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Abstract

This paper provides an overview of the most important structured finance instruments in the context of the development of the financial turmoil that started in the third quarter of 2007 and continued into 2008. These financial market tensions were triggered by concerns about exposures of financial institutions to the most risky segment of the US mortgage markets—the so-called subprime mortgage market—and related financial instruments, which predominantly were related to structured finance. As structured finance has developed very fast in recent years and often involves highly complex financial instruments and techniques, which may not be understood completely beyond a small circle of financial market experts, the aim of this paper is to provide an introduction to these instruments that may serve to better understand the specific characteristics of the financial turmoil. In this context, the paper proposes a specific classification of structured finance and discusses both securitizations and credit derivatives with the aim of explaining their specific contributions to the development of the financial turmoil. To this extent, the paper differentiates between two main categories of structured finance instruments. The first one played an important role in the initiation and propagation of the turmoil and includes mortgage-backed securities (MBS), asset-backed commercial paper (ABCP) and collateralized debt obligations (CDOs), both cash-flow and synthetic. The second category of structured finance instruments involves those that have been more instrumental in monitoring the crisis, both for market participants and policymakers. The main instruments here are credit default swaps (CDS), of which examples are presented for both single name and index contracts. Finally, the paper provides an overview of the specific contagion channels involving various structured finance instruments. This will be conducted on the basis of examples for hypothetical financial institutions that are nevertheless representative for real world developments such as they occurred in the course of 2007 and 2008.

Keywords: financial turmoil, financial markets, financial institutions, structured finance, securitization, credit derivatives.

JEL Classification: G10, G15, G21, G24.

1 Introduction and motivation

Global financial market conditions deteriorated sharply in the summer of 2007, triggered by concerns about exposures of financial institutions to the most risky segment of the US mortgage markets—the so-called subprime mortgage market—and related financial instruments.¹ As risk assessments were adjusted, the *financial turmoil* spilled over to other financial market segments and risky assets—particularly those linked to *structured finance*—were abandoned in favor of “safe haven” instruments such as government debt securities. Across the globe, stock prices fell, volatility levels jumped, credit spreads increased sharply and liquidity demand surged, prompting central banks to inject substantial amounts of additional liquidity into the markets. Uncertainty was particularly pronounced in the short-term money markets, as evidenced by a marked increase in risk aversion in the asset-backed commercial paper (ABCP) market and rather unprecedented rises in interbank money market interest rates. At the same time, the markets for the transfer of credit risk were affected as well, and the costs of credit protection increased markedly, particularly for specific sectors such as banks and other financial institutions. Although individual countries and specific market segments were affected to different extents, the scope of the financial market turmoil was truly global and discrimination by market participants among individual borrowers was uneven or nonexistent.

The financial market turmoil continued to develop into 2008, partly driven by losses that were actually reported by various large international banks and which were generally either larger or much larger than had been anticipated, and partly by information indicating further deteriorating conditions in US housing and (subprime) mortgage markets. In this respect, the liquidity concerns that dominated the initial phase of the turmoil were accompanied increasingly by credit risk concerns and what had started as a liquidity crisis seemed to develop more into a crisis of solvency related to major financial institutions. After the implementation of major new policy measures in the course of March 2008, particularly in the United States, some sense of normalization returned to global financial markets, but uncertainty in various market segments—in particular of the credit and structured finance markets—remained at elevated levels.

There is broad consensus that *structured finance* played an important role in the development and propagation of the financial turmoil. For example, the IMF has concluded that “... the proliferation of new complex *structured finance products*, markets, and business models exposed the financial system to a funding disruption and a breakdown in confidence” and that certain *structured finance products* “... likely exacerbated the depth and duration of the crisis by adding uncertainty relating to their valuation as the underlying fundamentals deteriorated” [IMF (2008a)].

The financial turmoil revealed a number of weaknesses related to the use of structured finance which can be summarized as follows. In numerous cases, banks underestimated their exposures to structured finance products and to specific

1. More formally defined, according to Kiff and Mills (2007), p.3, subprime mortgages are residential loans that do not conform to the criteria for “prime” mortgages and so have a lower expected probability of full repayment, as they are made to more “risky” mortgage borrowers. This assessment is made according to objective criteria such as the borrower’s credit score and record and loan-to-value ratios. An elaborate discussion of the sub-prime mortgage market is beyond the scope of this paper. An excellent overview is presented in the aforementioned publication.

“off-balance sheet” vehicles which play an important role in this type of finance. Moreover, certain banks invested heavily in structured finance products, with retaining large exposures to specific structured finance instruments such as collateralized debt obligations, but without understanding sufficiently their impact on the banks’ capital and liquidity positions. In addition, in recent years banks in general resorted to more volatile funding sources including structured finance products. When the financial turmoil hit and structured credit markets came to a virtual standstill, the funding capability of specific banks —such as Northern Rock in the UK— was impaired significantly. Furthermore, many of the globally operating banks had offered liquidity standby facilities to “off-balance sheet” vehicles engaged in structured finance, but generally underestimated the liquidity risk arising from off-balance sheet exposures. Finally, the financial turmoil has raised concerns that the process of securitization may have generated unwelcome incentive problems, in the sense that banks may not assess the credit risk of specific borrowers accurately as they put these loans off the balance sheet anyway through securitization techniques.

The aim of this Occasional Paper is to provide an introductory overview of structured finance, so that the reader may better understand its role and importance in the financial turmoil of 2007-2008, such as briefly described above. Thus, this publication serves as a background document which may be useful in providing rather specialized knowledge that is required to be able to comprehend recent developments in global financial markets, in particular the financial turmoil. Structured finance has developed very fast in recent years and often involves highly complex financial instruments and techniques, which may not be understood completely beyond a small circle of financial market experts. In this sense, the overview pays attention to the most relevant instruments of structured finance such as asset-backed securities and collateralized debt obligations and techniques such as securitization. In addition, the Occasional Paper provides a concise analysis of the most important channels linking specific structured finance instruments to the financial turmoil. At the same time, the aim of this paper is not to provide an in-depth analysis of the financial turmoil, of which excellent studies exist [for example: IMF (2008a and 2008b); ECB (2008b); BIS (2008c); Borio (2008)].

The paper is organized as follows. Section 2 provides an overview of structured finance and discusses its specific characteristics. It also presents a detailed classification of structured finance instruments that serves as a basis for the rest of the Occasional Paper. Furthermore, it is explained that a number of structured finance instruments such as *mortgage-backed securities* (MBS), *asset-backed commercial paper* (ABCP) and *collateralized debt obligations* (CDOs) have been at the centre of the financial turmoil, whereas other instruments such as *credit default swaps* (CDS) have been more monitoring devices to assess the development of the financial turmoil. Section 3 pays attention to *securitization* and to the aforementioned specific structured finance instruments that played an important role in the financial turmoil: MBS (section 3.1), ABCP (section 3.2) and (cash-flow) CDOs (section 3.3). Section 4 sets out the main characteristics of *credit derivatives*, in particular credit default swaps (CDS) (section 4.1) and synthetic CDOs (section 4.2). Section 5 concludes and analyses the main channels through which structured finance instruments contributed to the initiation and propagation of the financial turmoil.

