth of CDOs, asset transforming special purpose vehicles no longer served to alleviate the burden on bank’s balance sheets and market illiquid assets. Rather, they became real asset transformers, or ‘mini-banks’. These companies were not necessarily set up by commercial banks – the founders increasingly included investment banks, eager to serve investors’ needs, and hedge funds.

Special purpose vehicles built their portfolios so quickly that a separate industry emerged to finance investments from the market: the major participants were so-called conduits, a class of financial intermediaries, financed by highly leveraged tradable securities and mainly established by commercial banks and investment banks, and structured investment vehicles (SIVs). These intermediary and investment entities – similarly to CDOs – exploit the differential between short to medium-term interest rates and yields on structured finance instruments. Their investments are comprised of high-yield, long-term, mainly illiquid, bonds – particularly CDOs, ABSs and a few debt securities of financial corporations. However, they issued tradable short-term (usually with maturities of less than one year) asset-backed commercial paper (ABCP) of very good credit quality, and medium-term notes (MTNs) to finance their investments. So, in exchange for credit risk transfer, conduits and structured investment vehicles undertook a maturity risk, as the average maturity of their assets was four years, while as the average maturity of their liabilities was between 6 months and one year (Fitch, 2007). Mitigating this risk, the sponsoring bank compulsorily provided a credit line and a guarantee for conduits issuing ABCPs, in the interest of mitigating liquidity and credit risks. Later, with the emergence of the crisis, structured investment vehicles necessarily obtained liquidity support from the sponsor, in order to avoid the fire sale of assets held in the balance sheet at depressed prices.<sup>25</sup> The process discussed above is illustrated in Chart 5.

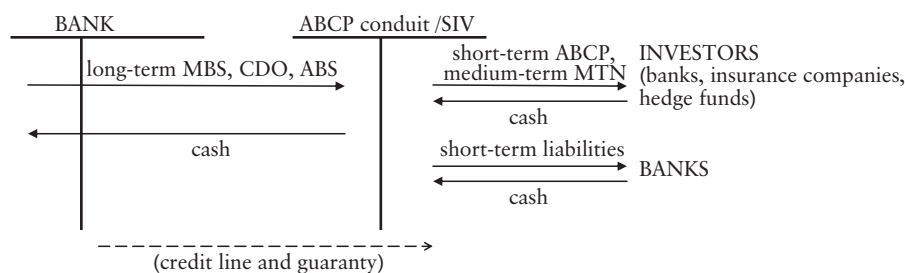
A structured investment vehicle<sup>26</sup> and a conduit issuing marketable securities are funds set up for the purposes of credit arbitrage with a high leverage (generally of 10:1-15:1), whose activities are not directly shown in the sponsoring bank’s books and, consequently, they remain hidden from regulators and the bank’s shareholders. In reality, the short and medium-term securities that they issue are also structured finance products and, moreover, third generation structured securities, as they are secured by second generation CDOs. However, by adding structured investment vehicles and conduits to the process, one of the biggest problems of the ABS and CDO markets appeared to have been solved: the illiquidity of the product. With a sound banking background, structured investment vehicles and conduits issued liquid, marketable assets. The high ratings of assets and implicit ‘guaranty’ of the banks behind the SIVs ensured the good quality of the securities issued. Buyers of ABCPs and MTNs included hedge funds, high net worth individuals (private banking customers) and money market funds which received extra compensation from conduits and structured investment vehicles, due to leverage, maturity gap and high credit risk.

<sup>25</sup> The institutions of special purpose vehicles, conduits and structured investment vehicles are often collectively called shadow banking system, due to their operational characteristics and relationships with banks.

<sup>26</sup> The so-called SIV-lite is a special form of structured investment vehicles, whose leverage may be 40:1, appeared only in 2003-2004; consequently, they did not have enough time to gain a significant market share.

## Chart 5

### Converting a long-term mortgage-backed asset into a short-term liquid asset – issuance of an ABCP through conduit and structured investment vehicle



ABCP: asset-backed commercial paper, ABS: asset-backed security, CDO: collateralised debt obligation, Conduit: a financial intermediary financed by marketable securities, MBS: mortgage-backed security, MTN: medium-term notes, SIV: structured investment vehicle.

With the development of the securitisation process, the three basic parties – the originating bank, the SPV repackaging the diversified pools of assets (together with the related shadow banking system) and the end-investor – were complemented by an increasing number of ‘auxiliary’ players.

Credit enhancement, i.e. reducing the credit risk on the original cash flow, was a fundamental and determinant factor in transforming the original cash flow. The conventional instruments of credit enhancement are guarantees and credit insurance. As discussed in the section on the development of the US market, guarantees provided by the government or government-sponsored enterprises for mortgage-backed securities were an important element of market-building. Credit protection for securities that could not be guaranteed by the government and for non-agency bonds were sold by specialised financial institutions, so-called monoline insurers. These securities were far less safe than those guaranteed by the government, but they were protected to a certain degree.

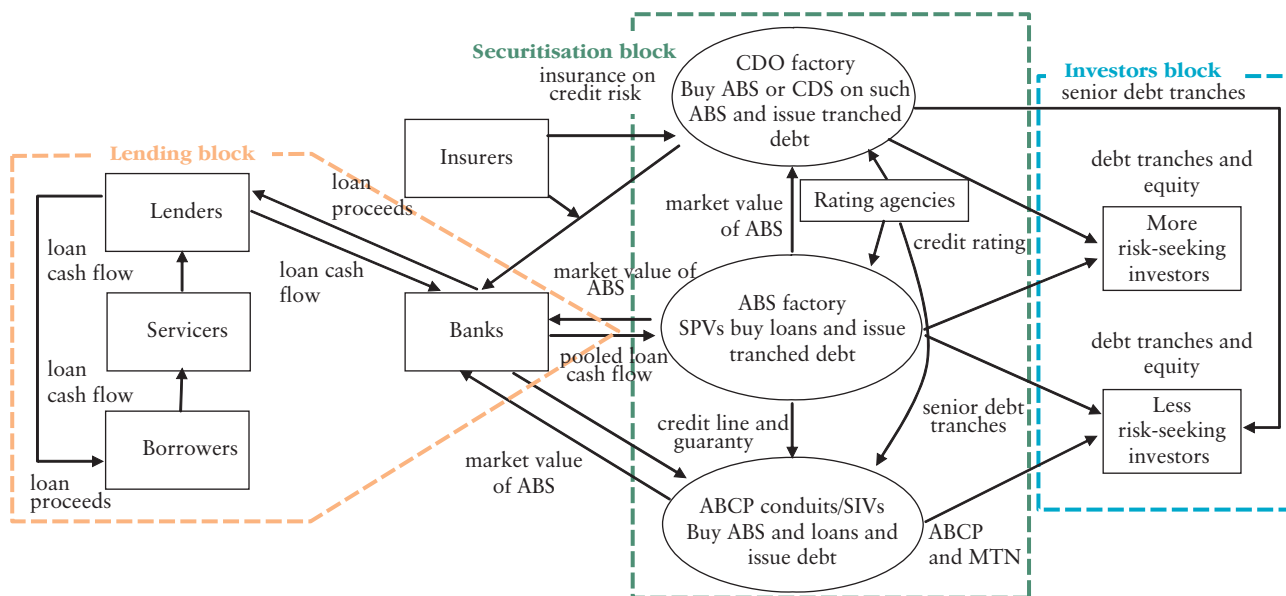
Ensuring the credibility of repackaging according to credit quality required the contribution from another group of market participants: credit rating agencies. Agencies<sup>27</sup> took a similar approach to assessing credit risk as in the case of corporate bonds, which proved to be a serious mistake, according to later analyses (Mason and Rosner, 2007; Fender, Tarashev and Zhu, 2008). In assessing the probability of default on a corporate bond, a firm’s financial performance is measured against an industry-wide set of corporate financial data. Statistical methods serve to help estimate, based on past observations and providing a co-existence of specific data, a lower probability of default for events on a larger scale. In the case of structured products, however, this sort of fundamental approach is not applied. And, considering the case where banks package a pool of sub-prime loans into mortgage-backed securities, rating agencies had to assess the risk parameters of the securities issued based on available statistical information on those loans. For this purpose, they used the historical performance of the original loans – probabilities of default (PD), losses given default (LGD), expected losses (EL) and correlation coefficients. As found in a number of subsequent analyses (Mason and Rosner, 2007), the use of historical default rates was an error, as the PDs of sub-prime loans increased exponentially as portfolios matured. The use of low correlation coefficients, assuming a high degree of diversification, proved to be an even larger error – using a much higher correlation rate would have been the suitable approach to assessing RMBSs packaging pools of sub-prime loans. In this manner, rating agencies made a significant contribution to the pollution of RMBS market of non-agency MBSs and to the strengthening of the ‘investor illusion’.

Finally, let us look at Chart 6, which provides a good summary of the building-blocks of the originate-and-distribute model and its connection with the structured finance market. The lenders’ block in Chart 6 indicates that the bank is not necessarily the lender; often an independent agent assumes the lending role from the bank and then passes its risk and cash flow to the bank immediately. The servicer is another party to the lending transaction, whose task is to collect interest and principal and channel it to the lender. Both the agent and servicer earn fee income. The middle, ‘securitisation’ block includes the participants presented above: conduits and structured investment vehicles sponsored by banks, which issue ABCPs or MTNs; the two major types of special purpose vehicles: ABS firms creating securities from prime loans; and the real asset transformers: CDO firms creating securities backed by ABSs or sub-prime loans. End-investors include the typical risk-averse investors in early securitised products:

<sup>27</sup> The three largest rating agencies played a key role in the securitisation market: Standard and Poor’s, Moody’s and Fitch.

Chart 6

## Interlinking of the originate-and-distribute model and the structured finance business



ABS: asset-backed security, ABCP: asset-backed commercial paper, CDO: collateralised debt obligation, CDS: credit default swap, SIV: structured investment vehicle.

Sources: IMF GFSR (2007) September and own source.

life insurers, pension funds, as well as risk-taking hedge funds and other professional investment funds. The arrows show the direction of cash flows, but the movements of incomes and fees are also easy to imagine.

This game which had grown to involve an extremely high number of players not only resulted in increased market size, but also in a dramatic disturbance in the information flow. Investors in the last block had practically no information about the 'quality' of underlying assets, i.e. the quality of the credit granted in the first block. When, in the first block, the borrower defaulted on the loan and the cash flow stopped, non-payment caused serious disturbances and losses in the third block due to the fire sales led by liquidity problems and deleveraging.

### 4.3 DEVELOPMENT OF STRUCTURED PRODUCT MARKETS

Securitisation of mortgages began in the 1970s, and the various products started to grow rapidly in the 1980s. The structured finance market emerged in the 1990s, together with all of its participants. And, indeed, the brisk growth of the market came about after the turn of the millennium: the period of the great securitisation boom.