2 Structured finance

Structured finance relates to a group of complex financial instruments and mechanisms that defers a simple universal definition, but broadly defined it could be described as referring to the repackaging of cash flows that can transform the risk, return and liquidity characteristics of financial portfolios [Issing (2005); Fabozzi et al. (2006)]. A more straightforward interpretation is provided in BIS (2005a), where structured finance is defined as a form of financial intermediation which is based on securitization technology: Structured finance "... involves the pooling of assets and the subsequent sale to investors of claims on the cash flows backed by these pools. Typically, several classes (or "tranches") of securities are issued, each with distinct risk-return profiles". This definition clearly involves the elements of a) *pooling* of assets (either cash-based or synthetically created by using credit default swaps) and b) the *tranching* of liabilities that are backed by the asset pool. In addition, c) the credit risk of the collateral asset pool is separated from the credit risk of the originator, through the involvement of a *Special Purpose Vehicle* (SPV) or *Special Purpose Entity* (SPE) [Gorton and Souleles (2005)]. These specific characteristics will be explained in the subsequent sections.

In structured finance, *rating agencies* play a crucial role. These agencies, such as *Standard & Poor's*, *Moody's Investors Service* and *Fitch's Investors Service*, provide ratings to structured finance products which are vital in the valuation process of these instruments. The ratings are indicative for the credit risk (and other risks) of the instruments and depend on the creditworthiness of the issuing bodies such as SPVs/SPEs. A common differentiation between ratings is *investment grade* and *below-investment grade ratings*. Following the ratings that are commonly used in the financial markets, investment grade structured finance instruments are those rated BBB or above by Standard & Poor's and Fitch's Investors Service, and Baa or better by Moody's Investors Service, whereas below-investment grade instruments have lower ratings.

As has become clear from the introduction above, structured finance is strongly interrelated with *securitization*. According to Fabozzi and Kothari (2007), structured finance, in a narrow sense, is used almost interchangeably with securitization [see also: The Economist (2008); Blundell-Wignall (2007a and 2007b); Citigroup (2007)]. Traditionally, securitization can be defined as the *pooling* of financial assets, such as for example residential mortgages, and their subsequent sale (of either the assets themselves or only their credit risk) by the originator to a SPV, which then issues debt securities —known as *asset-backed securities* (ABS)— for sale to investors. The principal and the interest of the ABS issued by the SPV depend on the cash-flows produced by the pool of underlying financial assets (such as residential mortgages) [ECB (2008a)]. In different words, securitization can also be interpreted as a financing mechanism, or a process in which assets are refinanced in the capital markets by issuing securities sold to investors by a SPV [Vink and Thibault (2007)].

Securitizations can be conducted basically in two ways. First, in a so-called *true sale* securitization, the underlying assets are indeed actually sold by the originator to the SPV and thus removed from the balance sheet of the originator (for example a bank). Second, in a so-called *synthetic* securitization, the underlying assets remain on the balance sheet of the originator, and only the credit risk of the underlying assets is transferred to the SPV by buying credit derivatives such as credit default swaps over this assets [ECB (2008a)].

Securitization is closely linked to the so-called “originate-to-distribute” model. Under this model, the bank that originates the assets (basically loans) puts them off its balance sheet through securitization and thus “distributes” them to the SPV and the ultimate investors who buy the ABS issued by the SPV. This model and securitization have major advantages for the banks involved, as they can free up capital and liquidity by not holding the loans on their balance sheets. As the same time, since the bank knows that it is going to put loans off its balance sheet, it may not apply the same strict credit risk assessment as it would conduct otherwise (incentive or moral hazard problems).

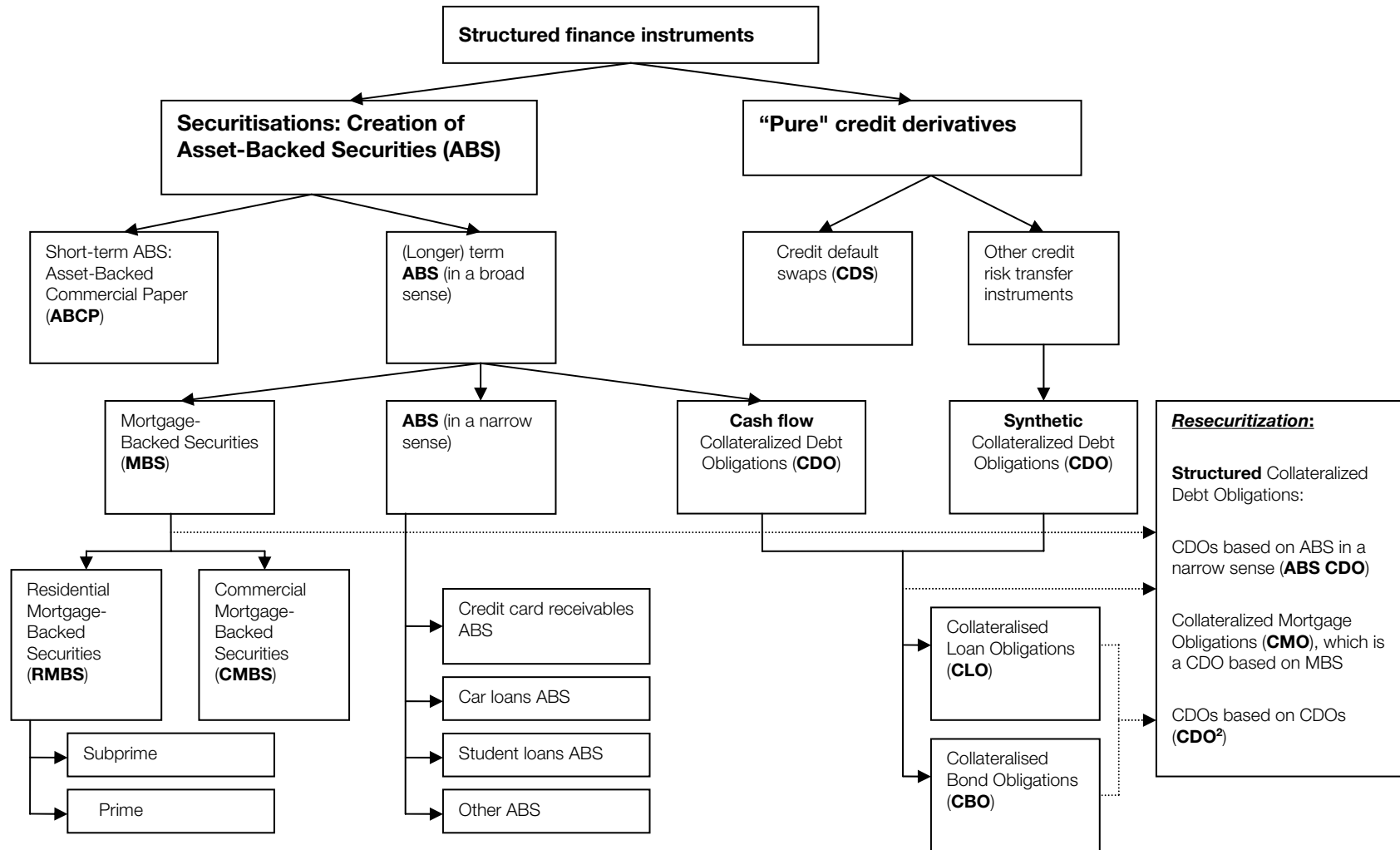
Figure 1 provides an overview of the main structured finance instruments. In essence, these instruments can be divided in *securitizations* and *credit derivatives*. Securitizations consist of *short-term asset backed securities* (short-term ABS, predominantly *asset-backed commercial paper* or ABCP) and *longer-term asset-backed securities* (term ABS), defined from a *broad perspective*. Broadly defined asset-backed securities include three main categories: *Mortgage-backed securities* (MBS), *asset-backed securities in a narrow sense* (ABS, which are basically collateralized by all kinds of assets except mortgages, such as car loans, student loans, etc.) and “*cash flow*” *collateralized debt obligations* (CDOs) [Jobst (2003 and 2006); Vink and Thibault (2007)]. In market practice, often when the term asset-backed securities or the abbreviation ABS is used, the narrow interpretation is followed, thus implying asset-backed securities (ABS) with the important exception of mortgage-backed securities (MBS) and “cash flow” CDOs.