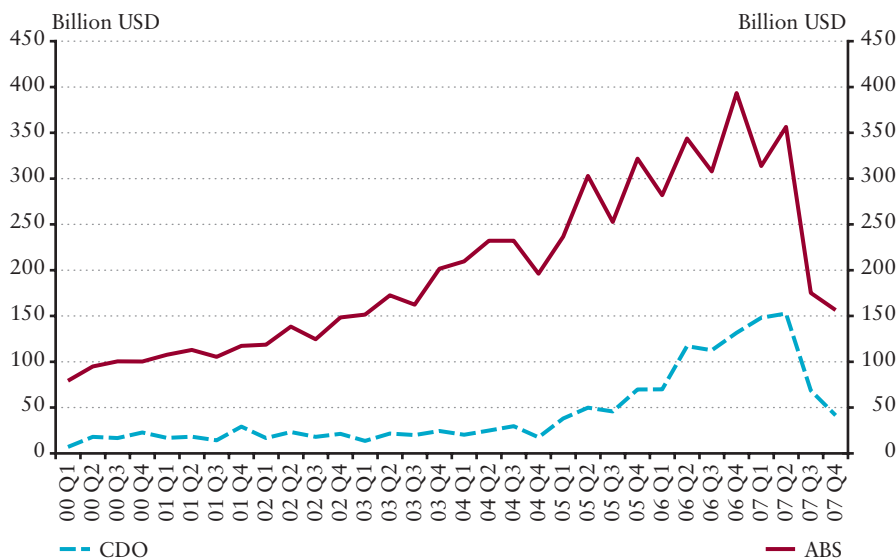
The CDO market grew extremely quickly. The first CDOs were issued in 1987; however, annual issuance did not exceed USD 5 billion until 1996. CDO markets became mature in the period between 1997-2003, when annual issuance reached USD 100 billion. And the quantities of CDOs issued began to soar so sharply from 2004<sup>28</sup> that it clearly created doubts in many analysts: the volume of issuance practically double from one year to the next, with annual issuance peaking at USD 440 billion in 2006 (Chart 7).<sup>29</sup>

<sup>28</sup> It seems that once again 'science became a productive force': Li's article on the valuation of default correlations using copula functions to price CDOs was published in 2000 (Li, 2000). It is thought by many to have given a new impetus to the development of the industry, similarly to the contribution of the Black-Scholes-Merton model of 1973 to the growth of the options market.

<sup>29</sup> Like every fast-growing market, the CDO market also had its own 'star' brokers, who invented new products on end, earning astronomical amounts for themselves and their banks. One of the characteristic figures of the CDO market was Chris Ricciardi, a CDO star of CSFB, later of Merrill Lynch and then of Cohen & Company. It is worthwhile to read the article on Ricciardi (Mollenkamp and Ng, 2004, 2007) to see that it was CDO manufacturers' good sense of the market, rather than their intellectual greatness that raised them to eminence. Ricciardi tells us about CDOs roughly as much as Nick Leeson about the futures market: it is a product that earns you a lot of money, if you have good marketing.

Chart 7

## Quarterly CDO and ABS issuance in the world



Source: Markit ([www.markit.com](http://www.markit.com)).

The market of CDOs is still not a dominant segment of the market of securitised assets, as the volume of agency-guaranteed and private-labelled mortgage bonds of very good credit quality is nearly four times as large and that of ABSs is nearly twice as large (in 2006, total issuance volume exceeded USD 1,300 billion); however, their influence on the market is dominant. As CDOs are long-term products, even the first issues are still in the market; consequently, the outstanding amount of CDOs, measured at asset value, was well in excess of USD 3,000 billion at the end of 2006 (OECD, 2007; SIFMA, 2008b), while ABSs outstanding amounted to only USD 2,300 billion (SIFMA, 2008a). And total market holdings of ABCPs, i.e. corporate debts due within a year, amounted to USD 1,000 billion. US issuers accounted for the lion's share of issuance.

For a long period, the European market of securitised products lagged behind the US market. In Europe, the United Kingdom was the first country to issue a CDO in 1987. The UK was followed by France in 1989, by Sweden and Italy in 1990 and by Spain in 1993. Today, securitisation is commonly used in every Member State of the European Union, except in the new Member States. For example, there is no securitisation law in Hungary.<sup>30</sup>

The European structured product market also began to develop from the turn of the millennium, but remained well below the US market in terms of size. In Europe, residential mortgage securitisations were also the dominant segment of the market (accounting for more than 50 per cent of the total), but with a more modest annual issuance volume of around EUR 250 billion. Total issuance of CDOs exceeded EUR 100 billion for the first time in 2006 (ESF, 2008). Nevertheless, the European market forms an integral part of the US CDO market, as the large European banks, and smaller banks as well, set up a great number of conduits and SIVs off-balance sheet, in order to invest in CDOs due to a decline in other fee-earning activities (Chart 8).

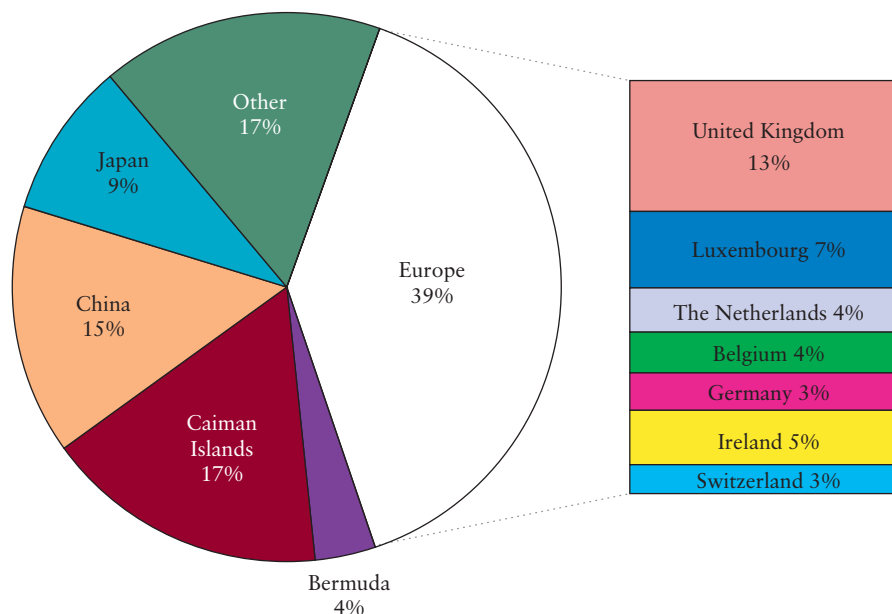
Banks had even more incentive for setting up off-balance sheet conduits to reduce the effects of the impending capital directive,<sup>31</sup> to which the consolidation rules of the new regulations did not apply.

To summarise: securitisation is nothing else than transforming one cash flow into another. Instead of the simple term of repackaging, structuring and the command 'slice and dice' became the key concepts. Special purpose entities, once passing cash flows through themselves, grew into independent asset transformers or 'mini-banks' that were able to detect every risk

<sup>30</sup> Despite several attempts, a securitisation law in Hungary has not yet been adopted. Naturally, the absence of law is not a barrier to investment in securitised products, but the uncertainty surrounding the legal environment hinders market development. A number of problems arise during securitisation that the legal system of a given country must clearly address. This paper does not deal with such issues.

<sup>31</sup> The new capital adequacy directive implements the Basel II framework for determining banks' regulatory capital requirements.



**Chart 8****Country breakdown of foreign holdings of US long-term asset-backed securities on 30 June 2007**

Source: US Treasury 2008, March ([www.ustreas.gov](http://www.ustreas.gov)).

of a cash flow and to issue securities – bonds – of seemingly lower risk than its investments at a lower cost of funds. Bond investors earned higher returns than those on non-structured securities of similar ratings, but they did not realise that this was the countervalue of higher loss related to tail events and increased liquidity risk. Investors absorbing the capital of the highly leveraged company bore a significant portion of additional risks. The volume of collateralised debt obligations grew at an extremely fast pace, which, in turn, led to an increase in leverage in the financial system. Using sub-prime loans first in residential mortgage-backed securities and then, through these, in CDOs foreshadowed non-linearly increasing losses, pricing difficulties arising from an illiquid market and declining leverage.

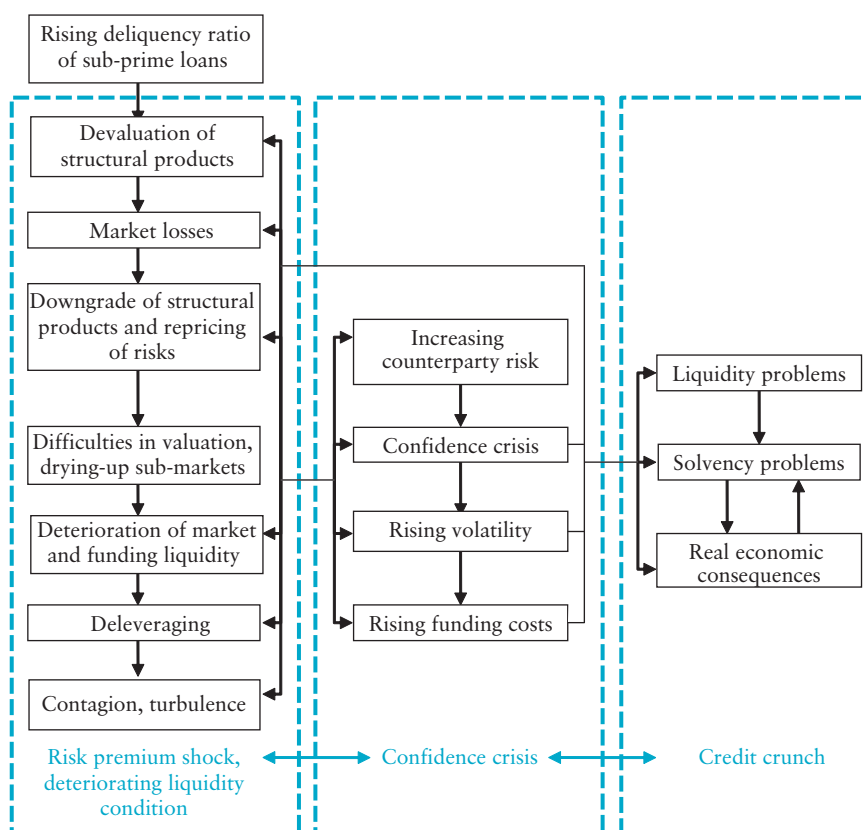
We have shown how securitised sub-prime mortgages led to pollution of the market and malfunctioning of the OAD model. We saw how the securitisation markets developed and how highly leveraged structured financing transactions evolved. Compared with the overall mortgage market, the total volume of sub-prime loans is insignificant. And the existing volume of MBSs backed by sub-prime loans can also be neglected compared to the total securities markets. Preliminary analyses suggesting that there would be difficulties in a certain segment of the market but would not necessarily spill over to the system as a whole, seemed realistic at their time. However, they did not take account of two effects: the self-perpetuating, damaging impact of declining leverage in the wake of the increase in liquidity risk and the confidence crisis arising from the uncertainty surrounding the size and distribution of losses. This proved to be a huge mistake.