CDOs are somewhat difficult to classify: In practice, they have been classified either as securitizations, credit derivatives or as a hybrid form incorporating elements of both [see also: IMF (2008a); Duffie (2007)]. In this Occasional Paper, “cash flow” CDOs are categorized as a hybrid form, but predominantly as securitizations, with only an indirect link to credit derivatives (see Figure 1). The reasons for this choice are twofold: First, their main characteristic is the explicit use of securitization techniques in transforming a pool of assets into new securities and second, various statistical sources include “cash flow” CDOs in asset-backed securities (and not in credit derivatives). At the same time, in this Occasional Paper, synthetic CDOs are included in “pure” credit derivatives (see Figure 1), which are not based particularly on securitization techniques, but are much more very specific instruments to transfer credit risk from one party to another. The classification of synthetic CDOs as “pure” credit derivatives is also done mainly in order to follow statistical market practices. For example, the credit derivatives statistics published by the BBA include only synthetic CDOs and not “cash flow” CDOs. The most important instruments belonging to “pure” credit derivatives are credit default swaps (CDS), with other instruments here are, in addition to synthetic CDOs, credit-linked notes, total return swaps and credit spread options. These latter three instruments will not be discussed.

In relation to the financial turmoil of 2007-2008, different groups of structured finance instruments played different roles. First, a number of these instruments were at the heart of the financial market tensions, as due to uncertainties about their valuations and exposures to the US (subprime) mortgage markets, investors started to shun them en masse. Subsequently, these tensions spilled over to other segments of the credit markets, other financial markets such as the equity and foreign exchange markets and the financial services industry, in particular (investment) banks which significant exposures to these instruments. The structured finance instruments involved in this process were in particular (*subprime*) *residential mortgage-backed securities* (RMBS), *asset-backed commercial paper* (ABCP) and *collateralized debt obligations* (CDOs), including both “cash flow” and “synthetic” CDOs.

Second, certain structured finance instruments were involved only indirectly in the turmoil, but provided very useful information on the development of the financial market tensions. This applies particularly to *credit default swaps (CDS)*. These financial contracts have been instrumental in monitoring pressures in specific market segments through *CDS index* contracts, which are representative for a group of companies, as well as uncertainties about the soundness and viability of individual commercial and investment banks and insurance companies through *single name* CDS contracts. Both groups of structured finance instruments related to the financial turmoil will be discussed in the subsequent sections.

Figure 1: Structured finance instruments and securitization



SOURCE: Own interpretation based on Jobst (2003) and (2006) and BIS (2005a).

3 Securitization and the creation of asset-backed securities

This section explains the basic principles of securitization and the creation of asset-backed securities and presents examples of securitizations which have played the most prominent roles in the financial turmoil of 2007-2008. These are mortgage-backed securities (MBS; section 3.1), asset-backed commercial paper (ABCP; section 3.2) and (cash-flow) collateralized debt obligations (CDOs; section 3.3).

3.1 *Asset-backed securities: The example of mortgage-backed securities*

Generally, asset-backed securities (ABS) are securities that are collateralized by loans or other assets. These securities are generated through a securitization process by Special Purpose Entities (SPEs) or Special Purpose Vehicles (SPVs) in order to transform illiquid assets of a certain entity (the “originator”) into transferable securities. When these securities are collateralized by mortgages, they are called *mortgage-backed securities* (MBS), including *commercial mortgage-backed securities* (CMBS) and *residential mortgage-backed securities* (RMBS) (see also Figure 1 in section 2).