## 5 The sub-prime crisis

The sub-prime crisis spread through the financial system quickly. Through the loan loss provisions of the underlying structured products, the increasing default rate of mortgage loans first resulted in a global risk appetite shock, and significantly impaired the liquidity situation of financial markets and financial institutions. The financial turbulence resulted in the evolution of a confidence crisis in developed countries' interbank markets, and financing costs grew markedly. Due to the self-reinforcing chain reaction, financial problems affected an increasing number of markets and institutions. Reacting to the significant deterioration in the operational environment, the banking system tightened its lending conditions and standards, which, in addition to the wealth effect stemming from the decline in housing prices, also had a negative impact on real economy. Moreover, financial market turmoil, coupled with a weakening performance of the real economy, added to the risk of a credit crunch. The main effect mechanisms illustrated in Chart 9 facilitate understanding how the crisis spread. The mechanisms presented here are examined below in detail, step by step.

**Chart 9**

### Spread of the US sub-prime mortgage credit market crisis



Source: MNB.

### 5.1 REPRICING OF RISKS

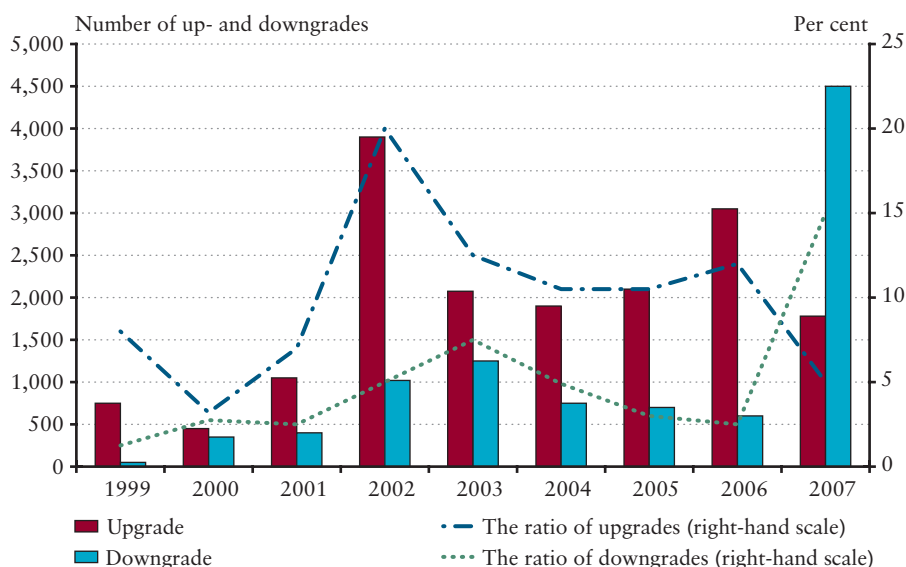
We have seen that, in parallel with a sharp house price deflation, the number of foreclosure filings increased from month to month in 2007. Accordingly, the portfolio of sub-prime mortgage loans started to deteriorate radically. RMBS bonds, which represented a significant segment of the securities market by then, were hard hit by the sharp increase in the non-performance of sub-prime loans, and losses reached the mezzanine bonds quicker than expected. On the other hand, in the case of the CDOs repackaged from the mezzanine series of the RMBS bonds, losses spread over not only to the mezzanine securities, but also to the category of senior securities, as projected in the analysis in the previous chapter.

An increasing number of investment funds reported heavy losses. The first one was the Swiss bank UBS on 4 May 2007, which closed its Dillon Read Capital hedge fund, after the fund suffered a CHF 150 million (USD 123 million) loss in the first quarter on its investments related to sub-prime loans. Almost every day starting from the end of June, various funds reported losses on mortgage-backed security portfolios.<sup>32</sup>

As a result of the suffered and expected losses, rating agencies downgraded structured securities in large numbers from a very high rating level. The first threatening sign was at end-2006 and early 2007, when Moody's and S&P indicated that, considering the deterioration in the sub-prime mortgage loan market, they were downgrading certain securities and lowering the outlook for some of them. The first significant step was taken on 15 June 2007, when Moody's downgraded 266 sub-prime housing loans backed securities, and indicated that further rating downgrades were in the works. Downgrading continued relentlessly. In mid-July, S&P, Moody's and Fitch downgraded a number of CDO, MBS and ABS series of securities with different ratings or included them in the 'negative outlook' category. The downgrading spread to all structured products (SIV, ABCP, etc.), then to risky investments as well. The magnitude of the problem is well indicated by the fact that a total number of 3,529 mortgage-backed securities rated by Fitch were downgraded in 2007 (Fitch, 2008). Ratings declined by two notches on average, but many securities were reclassified from the best category to the worst (Chart 10).

**Chart 10**

**Risk ratings of structured products (ABS, CDO, RMBS, CMBS)**



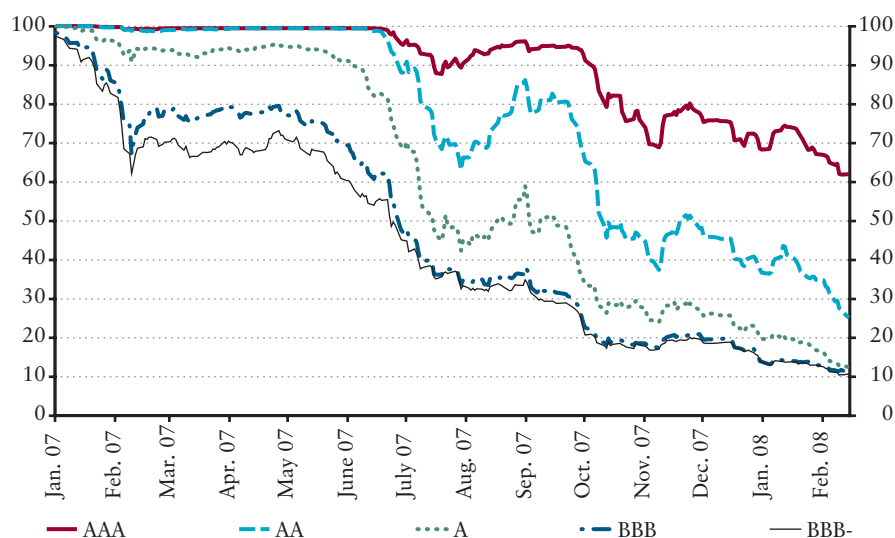
Source: Fitch Ratings (2008).

The uncertainty of the magnitude and distribution of losses suddenly cautioned all investors; issuing and buying had to be postponed several times as early as in this month. As investors stopped buying structured products, loans remained on banks' balance sheets. Banks tried to hedge their loan exposures and reduce the magnitude of their losses by buying loan derivatives (CDS), which resulted in a sharp increase in the premium (i.e. the cost of hedging) of these derivatives, while their price

<sup>32</sup> Looking only at the first month, i.e. July, there were new announcements nearly every day. Braddock Financial closed its USD 300 million Galena fund. The Eidos structured credit fund lost 8 per cent in one single month. Queen's Walk Fund established by Cheyne Capital reported that it had lost EUR 67.7 million (USD 91 million) in one year. Caliber Global Investment, registered in London and led by Cambridge Place, announced that it would sell its assets, and return the capital to its investors, after it had suffered a net loss of USD 8.8 million on its sub-prime investments. Australian Absolute Capital suspended payments to investors at two of its funds due to liquidity problems (it lost 6 per cent of its value in July). Two AXA (French) funds also lost 21 per cent of their value in July, and the parent bank (i.e. AXA) had to provide liquidity for the funds. The USD 11 billion flagship hedge fund of Caxton Associates (German) founded by billionaire Bruce Kovner lost 3 per cent of its value in July. United Capital Asset Management was compelled to suspend payments to investors. On 13 July, General Electric decided to sell its company named WMC Mortgage, which dealt with sub-prime lending. At the end of July, Bear Stearns, one of the largest and longest standing US investment banks, closed two hedge funds because of their sub-prime loss in excess of USD 20 billion. (Finally, at the end of March 2008 it declared bankruptcy, and it was bought up by J.P. Morgan with the assistance of Fed.) The Trio shares offered by Wharton Asset Management (UK) lost more than 20 per cent of their value. Of course, in the meantime there were winners as well: in June, at an annual level, Passport Capital, a fund in San Francisco, achieved a 13.8 per cent return, while the Paulson & Co. Fund achieved a 39.95 per cent return as a result of their speculations vis-à-vis investments related to sub-prime mortgage loans (MNB, 2008).

## Chart 11

## Developments in ABX-HE indices of different ratings, 19 January 2007 = 100



Note: The indices show the changes in the value of CDSs (credit default swaps) related to securities backed by US sub-prime mortgage loans. The chart depicts the ABX.HE 7.1 series.

Source: Reuters.

declined. It is clearly illustrated in Chart 11 that the most drastic fall took place in the prices of CDSs concluded for credit derivatives (BBB and BBB-) exclusively underlying sub-prime loans; the products lost their value almost completely.

Risk appetite waned, as investors moved to reduce their respective risk exposures on all markets. They started to deleverage their balance sheets, which led to fire sales of securities related to the US sub-prime mortgage loan market and also put all riskier instruments under selling pressure. It only added to the difficulties in selling that fair value accounting also leads to forced downgrading when market prices decline or disappear (Boyer, 2008).

All this resulted in an increase in risk premiums, which further boosted demand for low-risk and very liquid instruments, i.e. a 'flight to quality' started. A self-reinforcing negative spiral started up, which led to a deepening of the crisis.

## 5.2 DETERIORATION OF MARKET AND FUNDING LIQUIDITY

In the market of illiquid financial products, even very small shocks are able to start a self-perpetuating cycle which can generate downgrades and fire sales that become stronger and stronger. In addition, the spread of this negative process reaches even those institutions which are market makers, i.e. which are responsible for market operation. This 'liquidity contagion' effect (Cifuentes–Ferucci–Shin, 2005; Brunnermeier–Pedersen, 2007) played a decisive role in the spread of the crisis.

At this juncture in the analysis, it is worth making a distinction between the concepts of market liquidity and funding liquidity, which have already been used in this study several times. When examining market liquidity, we roughly measure if large-volume transactions can be carried out in the given financial market within a short time and without a significant change in market prices (BIS, 1999, 2008; Bank of England, 2008; Páles–Varga, 2008). Usual indicators of market liquidity are the magnitude (tightness) of the bid-ask spread, the minimum order flow (depth) required for a certain change in prices and the speed of the return of prices to their equilibrium level after shocks (resiliency). In the recent literature, mainly as a result of the 1998 LTCM crisis, the view has strengthened that market liquidity is not independent of the funding ability of the market makers (Brunnermeier–Pedersen, 2007). Funding liquidity is determined by the state of financial markets, i.e. money market instruments and the interbank market.

Following the basic rule of markets, after the publication of the first losses in 2007, an increasingly large share of market participants attempted to close their positions as soon as possible and to prevent future losses. Investors followed a similar

investment strategy, and as a result many of them tried to make deals in the same direction simultaneously. As there was practically no trading in ABS and CDO instruments (they were held to maturity), their value was determined on the basis of financial models. As a result of fire sales, these products appeared in the market, but due to the one-sided sales pressure their prices were drastically low, and investors had to revalue their assets at the new, low prices. The pricing confusion (Mishkin, 2007) and the weakening of confidence in credit rating institutions resulted in extreme price movements and increasing bid-ask spreads. The losses suffered on structured products led to difficulties in selling, new issues stalled, and thus benchmark prices slowly disappeared from the market, which meant additional difficulties in selling.<sup>33</sup> The rapid change in the fundamentals of valuation (default rates, correlations) also made model-based valuation uncertain, or even impossible in several cases. Liquidity, which had kept the market of structured products afloat, disappeared. Several elements contributed to the disappearance of liquidity: rating downgrades, the fundamentals required for valuation became uncertain, lack of transparency of products (Bernanke, 2008a).

With the decline in market liquidity, the crisis of the CDO market continued to spread, and reached the investment and hedge funds, the intermediary companies (conduits) financed basically with ABCPs and the structured investment vehicles (SIV). In early August 2007, these institutions, which provide the necessary liquidity for further investments, could only renew short-term liabilities with great difficulty or not at all. An increasing number of so-called ABCP programmes came to a halt; consequently, conduits and SIVs were compelled to draw on the sponsor banks' credit lines. As a result of the liquidity tension, a number of banks preferred to put the conduits and structured investment funds' assets, which had been off the balance sheet, on the balance sheet.

By this time, the market liquidity crisis which had started off from the US CDO market had already crossed borders. The direct CDO, conduit and SIV exposures affected not only US, but European and even Asian funds and banks as well. The possibility of a mass reduction in leveraged positions foreshadowed further deepening of the crisis.

The financial turbulence, which had started with valuation confusions of CDO products, started to develop into a market and then into a funding liquidity crisis:

- losses on CDO products, valuation confusions of CDO products in the market, spreading market illiquidity;
- difficulties in issuing by bank-sponsored funds (conduit, SIV) financing the CDOs – decline in funding liquidity;
- decline in securitisation;
- withdrawal of banks' credit lines, the start of the funding liquidity crisis;
- the reduction of leveraged bank and investment bank positions, the deepening of liquidity troubles, further price reduction of the structured products in the portfolio.

In this manner, another self-perpetuating process of contagion started, jeopardising both market and funding liquidity through the bear market and deleveraging.

### 5.3 CONFIDENCE CRISIS IN THE INTERBANK MARKETS

The developments described above affected the banking system through several channels. In addition to the direct exposure (mortgage loans), banks' investment portfolio also contained mortgage-backed securities, not only the senior part of capital, which keeps its value for a while, but also a mezzanine part, which lost its value rapidly and had almost no value by then. It was also banks that stood behind 'mini-banks' (conduits, SIVs) created for leveraged positions and funding 'the long from the short': partly as owners and partly as sponsors through credit lines. Founding banks generally undertook an important role, but this exposure was below the balance sheet, and did not appear in the books, i.e. the role of the 'mini-bank' with significant

<sup>33</sup> In cases like this, due to lack of trading, prices disappear not only from the less liquid markets, but the market of instruments necessary for model-based pricing (e.g. yield curve) also becomes unforeseeable, and basic product prices required for pricing become 'jelly-like' (Dunbar, 2000). Starting from this, the 1st and 2nd principles of asset pricing 'do not work', there is no mixable arbitrage free price, and there is no model-based pricing either.

illiquid positions behind the bank could not be discovered in the bank's life by regulatory eyes.<sup>34</sup> In addition, banks provided safe funding to several highly-leveraged corporations, such as investment banks and hedge funds. With the decline in market liquidity, those concerned used these credit facilities to an ever increasing extent, thus also adding to banks' future losses.

The first bank losses appeared as early as July: the institution IKB had to be saved by its German partners<sup>35</sup> as a result of the losses on the US sub-prime crisis, the Dutch company NIBC was sold, while the German regional bank, SachsenLB was acquired by one of the largest state-owned German banks, Landesbank Baden-Württemberg. Smaller banks' announcements were soon followed by the reporting of heavy losses by a number of large banks: HSBC, ING, Citibank, Wachovia, Bank of America, Barclays, RBS, Deutsche Bank, UBS, Credit Suisse, BNP, and Calyon as well as the large investment banks, Morgan Stanley, Merrill Lynch, Bear Stearns, JP Morgan and others reported increasing losses from month to month.

Due to the multi-faceted risk of exposure it was not possible to precisely assess the magnitude of banks' direct or indirect 'sub-prime exposures'. Therefore, in parallel with the first announcements of bank losses, confidence in the banking system gradually declined, although this confidence is a key element of funding liquidity (Warsh, 2007).

One of the most surprising features of the sub-prime crisis, which was different from any previous turbulences, was that the signs of crisis proliferating in the various market segments and discussed above came to a head on 9 August 2007 in an interbank market crisis, which also determined the further development of the turbulence. A distinguishing feature of the financial turbulence stemming from the sub-prime mortgage market crisis was that it was not a long queue of depositors that tried to receive their money (except for the Northern Rock episode<sup>36</sup>), but 'those who withdrew their deposits were replaced by interbank markets' participants' (Vives, 2008). As noted by Bagehot, in his classic work on financial systems as early as in 1873, 'the basis of financial markets is confidence' (Bagehot, 1873). Underlying the problem was the co-ordination crisis based on asymmetrical information: the basis of the operation of the interbank market is the same confidence which is the basis of the relationship between the depositor and the bank. The moment that this confidence becomes shaken, the continuity which provides for the operation of the system disappears.

On 9 August 2007, overnight rates, which indicate the smooth functioning of markets, soared to such heights in the US dollar markets and in the euro interbank markets which jeopardised normal operation, and triggered immediate intervention by the Fed and the ECB.<sup>37</sup> On the one hand, in the course of their operations performed with the set of monetary policy instruments, central banks temporarily increased the amount of central bank money available for the banking sector, and on the other hand, they expanded the range of collateral<sup>38</sup> (changing their own balance sheet structure) and of the institutions participating in central bank lending, as well as extended the term of credit operations (Fischer-Kóczán, 2008). The global character of the interbank turbulence is indicated by the fact that during crisis management central banks had to solve liquidity problems which arose not only in the currency of the given country, but also liquidity shortage in other currencies.<sup>39</sup>

In the interbank market, the significance and the protracted nature of the turbulence are well illustrated by the developments in the so-called TED spreads, i.e. the yield differential between three-month interbank rates and 90-day Treasury bills (Chart 12). It can be seen that the August interventions only brought temporary success, as uncertainty remained. Moreover, the

<sup>34</sup> Banks first tried to sort out the liquidity problems using their own resources: in October 2007, the idea of creating a 'super liquidity fund' came up (Citibank, JP Morgan and BankAmerica were the initiators), but finally, due to lack of adequate partners (i.e. investors) the idea of the MLEC (Master Liquidity Enhancement Conduit) died on 21 December.

<sup>35</sup> KfW extended a loan of EUR 8.1 billion, and a group of private and state-owned banks led by KfW provided assistance in the amount of EUR 3.5 billion to cover portfolio losses. IKB's shares fell by 18 per cent, and the CEO resigned.

<sup>36</sup> Northern Rock, considered to be the 8th largest credit institution in the United Kingdom, created a specific financial model: it funded its extremely rapid mortgage loan portfolio, which exceeded 100 per cent at an annual level, to a significant extent from the market, through securitisation. In August 2007 Northern Rock indicated that it would have funding problems, the market of its securities had tightened as a result of the turbulence. In early September 2007, increasingly bad news about Northern Rock circulated in the market. Finally, on 14 September, investors' and depositors' nervousness triggered a bank panic not seen in the United Kingdom since 1866. There was a run on the bank by the depositors of Northern Rock (whose number was small compared to a large retail bank), and until 17 September, when the UK Treasury announced the full insurance of the deposits, depositors who exchanged their deposits for money were standing in long queues outside the Northern Rock branches (Weale, 2007; Buiter, 2008; HCTC, 2008). The technical factor that the website of Northern Rock 'crashed' also added to this situation.

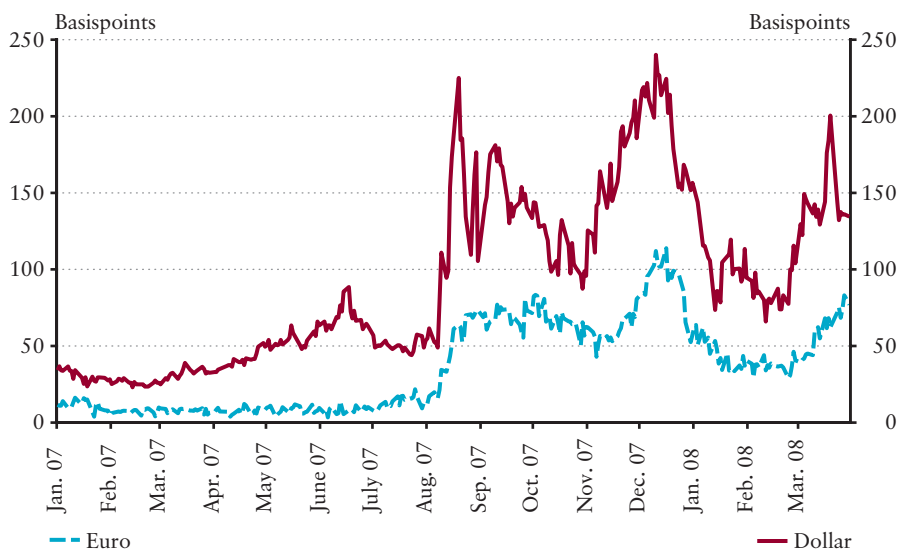
<sup>37</sup> Short-term liquidity problems in the dollar market quickly appear in the euro market as well, since a significant part of the balance sheet items of euro area large banks is dollar-denominated.

<sup>38</sup> Due to yield hunting, banks have reduced their government securities portfolio in recent years, thus in case of borrowing, the range of low-risk collateral has narrowed.

<sup>39</sup> A good example for this is the agreement concluded at end-December 2007 between the ECB, the Fed and the Swiss central bank about the mutual opening of swap credit lines.

Chart 12

## Difference between three-month interbank rates and yields on three-month Treasury bills (TED spread)



Source: Reuters.

turmoil repeated itself in November 2007 and in March 2008. The main underlying reason for the failure may have been that central banks' monetary policy instruments mainly target monetary stability and only aim at financial stability to a lesser extent. However, the 'failure' is partly also attributable to the fact that while the August and November turmoil were mainly the results of a growing liquidity risks, in the last instance credit risks also played a significant role.

## 5.4 RISK OF A CREDIT CRUNCH

A fall in asset prices through the deleveraging process, an increase in financing costs and the risk aversion due to high reported losses as well as the 'financial accelerator' mechanism over a longer period of time (Bernanke–Gertler–Gilchrist, 1996) may lead to a credit crunch in extreme cases. Credit crunch means the risk that, as a consequence of a significant decline in their willingness to take risks, banks considerably restrain their lending activity, and despite increasing prices they do not lend, i.e. the loan supply curve becomes vertical. Abnormally weak credit supply may lead to an economic recession. The market turbulence evolving due to the US mortgage loan market crisis may result in a shortage of loans mainly in those countries with developed financial markets, where capital markets play an important role in financial intermediation.