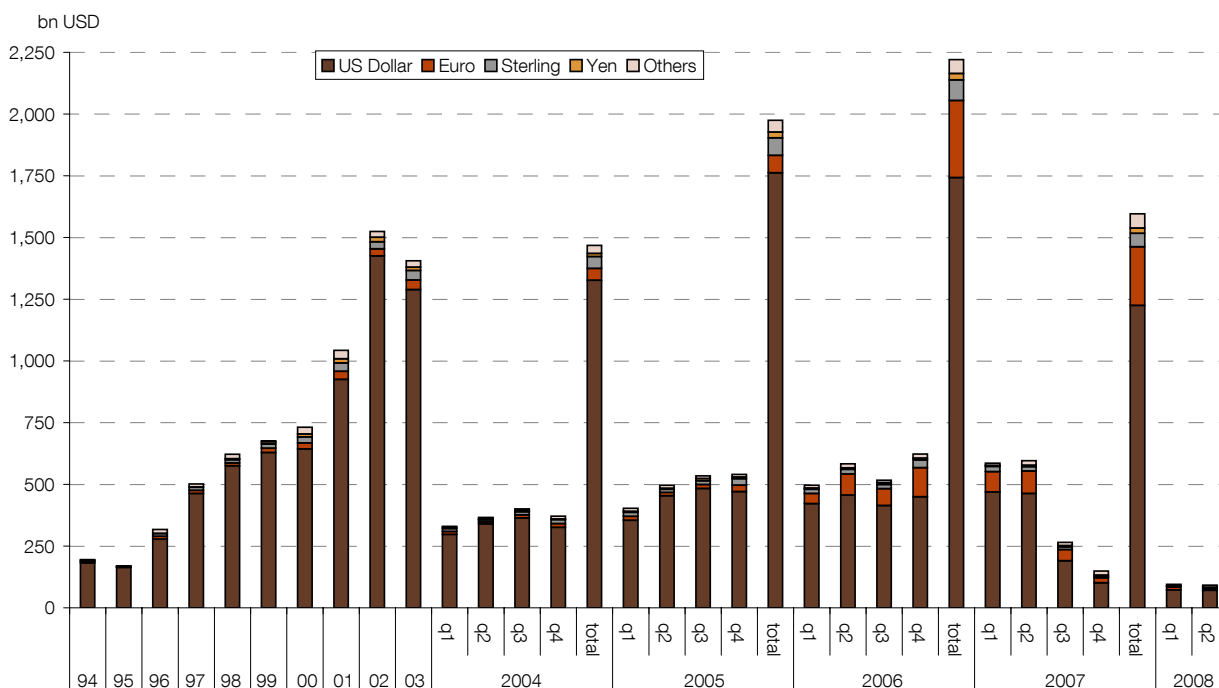
An example of the securitization of residential mortgages, which involves the creation of RMBS and is based on the “true” sale of the mortgage pool to the SPV, is shown in Figure 2. A bank provides mortgage loans to various homeowners A, B, etc., and puts these mortgages together in a pool of many mortgages. Subsequently, this bank that has “originated” these loans, sells the pool of mortgages to a SPV, in return for cash. In this “true sale” securitization, the mortgage loans disappear from the balance sheet of the bank. In order to finance its purchase of the mortgage pool, the SPV issues RMBS and sells these securities to various investors. The RMBS sold are “tranching” in specific classes according to their credit risk, such as rated by the rating agencies [Elul (2005); Citigroup (2007)]. Thus, a tranche can be defined as a specific portion of a securitized portfolio of assets [Morgan Stanley (2008)], based on a group of assets with similar credit risk characteristics. The process of *tranching* is shown in Figure 3. On the basis of a pool of mortgages of €100 million, RMBS are created which consist of €96 million of investment grade securities, subdivided in tranches rated “super-senior” AAA, “senior” AA and “mezzanine” BBB, and of €4 million of below investment grade securities, with tranches rated “subordinated” B and unrated (the so-called “equity” tranche). According to their specific risk preferences, various types of investors buy specific tranches. For example, pension funds often may have a preference for the less-risky, higher-rated but lower yielding AAA or AA tranches, whereas more risk-prone investors such as hedge funds may invest in the more risky and higher yielding B or equity tranches. Thus, in the process of the creation of the RMBS, *rating agencies* are of enormous importance, as they rate the bank that originates the mortgage loans, the SPV that creates the RMBS and the specific tranches of the RMBS. Furthermore, in order to raise the credit quality of the RMBS tranches issued, the SPV may use *credit enhancement* techniques. This implies the use of certain mechanisms that elevate the credit quality of the financial instruments involved and consequently protect investors from losses incurred on the underlying assets [Standard & Poor’s (2007)]. This is attractive for the SPV, because if it can raise the rating of some part of the RMBS issued, it can lower its financing costs on this debt. For example, by using credit enhancement techniques, it may be able to issue a greater part of the RMBS tranches at investment grade level. Credit enhancement can take many forms but some common credit enhancements are *over-collateralization* and third-party guarantees

by *financial guarantors* or *monolines* (see Figure 2). In the case of over-collateralization, the amount of RMBS issued is less than the amount of the underlying assets or collateral. In the case of monolines, they may guarantee that interest and principal of the RMBS issued will be paid on time and in full in the event of a default by the SPV issuing the paper. They can do this by either issuing financial guaranties (or “wraps”) or by selling protection via credit default swaps (CDSs) [Moody’s (2008c)].

The mortgages underlying the RMBS issues may be either of “prime” or “subprime” quality, depending on the creditworthiness of the respective borrowers, or combinations of both. The financial turmoil that started in the summer of 2007 originated in the subprime mortgage markets and affected particular those structured finance instruments that were collateralized by these assets [see Ashcraft and Schuerman (2007)].

In order to grasp the importance of securitization at a global level, Chart 1 and Chart 2 depict the breakdown of securitization by region respectively by collateral. The figures on securitization presented in these charts include the amounts of “cash-flow” CDOs issued. The charts show the very rapid growth of securitization over the past 15 years and its collapse in the wake of the financial turmoil that started in the third quarter of 2007, which proceeded well into the second quarter of 2008. The main reason behind this was the crisis of confidence that hit structured finance and securitization, as the financial turmoil revealed important shortcomings in the valuation and disclosure of these financial instruments [see: IMF (2008a and 2008b); ECB (2008b); BIS (2008c)]. Chart 1 shows that global securitization is clearly dominated by US originators, but that the relative importance of European originators has been growing. Chart 2 exemplifies that mortgages are by far the most important underlying asset of global securitization, with residential mortgages being the most important single asset class. The chart also shows that “cash-flow” CDOs have increasingly become important in recent years.