Due to the drying-up of structured products' market as well as the more difficult founding of conduits and structured investment funds, banks' liquidity was in danger. On the other hand, the transfer of structured products and off-balance-sheet enterprises (conduits, SIVs) onto the balance sheets resulted in significant write-offs, threatening banks' solvency situations.

A decline in leverage, however, can significantly contribute to the risk of a credit crunch (Adrian–Shin, 2008; Greenlaw et al., 2008). As opposed to commercial banks, investment banks actively manage their leverage (Adrian–Shin, 2008). Therefore, before the start of the turbulence, due to increasing asset prices in the portfolios, balance sheets strengthened, which encouraged investment banks to increase their leverage and thus to buy more assets (leveraging). The chain reaction turned round following the outbreak of the sub-prime crisis, when asset prices started to decline, which narrowed banks' balance sheets. Further sales of assets – often at a loss ('fire sales') – were required to pay back the debts, which reduced the leverage (deleveraging). Funding the build-up of the leveraged position mainly with short-term repo transactions carried a significant risk for investment banks. During the deleveraging process many money market funds left the market.<sup>40</sup> This contributed considerably to the liquidity crisis at Bear Stearns in March and the forced capital increase at Lehman Brothers in early June.

<sup>40</sup> Repo is a hedging transaction in which a money market fund provides liquidity to a bank in exchange for securities (mainly highly rated government securities, and structured products to a lesser extent). As money market funds did not want long government bonds or bad-quality securities in their books in the event of default, they did not provide repo to riskier institutions.

However, in addition to the unfavourable liquidity situation, the deterioration in the capital position is also an important factor for investment banks. The widespread market turbulence may have a negative effect on profitability and the capital situation mainly in the case of investment banks and complex banking groups which have a strong investment banking divisions. Besides securitisation, a channel of this kind can be constituted by the decline in leveraged buyouts (LBO) and corporate bond issues rated as speculative, the significant deterioration in trading profit or possible loan losses related to ‘collapsing’ hedge funds (i.e. ones which are becoming insolvent).

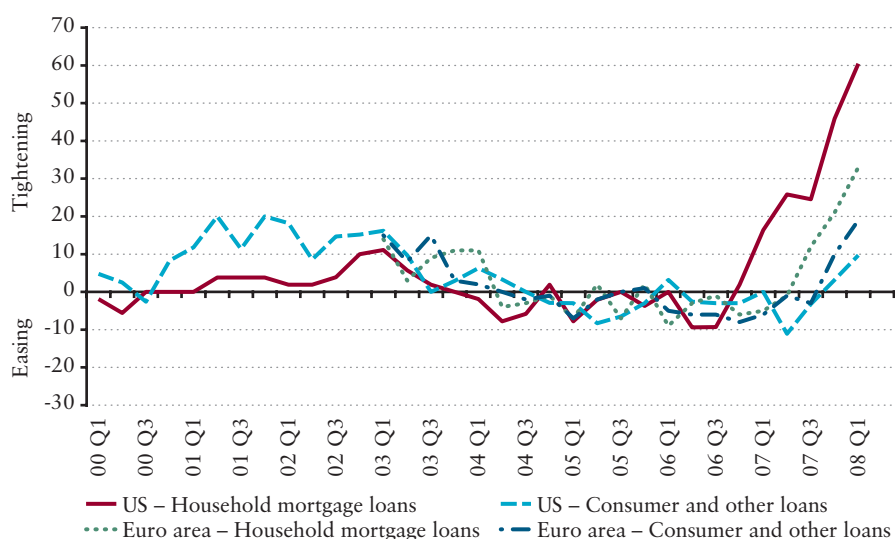
Commercial banks manage their leverage to a lesser extent, although they are also affected by the process of mutual strengthening of liquidity, market and credit risks. Due the weakening securitisation, deceleration in lending may continue. Loans remaining on the balance sheet – in addition to returning structured products into the balance sheet – may put banks’ capital adequacy under further pressure. In the future, due to the increase in risk premiums and deterioration in the liquidity situation, a permanent, substantial increase in financing costs may also result in a tightening of lending. Banks may react to the growing funding costs by tightening their lending conditions or transferring the costs into the lending rates and pricing increasing risk premium. In extreme cases, obtaining funds may become so difficult that banks cannot provide new loans (or only do so with such high lending rates that there is no credit demand), while the funding of existing loans is also jeopardised.

Due to all these factors, several US and some European large banks’ profitability declined significantly, and due to the narrowing of market opportunities, they were compelled to obtain additional capital mainly from large sovereign wealth funds (SWF).<sup>41</sup> The deterioration in the solvency situation of large US and European banks is a significant risk factor in terms of the developments in loan markets (Bernanke, 2008b).

As a result of the sub-prime mortgage credit crisis, it can already be observed in developed markets that banks have significantly tightened the non-price factors of lending. The most significant tightening took place in the US mortgage loan market (Chart 13).

All this may speed up the financial accelerator mechanism, i.e. the slowdown in economy will be followed by a tightening of banks’ lending conditions and an increase in lending rates, which will result in an acceleration of the economic downturn. In extreme cases, the financial accelerator mechanism may be so strong, i.e. lending may slow down to such an extent that it can

**Chart 13**  
**Lending conditions in the United States and in the euro area**



Sources: Fed, ECB Senior Loan Officer Survey.

<sup>41</sup> Primarily through the investments by major sovereign wealth funds. Separate literature examines the role of SWFs in the current crisis.



cause economic recession by itself. As the process is slow, i.e. the result of the interaction between the financial system and macroeconomy becomes visible only over the longer term,<sup>42</sup> it will be possible to assess the complete real economy effect of the sub-prime crisis only after a sufficient period of time has passed.

## 5.5 SPREADING, MAGNITUDE AND DISTRIBUTION OF LOSSES

The sub-prime credit crisis spread along several dimensions: it infected other loan markets, stock markets, foreign exchange markets and numerous other financial markets, as well as affecting various financial institutions and market players and passing through into remote regions and countries.

The mortgage credit crisis also passed through to the market of other US household loan products: starting from the summer of 2007, losses on the credit card market and on unsecured loans grew steadily. The turbulence slowly reached the corporate loan market as well, although for the time being the default rate here remained below the year 2001 peak. While the corporate loan market was relatively less affected, the risk premiums of lower credit rating (speculative grade) corporate bonds soared, and the increase in the risk premium affected, to a smaller extent, higher-rated corporate loans as well. In addition to the increase in risk premiums, loan market turmoil was also indicated by the postponement of leveraged buyouts (LBOs are financed from credit and carried out by private equity funds) and the planned corporate bond issues.<sup>43</sup>

After the banks and investment funds, the US credit insurance companies (Ambac, MBIA, etc.) were also affected by the financial turbulence by the end of the year. In recent years, credit insurance companies, which were originally founded for insuring local government bonds, extended their activity to the insurance of the issue of asset-backed securities and structured loan products. Credit insurance allowed lower-rated issuers to issue securities at lower interest rates which correspond to the high (usually AAA) rating of the credit insurance company. However, as the default rate increased credit insurance companies were threatened by mounting payment obligations and a related downgrading. In early 2008, smaller, then larger and larger credit insurance companies found themselves in increasingly risky categories, and finally the downgrading wave reached the largest companies as well.<sup>44</sup> The downgrading of the credit insurance companies brought down the ratings of all securities insured by them, causing a feed-through of losses to the owners of these securities. Avoiding further losses, the owners, most of which are investment banks, bolstered the financial strength of the insurance companies.

Fears of contagion of the loan market problems and the expected slowdown in mergers and acquisitions led to a significant deterioration in sentiment on the stock markets. The main industry, which suffered, was the financial sector in developed markets.

In parallel with the increase in risk premiums, the side effect of the crisis was felt to a certain extent in all investment markets which were deemed risky. Moreover, in March 2008 a minor shock reached even the European (Italian, Greek, French, Hungarian and Polish) government bond markets.

Finally, it is important to mention that global investments, the direction of which altered due to changing risk appetite and as a result of the monetary responses to the crisis, had a significant impact on foreign exchange markets as well: besides the depreciation of the currencies of certain vulnerable emerging countries (see details in the next chapter), it was mainly the historic depreciation of the US dollar which may significantly influence the future evaluation of the crisis.

Taking this effect into account, several institutions have tried to estimate the expected total losses of the sub-prime crisis. As a significant part of the losses has not been disclosed yet, estimates are still surrounded by a high degree of uncertainty. First, in the sub-prime mortgage loan market, further substantial losses can be projected, due to the anticipated increase in the instalments until end-2009. Second, the drying-up of the asset-backed commercial paper market (ABCP) significantly influences the future liquidity situation and potential losses of the sponsoring (founding and refinancing) banks. Third, the

<sup>42</sup> In May 2008, Ben Bernanke also warned that banks have to strengthen their capital position and reshape their balance sheets, otherwise one will have to face a protracted credit slowdown, which may entail extremely harmful macroeconomic effects (Bernanke, 2008b).

<sup>43</sup> Only in June and July, new issues in the magnitude of several billion dollars were withdrawn by companies like Foodservice, the US subsidiary of Ahold, the Canadian CanWest Media, Magnum Coal, the British Thomson Learning, the company British Carphoe Warehouse, the German steel manufacturer Arcelor, the Malaysian MISC, the South Korean KIA Motors, the British Virgin, etc.

<sup>44</sup> In January and May 2008, Fitch downgraded Ambac and MBIA credit insurance companies, respectively.

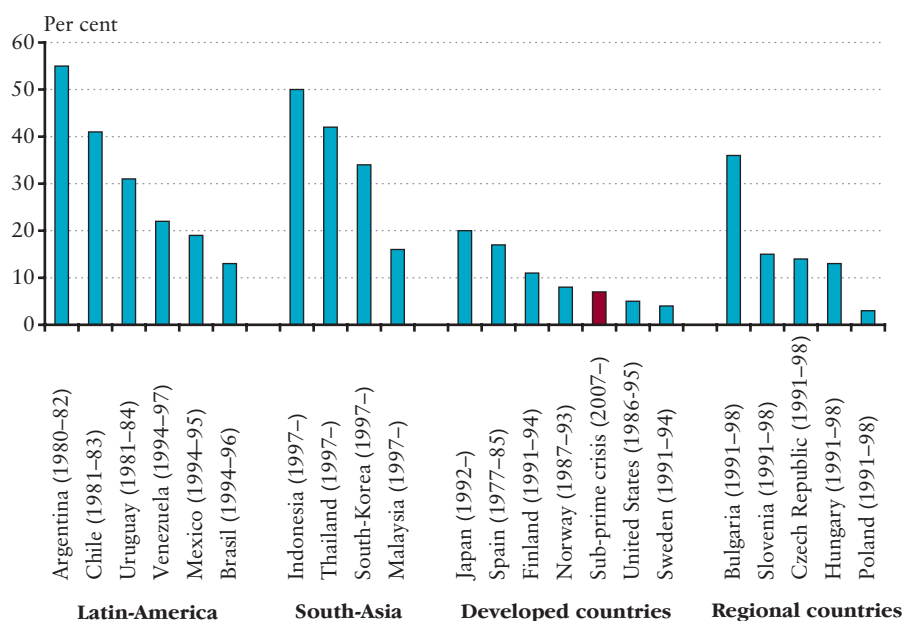
increasing market role of the less regulated financial institutions (hedge funds, private equity funds) and financial innovations [credit risk transfer (CRT) products] makes financial markets less transparent, and renders the pricing of risks and consequently the assessment of the distribution of direct and indirect loan market exposures and losses related to sub-prime loans within the financial system more difficult.

One good indicator of losses may be found in the change in the equity prices of financial institutions. According to the OECD (2008), the total capitalisation of the financial system has declined by approximately USD 700 billion since the middle of last year. According to another approach, using stress tests – determining the expected default rate of mortgage loans and deriving from that the loss in the value of structured products – the OECD and the Bank of England estimate the total expected loss of the financial system to be between USD 300-500 billion. Finally, based on the current mark-to-market prices, the IMF reports an expected loss of USD 1,000 billion.<sup>45</sup> When our study was being prepared, in the opinion of the aforementioned institutions about half of this amount had already disclosed, while the other half may be reported in the near future.<sup>46</sup> The two types of analyses may represent the possible minimum and maximum level of expected losses. While the approach calculated on the expected defaults on the mortgage loans assumes that investors hold the asset-backed securities until maturity, losses valued at market prices are calculated assuming the immediate sale of the securities.

Taking into account the most extreme approach, the expected total financial loss of a nominal USD 900-1,000 billion renders the 2007 crisis one of the most extraordinary events in crisis history. As a proportion of GDP, the cost of the sub-prime crisis is nearly 7 per cent (IMF GFSR, 2008). However, according to our current knowledge, it lags well behind the consolidation costs of past crises of developed markets (Chart 14).

**Chart 14**

**Losses of financial crises as a proportion of GDP**



Sources: Honohan-Klingebiel (2003), Hoggarth-Reis-Saporta (2001), IMF.

Note: Methodological differences allow only a limited comparison of the costs of crises.

<sup>45</sup> As a point of interest, it should be noted that before the crisis, on 20 July, Ben Bernanke stated that the costs of the sub-prime mortgage market problems might reach as much as USD 100 billion. As it can be seen, current calculations estimate the expected costs to be ten times higher.

<sup>46</sup> When estimating the losses, further uncertainty is engendered by the question, whether only the losses realised directly in the financial system or real economy costs appearing over the longer term also have to be taken into account.

## 6 Outside the epicentre

Based on traditional theories, contagion is basically of geographical character, and non-epicentre countries can primarily be affected by a crisis through foreign trade relations. In addition to crisis theories based on fundamental, economic relations, increasing emphasis is also devoted to theories which place more emphasis on money and capital market relations as the determining channels of contagion. The literature analyses several possible channels of contagion highlighting the spillover effects, the importance of portfolio decision and the close ‘interlinking’ of markets (Kaminsky–Reinhardt–Végh, 2003; Schinasi–Smith, 2004). However, regarding the strength, underlying reason and exact effect of the contagion spreading through global financial market channels there is still no common understanding. Some opinions suggest that the crises were triggered and their fast spread was caused by the rapid capital market liberalisation forced onto the developing countries, while in others’ opinion it was exactly the liberalised markets where crises were less devastating, and recovery was also quicker.<sup>47</sup>

The analysis of contagions not building directly on economic trade relations has especially strengthened since the Russian crisis, as then the starting event – the Russian state suspending payments on its bonds – resulted in much more serious consequences at (seemingly) very remote markets than the Mexican and Asian crises in 1994-1995 and 1997, respectively. On the one hand, the crisis had a strong effect on the economies of countries (namely Hong Kong, Brazil and Mexico), which did not have a close relationship with the Russian economy, and on the other hand, it strongly infected the markets of high-risk products in developed countries as well. Following the outbreak of the Russian crisis, risks were repriced at the global level, all risky investments depreciated, risk premiums soared, and investors turned to lower-risk products (‘flight to quality’ or ‘save havens’). This was the crisis which – mainly through the LTCM episode – called attention to the danger that highly-leveraged financing may result in contagion, as the shortage of market liquidity caused financing problems similar to the 2007 crisis, and highly-leveraged funds simultaneously left geographical regions which seemingly did not have any relationship with one another.

In this sense, the 2007 crisis is most similar to the Russian one, with one significant difference: it was not the developing, but the developed money markets which were the epicentre of the crisis. Consequently, the recent crisis has been more widespread. As presented in the previous chapter, the market of structured products, the interbank market and, through deleveraging, the liquidity channel played a decisive role in contagion in the developed financial markets.

The typical peripheral countries affected by the 2007 crisis were not directly exposed or only to an insignificant extent to the damaged security markets. Nevertheless, due to the strong integration of financial markets, the countries in the periphery were reached by the ‘cross-winds’ of the crisis. As a result of the ‘flight to quality’, i.e. reconsidered portfolio decisions, risk premiums increased sharply in regions and markets which were deemed to be vulnerable. On the one hand, this added to the volatility of the financial markets of the given region/country, increasing on the other hand the financing cost of portfolio investments. The financing structures which had evolved, the dependence of the periphery on financing from the centre and the reduction of leverages led to a deterioration in both market and funding liquidity conditions. All in all, the revaluation of risks and the related decline in liquidity played the key role in the contagion of peripheral countries.<sup>48</sup>

Below, we examine the financial contagion in Hungary, what role the developments in risk premiums and especially the banking sector’s financing problems played in the Hungarian effect mechanism of the sub-prime crisis, and what the chances of a credit crunch in Hungary are.

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<sup>47</sup> The two best-known economists to the debate are: Joseph E. Stiglitz, Nobel Prize winner and former Vice President of the World Bank, today one of the best-known critics of the absurdities of globalisation, on the one side, and Stanley Fisher, (not yet, but potential Nobel Prize winner) former First Deputy Managing Director of the IMF, who trusts in the stabilising power of global financial markets and their effect facilitating catching up, on the other side.

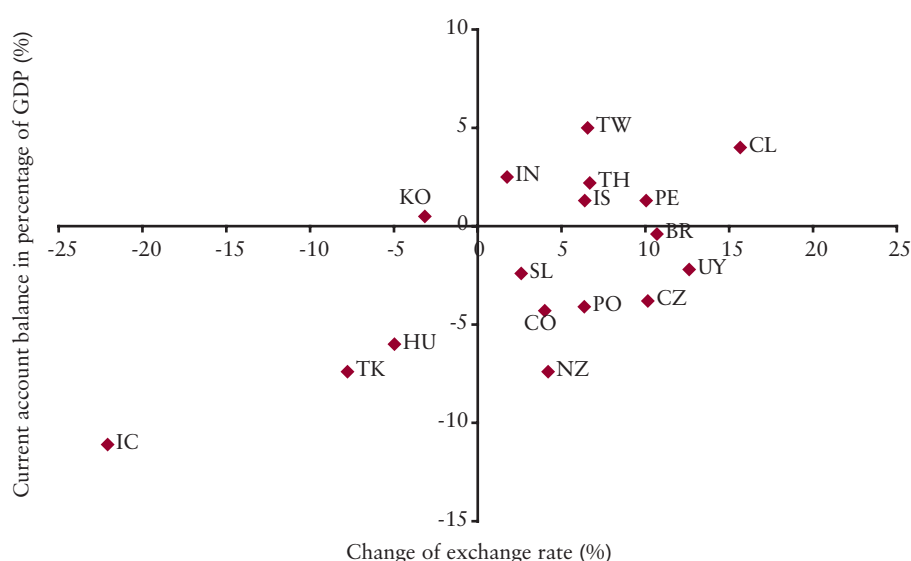
<sup>48</sup> This type of contagion from the epicentre towards the periphery is well characterised by the mechanism described in the study by Kaminsky-Reinhardt-Végh [2003]. However, these three authors expressly talk about the ‘Holy Trinity’, as they call the ‘shocking strength of news’ the third channel. If we think of the damages caused by the sub-prime crisis to the Icelandic market, for example, we tend to acknowledge the strength of this third channel.

## 6.1 'FLIGHT TO QUALITY' – SHARP RISE IN RISK PREMIUMS

For countries integrated into the international financial system, exposure to external financial contagions depends greatly on the specific country's fundamentals or, more exactly, on investors' risk assessment. Of course, this assessment is subjective and changing, and is able to drift away from reality especially in the event of market panics. This can explain the paradoxical phenomenon that, although the sub-prime mortgage loan market affected the US economy the most, investors still considered US government securities as the safest investment, withdrawing their investments from regions and countries deemed volatile, where this resulted in a sharp increase in risk premiums. Investors' assessment of the 'volatility' of a country or region, even if not always precisely and with certain delays, moves together with the developments in the economic fundamentals of the given country (Chart 15). Of them, the external financing requirement of a country, i.e. the absolute size of the balance of payments or its size relative to growth is considered to be decisive according to the 'rule of thumb' of investors.

**Chart 15**

### Current account balance and developments in exchange rates, 2007



Note: The exchange rate is compared to the determining foreign trade currency (euro or dollar).

Brazil (BR), Chile (CL), Colombia (CO), Czech Republic (CZ), South Korea (KO), Indonesia (IN), Iceland (IC), Israel (IS), Poland (PO), Hungary (HU), Peru (PE), Slovakia (SL), Taiwan (TW), Thailand (TH), Turkey (TK), New Zealand (NZ), Uruguay (UY).

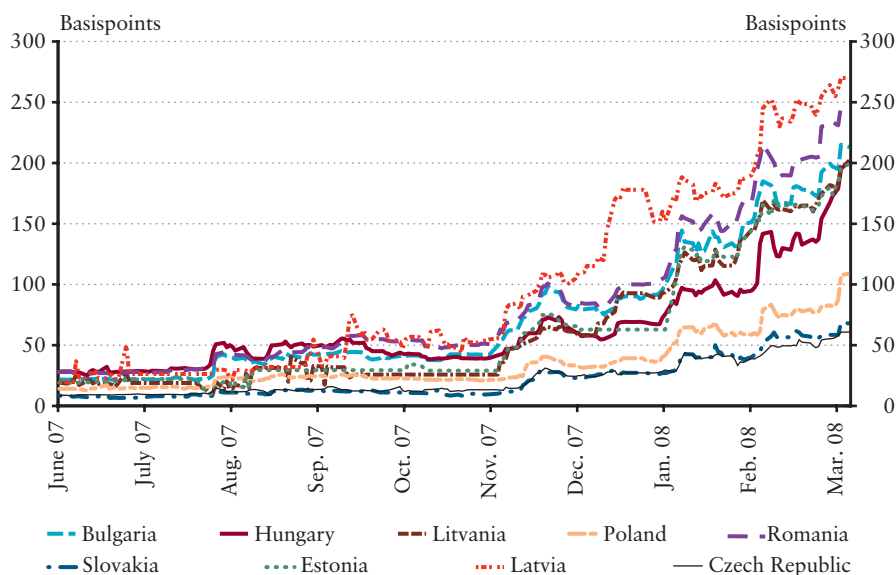
Source: EIU, Thomson Financial Datastream.