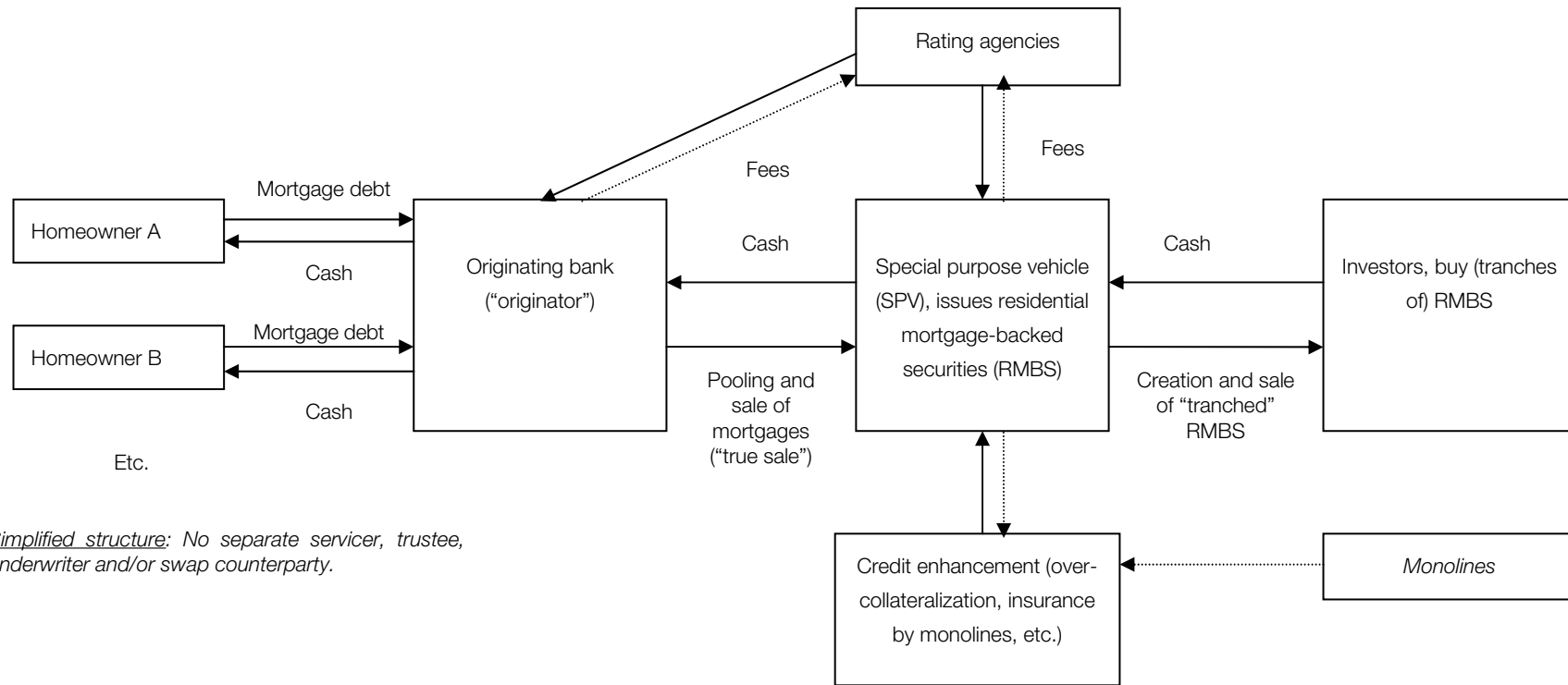
Chart 1. Global securitization by currency



SOURCE: Dealogic.

Figure 2:

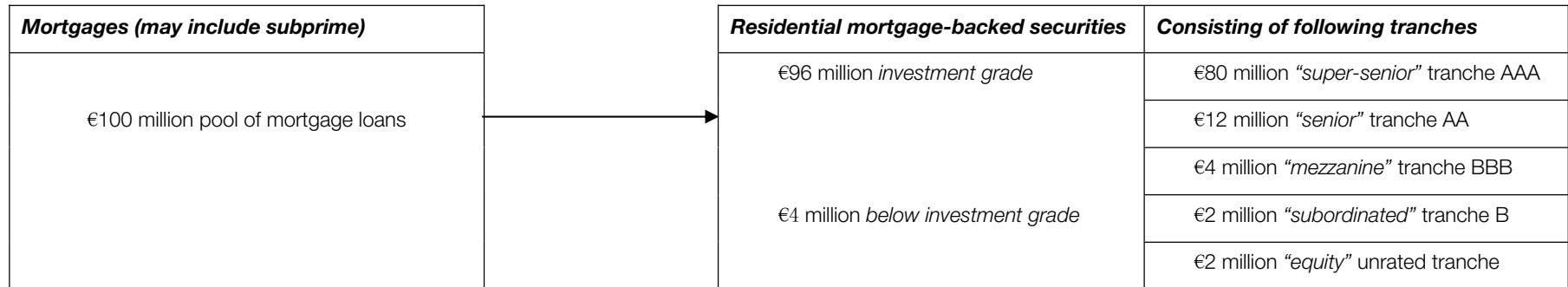
Example RMBS securitization: Creation of residential mortgage-backed securities (RMBS) (“Cash flow”, “true” sale securitization)



Simplified structure: No separate servicer, trustee, underwriter and/or swap counterparty.

SOURCE: Adapted from: ECB (2008a), Mingle (2007), Fabozzi et al. (2006), Elul (2005), Gorton and Souleles (2005), The Bond Market Association (2004) and Jobst (2003).

Figure 3: “Tranched” residential mortgage-backed securities



SOURCE: Own elaboration.

3.2 Asset-backed commercial paper (ABCP)

Asset-backed commercial papers (ABCP) are collateralized short-term debt instruments (commercial paper or CP), which are constantly rolled over and issued by so-called *conduits* (which include *Structured Investment Vehicles* or SIVs) to finance investments in often longer-term securities [Fitch Ratings (2001); Moody's (2003)]. These securities can be regarded as the collateral underlying the ABCP issued, in other words are the “asset-backed” component of ABCP.

Figure 4 explains the basic mechanism of ABCP. Certain investors, or collateral providers which can be banks or other entities, want to obtain financing by selling certain assets to an ABCP conduit. These assets need to be “eligible”, i.e. they need to have a certain rating that allows the conduits to purchase them. The ABCP conduit finances its purchase of the eligible assets by issuing ABCP, which is subsequently bought by investors in the ABCP market. In order to make the paper more attractive for the investors, often credit enhancement is sought (see section 3.1). Finally, an ABCP program involves the presence of a liquidity provider (bank or syndicate of banks) (see Figure 4), which commits itself to provide liquidity to the ABCP conduit in case of financing shortages (for example when the conduit cannot issue sufficient amounts of ABCP and consequently experiences a financing gap). This liquidity support may be important, since the ABCP issued has short to very short maturities.

The ABCP market has been heavily hit by the 2007-2008 financial turmoil. When pressures stemming from the US subprime mortgage markets spilled over to structured finance products directly or indirectly linked to these markets, in August 2007 issuers of ABCP started to experience increasingly problems in finding investors willing to purchase these securities. The problem was that the exposure of ABCP programs to mortgage related financial instruments (which were included in the assets sold to conduits by collateral providers in Figure 4) had grown very fast to an estimated \$300 billion [BIS (2007)], so that investors completely lost confidence in ABCP when the subprime tensions mounted, as potentially this instrument could incur significant losses due to the crisis. The high exposure of ABCP programs to mortgage markets is exemplified in Table 1, where it is shown that mortgages were the largest single collateral category—representing more than one quarter of all collateral—in US ABCP programs.² The ABCP conduits that were hit the hardest in the turmoil have been so-called *Structured Investment Vehicles* or SIVs, which specialized in investing in structured finance products. An overview of these and other ABCP conduits is provided in Table 2. Chart 3 shows that the amount outstanding of US ABCP, which is by far the main segment of the global ABCP market, started to decline rapidly in the third quarter of 2007 and that in 2008 outstanding levels remained at relatively subdued levels from a historic perspective.

Table 1: Composition of the US ABCP market by collateral type (end-March 2007)

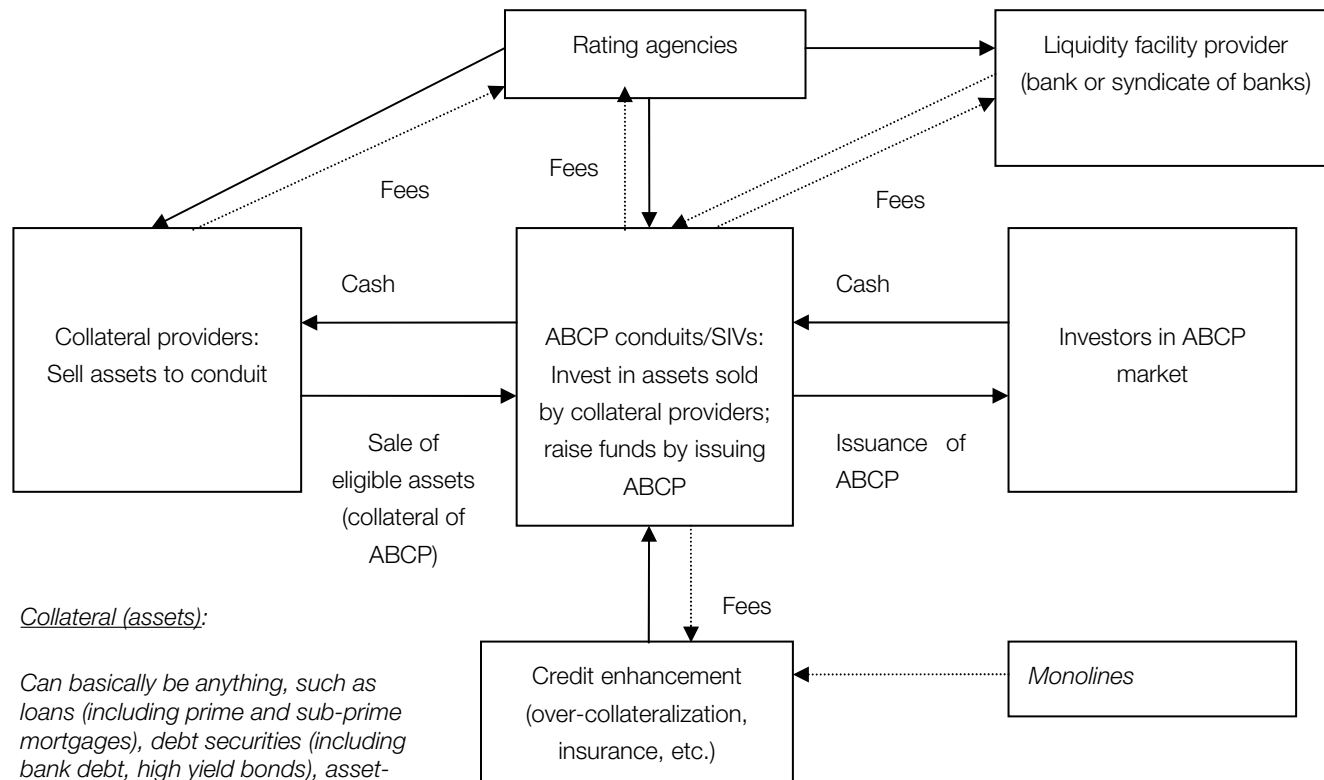
Mortgages	26%
CDOs	13%
Credit card loans	10%
Car loans	10%
Commercial loans	7%
Other	34%
	100%

SOURCE: JP Morgan (2007).

² The actual exposure to mortgage markets actually may have been higher, as other collateral types such as CDOs may have had exposures to prime and subprime mortgage markets as well.

Figure 4:

Example ABCP: Creation of Asset-Backed Commercial Paper (ABCP) by ABCP “conduits / structured investment vehicles (SIVs) (“true sale”)



Simplified structure:

No separate administrator or servicer, asset owning SPVs, issuing & paying agent, dealers and conduit owner.

Collateral (assets):

Can basically be anything, such as loans (including prime and sub-prime mortgages), debt securities (including bank debt, high yield bonds), asset-backed securities (RMBS, CMBS) and CDOs (CBOs, CLOs).

SOURCE: Adapted from: Fitch Ratings (2007), Moody's (2003) and Fitch Ratings (2001).