Due to the high fiscal deficit, low growth, the high current account deficit and increasing external debt, the assessment formed of Hungary was unfavourable in mid-2007. In this market atmosphere, it did not even matter that most of the important indicators had already shown improvements in terms of their dynamics, and that, as opposed to many countries, the increase in household mortgage loans, which suddenly received special attention, did not entail a rapid increase in real estate prices in Hungary (i.e. no real estate price bubble had developed). Markets ignored the positive news in the same way as they had not 'punished' the deterioration in Hungary's macroeconomic indicators amongst improving international risk appetite in previous years.

The increase in risk premiums can appear in individual assets to various extents, and the distribution of an external shock partly depends on the monetary policy regime of the given country as well. In countries which apply free floating, it is usually the depreciation of the exchange rate which absorbs the greater part of the increase in the premium, while in currency band exchange rate regimes there is higher pressure on the interest rate (and/or on foreign exchange reserves). In the case of a currency board, the exchange and the domestic interest rate level are given, thus an increase in the premium cannot appear in them. This explains the development that while the forint temporarily depreciated and domestic yields increased, assets in Baltic countries showing the signs of an overheated real estate and mortgage market did not depreciate. With regard to the latter, the increase in the premium appeared in the growth of the costs of external sources (CDS – credit default swap), which was higher than in Hungary (Chart 16).

## Chart 16

## Developments in selected countries' five-year CDS spreads



Source: Thomson Financial Datastream.

The significant increase in the risk premium of forint assets reflected the fact that investors considered Hungary to be a risky country. This was also illustrated by the fact that the price of forint assets moved together more so with the assets of more remote emerging market countries than with those of vulnerable countries in the region. One feature of the current crisis is that, besides the increase in the premium, there were liquidity problems and extreme price fluctuations in the government securities market, which affected the interest rate swap market as well.<sup>49</sup>

## 6.2 DETERIORATING FINANCING CONDITIONS

Banks in Hungary do not have foreign mortgage-backed or structured securities, and according to the securities statistics, a negligible amount of such securities can be found mainly in the portfolio of investment funds. It is also important to emphasise that, based on the information available, the majority of the parent banks of domestic large banks also have only marginal exposures which can directly be brought in connection with the sub-prime mortgage markets. A few parent banks suffered considerable losses during the market turbulence, but this has not affected the operation of their Hungarian subsidiaries so far. Direct withdrawal of funds or liquidity 'sudden stop', i.e. an unexpected drying-up of financing, was not experienced at any bank. Accordingly, funding liquidity has not dried up, although the conditions of obtaining funds have clearly deteriorated.

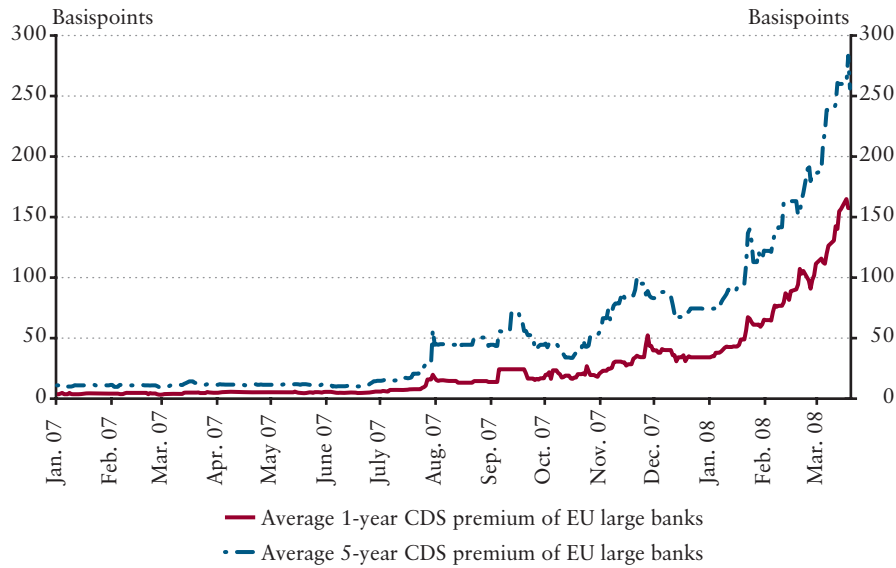
In terms of the developments in the financing situation, the events in domestic and foreign interbank markets must be separated. Theoretically, a possible confidence problem between parent banks may also spread to the subsidiaries' interbank market. But the turnover of the forint FX swap market, which is of key importance from the aspect of the interbank market of unhedged forint and the forint liquidity of foreign participants, was as usual in the year following the crisis, until the cut-off date of our study. There was no material reaction in overnight forint yields to the news from abroad, and nor was any extraordinary central bank credit extended. So far, the deterioration in the liquidity conditions in the domestic financial system has mainly been attributable to the general tightening in European liquidity. Domestic banks were affected by the increase in liquidity risks through the pricing and shortening of foreign interbank and capital market funding.

Short-term euro area interbank rates and European banks' CDS spreads, the values of which are higher than at the end of last summer, suggest that an increase in funding costs should be expected. In the spring of 2008, the 3-month TED spread

<sup>49</sup> Several factors jointly contributed to the turmoil observed in the government securities market in February and March 2008. However, their analysis is beyond the scope of this study. See MNB: Report on Financial Stability, April 2008.

**Chart 17**

**Developments in short- and long-term risk premiums**



Source: Thomson Financial Datastream.

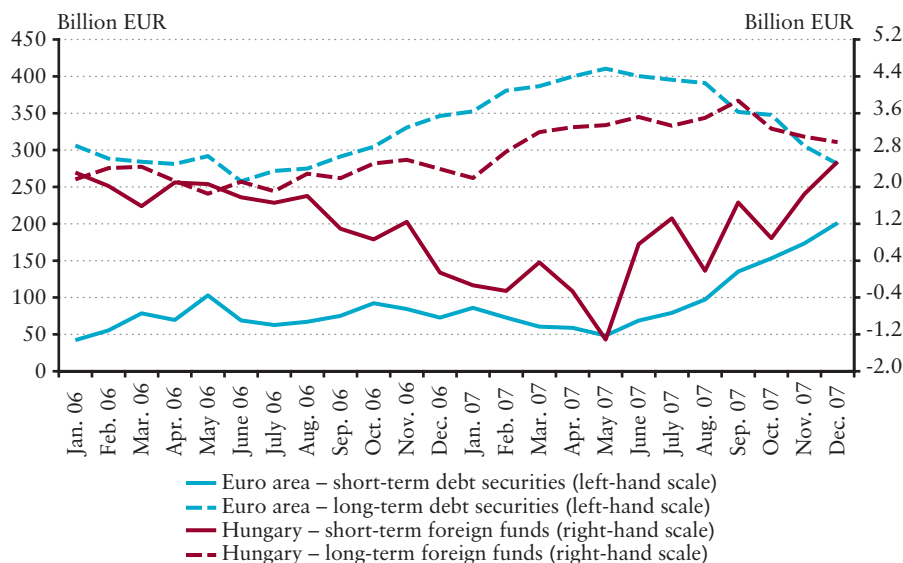
(difference between 3-month interbank and 3-month discount Treasury bill interest rates), which was already analysed in the previous chapter, exceeded the August 2007 level by 60-100 basis points. ‘Pulling back’ the spread, which jumps up from time to time, was mainly the result of central banks’ interventions which dampened uncertainty temporary.

Meanwhile, the CDS spreads, which are used for the approximation of the prices of long-term funding, showed a very significant increase. The 150-200 basis point increase in CDS spreads observable since July 2007 is attributable to the increase in credit risks on the one hand and to weaker trust in ratings on the other hand (Chart 17).

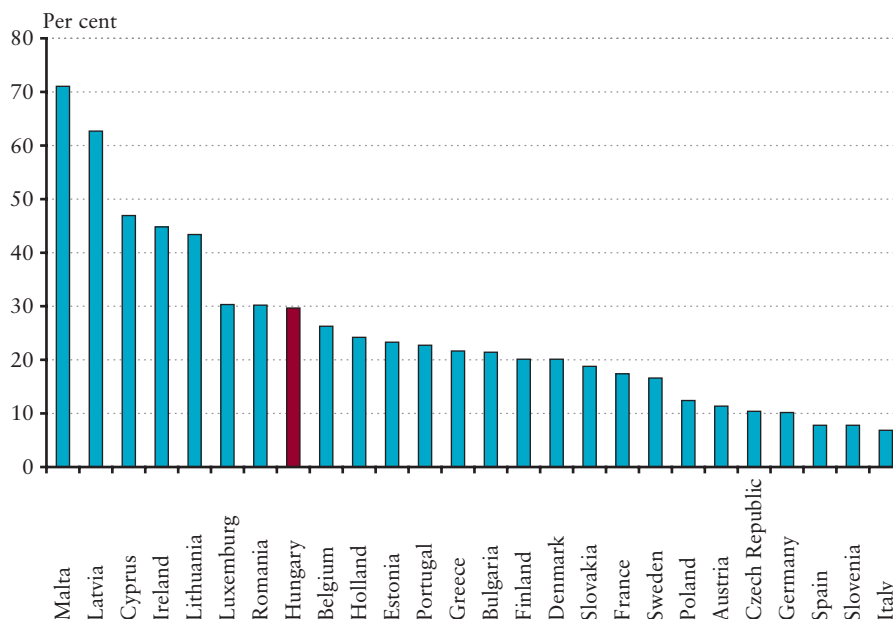
The euro area banking system reacted quickly to the increasing gap between short-term and long-term funding costs, i.e. to the different liquidity conditions observable over different maturities. Afraid of a freezing of high long-term funding

**Chart 18**

**Year-on-year changes in short and long-term external liabilities**



Sources: ECB, MNB.

**Chart 19****Ratio of foreign liabilities in external liabilities (2007)**

Source: ECB.

cost, euro area banks increased the issue of short-term securities and interbank lending markedly, and reduced long-term loans (Chart 18).<sup>50</sup>

In Hungary, due to the high ratio of external financing (especially by parent banks, see Chart 19), the shortening of liabilities' maturity appeared automatically. At end-2007, domestic banks could finance their clients only with an unfavourable financing structure (increasing the ratio of short-term foreign liabilities) and at a higher price (increasing funding costs).

The risk has grown that external funding, which plays an increasingly important role in financing the banking sector, is not only becoming more expensive, but is becoming tighter as well. Reduced access to external funds may hinder new lending, and may entail renewal risk. Renewal risks may be mitigated by the fact that nearly half of the banking sector's foreign liabilities is from the foreign owners. However, a shortening of the average maturity of the liabilities provided by parent banks may challenge the liquidity management of subsidiaries.

### 6.3 RISK OF A CREDIT CRUNCH IN HUNGARY

Earlier, we also mentioned that the financial turbulence affected most of the parent and domestic banks only moderately, and that due to the underdevelopment of the capital markets and the lack of loan securitisation Hungarian banks also felt only the cross-winds from the tornado.