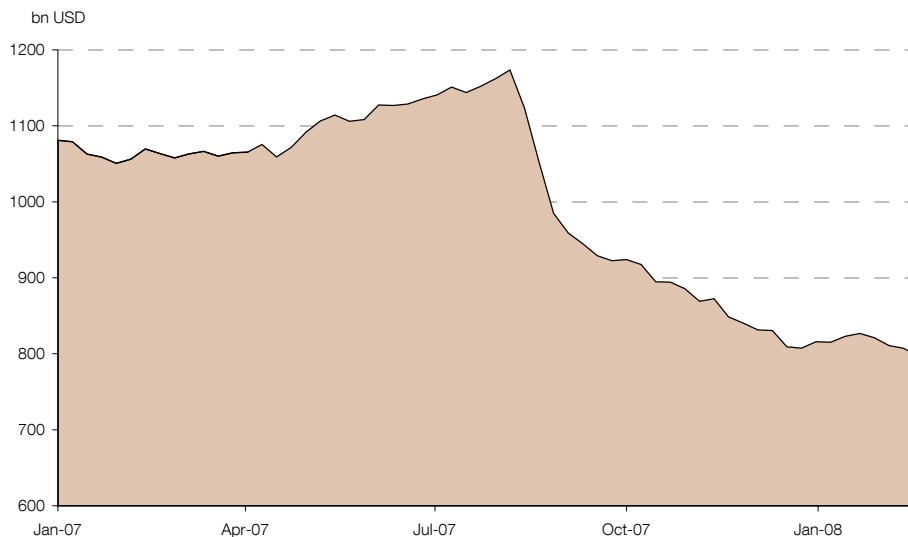
Table 2: Types of ABCP conduits

	% of total ¹ (US, end-March 2007)	Types of conduits
Single-seller conduits	16%	Conduits based on a single collateral provider which sells assets to the conduit. These conduits are often managed by a finance subsidiary of a large company or by a bank for its own business. For example, Ford Motor Company has its own finance subsidiary ("Ford Motor Credit") which manages the conduit FCAR Owner Trust in order to finance specific activities of Ford (i.e. Ford Motor Company is the only seller of collateral).
Multi-seller conduits	54%	Conduits based on various collateral providers. For example, a bank can set up a multi-seller conduit to provide financing for a variety of bank clients. Collateral is mostly provided in the form of loans (i.e. trade, car, credit card, commercial and equipment loans/receivables). Limited exposure to mortgages and CDOs (8% respectively 4% of total collateral, end-March 2007).
Hybrid-conduits		Multi-seller conduits that not only invest in loans but also in securities.
Securities arbitrage conduits	15%	Conduits that have been especially established to exploit arbitrage opportunities. Most often used is "maturity arbitrage" (on the term structure of credit spreads) by issuing short-term ABCP and investing the proceeds in longer-term assets. Another possible form of arbitrage is arbitrage by banks, which seek arbitrage opportunities or capital relief associated with moving assets off the balance sheet. The exposure of these conduits to mortgages and CDOs is much larger than with single and multi-seller conduits (33% respectively 26% of total collateral, end-March 2007)
Structured investment vehicles (SIVs)	6%	Conduits which invest heavily in structured finance products (such as asset-backed securities) and obtain funds by issuing ABCP and medium-term notes (MTN) and long-term capital notes. SIV funds consist between one-third to more than 50% of ABCP; on average 35% of their liabilities consist of ABCP. SIVs also conduct "maturity arbitrage" by issuing short and medium-term paper and investing the proceeds in long-term credit assets. These conduits have significant investments in asset-backed securities. For example, as of end-October 2007, according to Moody's, SIV's assets comprised of prime US RMBS (11.3% of total assets), non-US RMBS (8.6%) and CMBS (7.4%). In addition, direct exposure to non-prime US RMBS was around 5%. Thus in total, almost one-third of SIV assets was linked to mortgage-backed securities. Further important assets were bank debt securities (29.4%) and CDOs (12.1%).
CDO program conduits (SIV-lites)	4%	Conduits that partly or fully finance specific CDO tranches by issuing ABCP. They operate more like CDOs than like "traditional" SIVs.
Other	5%	

SOURCE: Moody's (2008a) and (2008b), BIS (2008d), Criado and Van Rixtel (2007), Deutsche Bank (2007), JP Morgan (2007), Polizu (2007), Moody's (2003) and Moody's (2002).

¹ JP Morgan (2007), p.2.

Chart 3. US ABCP outstanding amounts



SOURCE: Federal Reserve.

3.3 Cash-flow collateralized debt obligations (CDOs)

Collateralized debt obligations (CDOs) are securities that are based on the packaging of in particular higher risk assets, such as risky loans, mortgages, bonds and asset backed securities, into a new security [Cousseran and Rahmouni (2005); Lucas et al. (2007)]. Thus, a pool or number of debt contracts is grouped within a SPE/SPV (see also section 2). The CDO's liabilities are divided in tranches of different credit quality and therefore of different subordination, as is the case with the asset-backed securities discussed before. The investors in the tranches of a CDO have the ultimate credit risk exposure to the underlying reference entities.

There are a number of ways to classify CDOs. The main classification of CDOs is based on the specific way credit risk is being transferred, in accordance with similar practices in securitizations in general. If the SPE/SPV of a CDO owns the underlying debt obligations, the CDO is referred to as a "cash flow" or "true sale" CDO. In case the SPE/SPV does not acquire the portfolio of underlying debt instruments, but sells a credit default swap (CDS) to transfer the credit risk exposure of these instruments, the CDO is referred to as a "synthetic" CDO. In addition, some other types of CDOs exist, such as a *hybrid* variant combining elements of the "cash flow" and "synthetic" CDOs. These other CDOs will not be discussed in this Occasional Paper. As is shown in Chart 4, the bulk of CDOs exist of "cash flow" CDOs (including "hybrid" CDOs), with a much smaller share accounted for by "synthetic" CDOs.

Another classification of CDOs is based on the specific underlying portfolio. Here, CDOs can be divided in *collateralized loan obligations* (CLOs) and *collateralized bond obligations* (CBOs). CLOs are CDOs completely based on the packaging in a new security of loans, such as bank loans. CBOs are similar but then based solely on bonds [Jobst (2003)]. As is shown in Chart 5, the issuance of CDOs collateralized by loans traditionally has been much larger than that of CDOs collateralized by bonds. Apparently, institutional investors in the US and Europe have been the main investors in CLOs. A large part of the loans underlying CLOs has been originated by private equity and LBO operations and consequently CLOs have performed a crucial role in the recent boom in these operations [see BIS (2008b)].

Furthermore, *structured CDOs* exist, which are CDOs that are based on collateral that exists of structured finance instruments and which will be discussed below.

Finally, CDOs can also be classified according to the aim of the transaction [Cousseran and Rahmouni (2005)]. *Balance sheet CDOs* allow the originator to place certain assets off their balance sheet, allowing assets and/or credit risk to be transferred to an off-balance sheet legal entity. *Arbitrage CDOs* allow the originator to take advantage of spread differences between the average yields on the underlying portfolio and on the tranches issued. These CDOs will not be discussed here further in detail.

Taking into account that the classification of “cash flow” and “synthetic” CDOs is the main one, this Occasional Paper specifically will discuss them. As the former CDOs can be regarded as a form of securitization and since they are often included in statistics on asset-backed securities (see section 2), they are discussed in this section. The latter CDOs have been included explicitly as “pure” credit derivatives and therefore are presented in section 4 on credit derivatives.

Turning now to “cash flow” CDOs in detail, these instruments allow the SPE/SPV to obtain the credit risk exposure by purchasing outstanding debt instruments and to transfer the credit risk by issuing its own collateralized financial instruments, primarily debt but could also be equity. Credit rating agencies rate the various tranches of debt issued by the SPE/SPV, depending on differences in seniority, similar to the asset-backed securities described in Figure 3 in section 3.1.

An example of a “cash flow”, “true sale” CDO is presented in Figure 5. This is a CDO based on an underlying pool of “mezzanine” tranches of residential mortgage-backed securities (RMBS). The “mezzanine” tranches of RMBS are usually rated BBB (see Figure 3 for an example), thus are relatively low rated. In the example, the originator creates a pool of “mezzanine” tranches from various RMBS and sells this pool to the SPV. The SPV finances its purchase of the pool by issuing a CDO in the form of “tranching” notes, which are bought by various investors. According to their risk preference, these investors buy either lower or higher-rated tranches, with corresponding higher or lower yields.

The explanation in Figure 5 of a CDO based on RMBS tranches is an example of a so-called *structured CDO* (ABS CDO), such as included in Figure 1. These structured CDOs are based on the securitization of another securitization, for example a CDO based on mortgage-backed securities (i.e. CDO of MBS, which is called a *collateralized mortgage obligation* or CMO). Another example of a structured CDO is a CDO based on other CDOs, which is called a *CDO*² [Citigroup (2005 and 2006a)]. Thus, structured CDOs constitute an element of re-securitization, in other words consist of a “*double layered securitization*” process.³ Chart 5 shows that the issuance of structured CDOs increased very fast from the fourth quarter of 2005 to the second quarter of 2007, but when the financial turmoil hit in the third quarter of 2007, their issuance rather collapsed, a process that continued way into 2008.