There is, however, significant uncertainty as to how the stability of the European parents of domestic banks will be affected by the liquidity and solvency situation of US and European large banks.

The impact on foreign banking groups playing a key role in the Hungarian banking sector is mitigated by the fact that due to the high ratio of retail funding their liquidity situation is relatively more favourable, and their capital position is more balanced than those of the aforementioned banking groups in the epicentre. In their business activity and in the increase in income in recent years the role of revenues from traditional business (for example from the retail business) was more

<sup>50</sup> At euro area banks, the Basel-II regulations could also play a role in the shortening of liabilities. According to the new capital requirements, less capital has to be provided in case of short-term loans than in case of long-term ones. One of the imperfections of the regulation (besides procyclicality) is that it focuses only on credit risks, and does not take account of liquidity risks. The relative preference of short-term loans may add to borrowers' renewal risk.

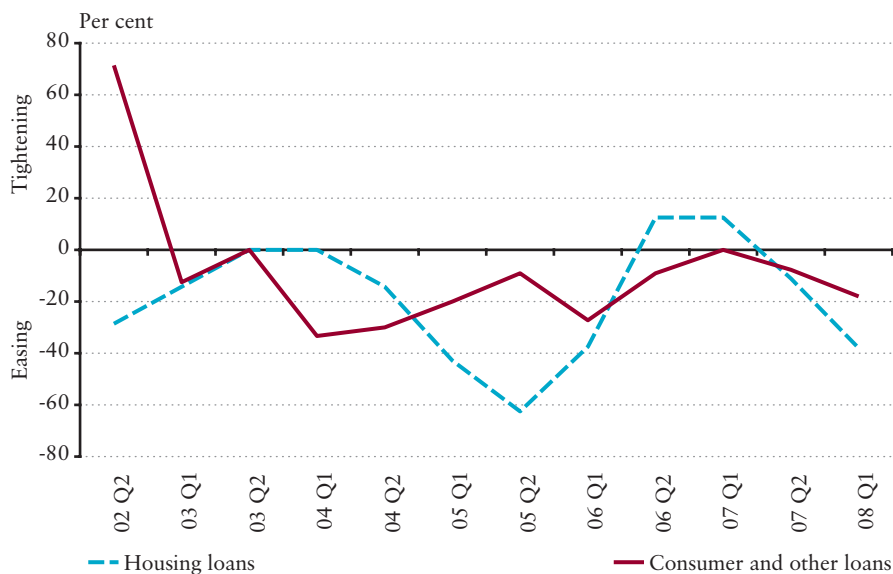
significant, which is also attributable, due to a large extent to the rapid credit expansion in the Central and Eastern European region.

In the event that the financial turbulence also has a significant effect on parent banks' willingness to take risk and they strictly tighten their lending conditions, risk limits of subsidiaries might also be reduced. This has not been experienced so far. Moreover, in the case of housing loans, following an initial tightening, commercial banks loosened their conditions last year, and are expected to continue doing so in the first part of 2008. In the case of consumer credit, the loosening of lending standards has been continuous (Chart 20). In our region, the statistics of Poland and Lithuania are different than those of Hungary: in both countries, lending conditions for housing loans tightened at the end of last year, while lending conditions for consumer credit remained practically unchanged. In the neighbouring countries, banks explained the tightening of the conditions on housing loans with reference to the deterioration in the capital position accompanying the rapid credit expansion.

**Chart 20**

**Lending conditions in Hungary**

*(net ratio of institutions tightening/loosening)*



Source: MNB lending survey.

In addition to non-price factors, we must mention price factors as well. The banking sector can react to the increase in funding costs not only by tightening lending conditions, but also by raising interest rates for (existing and new) clients. Higher interest costs for existing clients may primarily result in a deterioration of portfolio quality and, due to the increase in instalments, in a decline in that part of the disposable income which can be spent on consumption. Transferring the higher funding costs to new clients may have a strong impact on credit demand and thus on consumption. In the first year following emergence of the sub-prime crisis, a transfer of increased funding costs was not observed in Hungary. However, in the near future, increased funding costs may appear rapidly and to a great extent in lending rates to companies, while only a slow, partial shift is expected in the case of households.

Overall, at the moment, the risk of a contagion effect which could result in a credit crunch through a radical change in parent banks' behaviour is very limited.



## 7 Conclusions

The unusual size and sudden rise in the losses of the US sub-prime mortgage loans was the starting point of the 2007 crisis. The increase in losses was directly triggered by the peculiar interference of the interest rate cycle and the housing price cycle. However, a major role in the development of the losses was played by the deficiencies of the so-called originate-and-distribute (OAD) model, which connected credit, financial and real asset price cycles. This model is based on securitisation, which, within adequate limits, allows lower costs for borrowers, sufficient and safe yields for securities investors as well as capital easing for intermediary institutions. Due to lack of an adequate incentive system and/or regulations, the model makes participants interested in increasing the volumes and not in keeping the risk at a reasonable level.

In a favourable interest rate environment and at the time of the housing price bubble all this triggered a rapid increase in sub-prime loans, which strongly polluted (damaged) the originally transparent mortgaged-backed securities market. In this form, the originate-and-distribute (OAD) model did not distribute the risk, but rather exacerbated it.

In parallel with the rapid increase in sub-prime mortgage loans, the market of securitised products also changed. The structured transformation of the flow of funds constituting the basis of securitisation is mainly attributable to the development of collateralised debt obligations (CDO). Structured securities not only transform loans, but also asset-backed securities into bonds of different credit quality. However, this transformation does not take into account that the losses of underlying assets increase exponentially in the structured products, using up the equity part faster than usual. The lack of transparency and the incorrect practices of rating agencies concealed the real risk conditions. CDO products – as opposed to the original mortgage-backed securities (MBS) – are not transparent, and, above all, they are not liquid. Therefore, in the case of the development of CDOs it is not clear whether the positive risk-distributing or the negative risk-hiding role is stronger. Accordingly, the usefulness of CDO papers is highly questionable.

In addition to securitisation factories, conduits and structured investment vehicles (SIV) came into being, which provided leveraged financing to CDOs, and, similarly to banks, transformed ‘short-term money market liabilities’ into investment, without any risk management limits.

The soaring default rate of sub-prime loans reached the market of repackaged products faster than projected. In the CDO market, rating downgrades and initial losses triggered a self-amplifying negative spiral, which resulted in a significant change in investors’ risk assessment. Risk premiums of financial products which were not considered completely safe and liquid increased sharply from the earlier historically low levels. The decline in market liquidity – the higher bid-ask spreads and low turnover as well as the lack of prices required for model-based evaluation – led to a fall in funding liquidity. At the epicentre, the liquidity channel was the path of contagion, i.e. the spread of the crisis crossing borders of countries.

Banks which were affected in multiple ways – as investors in structured products, providers of refinancing for ‘mini banks’ (conduit, SIV) established off-balance sheet, financiers of the highly leveraged investment banks and hedge funds – were compelled to write off huge losses. The uncertainty of the magnitude and distribution of hidden losses affected the interbank market, which is the most important confidence-based financing market. The key money markets of the epicentre, namely the interbank markets, ‘seized up’ several times last year, jeopardising the ‘normal’ operation of economies.

The deleveraging process and the financial accelerator mechanism jointly portend a significant tightening in lending conditions and weak credit expansion, and possibly, in an extreme scenario, a credit crunch.

The spread of the crisis from the epicentre could be observed if certain conditions were met. For a long time, no major signs of a crisis were observed on the periphery. Gradually, two channels of contagion appeared: the spread of the crisis through the sharp increase in risk premiums and the decline in funding liquidity. The first channel was significant only in those countries, where substantial macroeconomic vulnerability could be observed. The other channel mainly played a role in those countries where the external financing requirement was significant, i.e. the dependency of the domestic banking sector on foreign money markets was high due to financing needs related to rapid credit expansion. The sometimes surprising turbulence observable in the Hungarian financial markets is the consequence of contagion through these two channels.

The 2007 crisis is not finished yet, and it will take longer to subside than earlier crises ('tequila', Asian, Russian). The uncertainty of the magnitude and distribution of losses may have a long, protracted effect on the financing of the economy, the eventual real-economy consequences of which cannot be forecasted today.

The crisis which evolved in the summer of 2007 can be considered as special from several aspects. First, it spread rather differently than the crises in the preceding decades: its epicentre was in the most developed money markets in the world (United States, United Kingdom), and it spread primarily to the markets of the euro area and then to the markets of emerging countries through the most innovative products. Second, the operational problems in the most developed markets were caused not only by the problems of a commercial banking product (sub-prime mortgage loan), but, in relation to this, by the imperfection of the market of a typical investment bank product (CDO). Third, in addition to solvency problems, one may talk about liquidity crisis as well, which was indicated by interbank markets first. Fourth, contagion to peripheral countries took place without their direct sub-prime exposure. Finally, in none of the earlier crises were central banks of developed countries so active at the system and individual bank level in order to avoid significant real-economic consequences.

Based on all of the above, we consider our study only as a preliminary summary. For a final and more complete analysis of the crisis we will have to wait another one or two years and investigate the post-Lehman period as well.

# Acronyms used in the text

ABCP: asset-backed commercial paper.

ABS: asset-backed security (main types: MBS, RMBS).

ABX INDEX: synthetic asset-backed credit derivative index showing the price developments in the ABS market.

ALT-A LOAN: in the US mortgage loan market, from a risk aspect the ALT-A (alternative documentation) category is between the prime market and the sub-prime market.

ARM: adjustable rate mortgage.

CBO: collateralised bond obligation.

CDO: collateralised debt obligation.

CDO2: CDO squared, a CDO, the collateral of which is also a CDO.

CDOS OF ABS: CDOs issued with ABS as collateral.

CDS: credit default swap.

CLN: credit linked note.

CLO: collateralised loan obligation.

CMBS: commercial mortgage based security.

CMO: collateralised mortgage obligation.

CONDUIT: firm, intermediary company established for carrying out maturity transformation.

CP: commercial paper.

CRT: credit risk transfer.

DIDMCA: Depository Institutions Deregulatory and Monetary Control Act.

ECB: European Central Bank.

FED: Federal Reserve System.

FHA: Federal House Administration.

FHL(B): Federal Home Loan (Banks).

FHLMC: Federal Home Loan Mortgage Corporation (Freddie Mac).

FNMA: Federal National Mortgage Association (Fannie Mae).

GNMA: Government National Mortgage Association (Ginnie Mae).

GSE: Government-sponsored enterprises.

LBO: leveraged buyout.

LTCM: Long Term Capital Management.

LTV: loan to value.

MBA: Mortgage Banking Association.

MBS: mortgage-backed security.

MTN: medium term notes.

OAD: originate and distribute.

RMBS: retail mortgage-backed security.

SIV: structured investment vehicle.

S&L: Savings and Loan.

SPV: special purpose vehicle.

SWF: sovereign wealth fund.

TED SPREAD: difference between the yield of the 3-month discount treasury bill and the 3-month interbank rate; originally, the difference between the 3-month discount treasury bill and the eurodollar LIBOR.

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