The process of creating *structured CDOs* is exemplified in Figure 6. As a first securitization, based on various pools of residential mortgage loans, a number of residential mortgage-backed securities (RMBS) are created. Then, on the basis of a pool of “mezzanine”

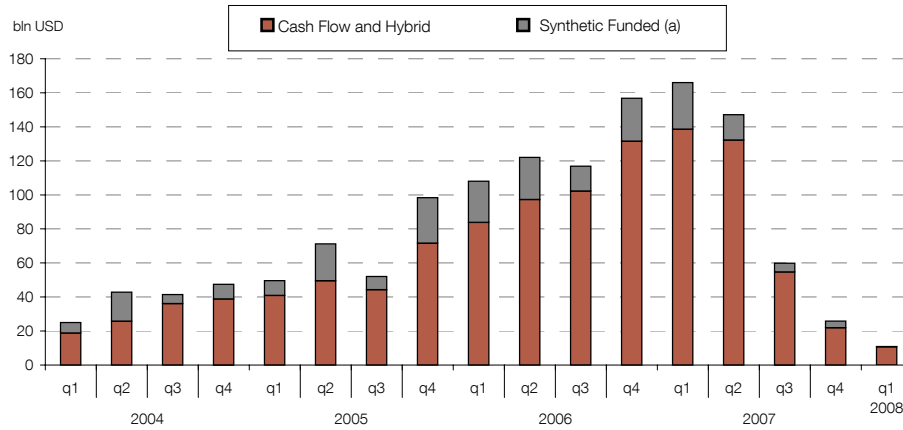
3. This process has also been described as a broadening of securitization. See BIS (2008a), p. 5.

tranches derived from these RMBS, a second securitization is conducted, which is the creation of a CDO based on the pool of “mezzanine” tranches. The interesting aspect is that the rating of the tranching CDO is for 87% “super-senior” and “senior” (i.e. 75% AAA and 12% AA), thus much higher than the BBB rating of the underlying “mezzanine” tranches from the RMBS. The new CDO has also a “mezzanine” tranche, which however is only 4% of the CDO. Thus, via “financial alchemy” of the rating agencies, a considerable part of the tranches of the CDO receives here much higher credit ratings (namely AAA and AA) than the original BBB tranche of the RMBS, linked to residential mortgages [on the inherent weaknesses of this process, see Mason and Rosner (2007a and 2007b); The Banker (2008)]. The main reason for this is that the correlation between the various “mezzanine” tranches is perceived to be lower than between the mortgages in the individual mortgage pools, because the “mezzanine” tranches are backed by different mortgage pools. For example, the correlation between the “mezzanine” tranche from a RMBS backed by a pool of mortgages from New York and the “mezzanine” tranche from a RMBS backed by a pool of mortgages from Alaska is perceived to be lower than the correlation between the mortgages in either the New York or Alaska mortgage pools. As a result, the debt issued by the SPE/SPV usually has a higher rating than that of the underlying or collateral debt. This has allowed institutional investors in certain countries to invest in such debt.

In Table 3, it is shown how vulnerable in particular *structured CDOs* were to the US subprime mortgage crisis—in fact, they played a key role in the 2007-2008 financial turmoil [see BIS (2008a), for an excellent exposition]. The table includes CDOs which are based on structured finance products, such as subprime and other residential mortgage-backed securities, CDOs and other underlying collateral. For example, 50% of the CDOs which were based on relatively highly rated “high grade” asset-backed securities (ABS) had in fact as collateral subprime residential mortgage-backed securities. For the CDOs based on lower rated “mezzanine” ABS this percentage was even 77%. Essentially what happened during the recent financial turmoil is that as problems in the subprime mortgage markets in the US mounted during the second and third quarters of 2007, CDOs based on tranches of mortgage-backed securities linked to the subprime market eventually were negatively affected as well, and their credit spreads widened drastically, inflicting huge valuation losses on investors (as prices went down sharply). Markets for these products completely dried up and as a result prices could not be established. Consequently, investors were not able to calculate their losses, which added to the growing uncertainty in global financial markets and led to a spill-over of the financial turmoil to other financial market segments. In the process, global CDO issuance completely collapsed, as is shown in Charts 4 (by type of CDO), 5 (by type of collateral) and 6 (by currency). This development intensified even more in the course of 2008.

The description of “cash flow” CDOs above shows their similarity to standard securitizations, with the use of a pool of underlying debt instruments and their transformation into new securities backed by this pool of collateral assets. However, CDOs in general are in some important ways different from conventional securitizations. In essence, CDOs are based on pools of relatively few numbers of relatively heterogeneous assets (for example on small numbers of specific tranches from various mortgage-backed securities), whereas securitizations or the creation of asset-backed securities (in the narrow sense) are based on pools of relatively large numbers of relatively homogeneous assets (for example many residential mortgages of a few cities) [Cousseran and Rahmouni (2005); ECB (2008a)]. Consequently, generally it is much more complicated to assess the risk of CDOs than that of standard securitizations such as residential mortgage-backed securities.

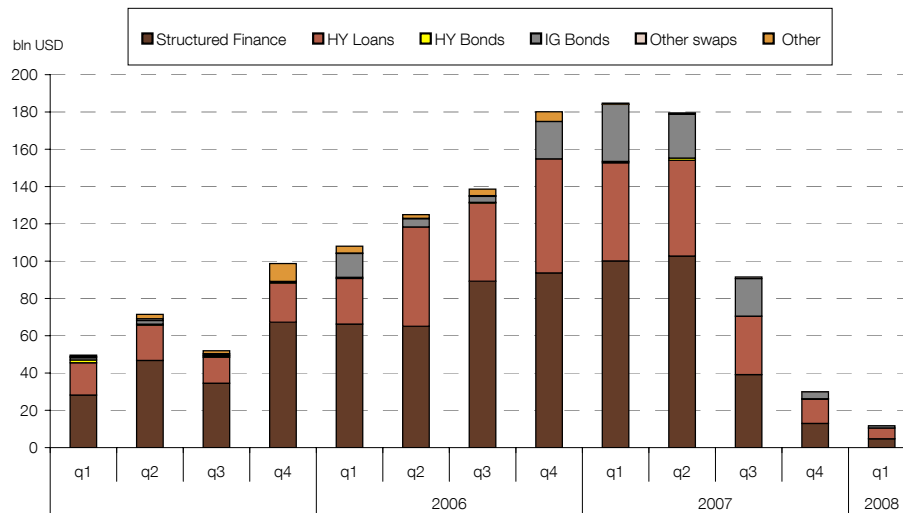
Chart 4. Global CDO issuance by type



SOURCE: SIFMA

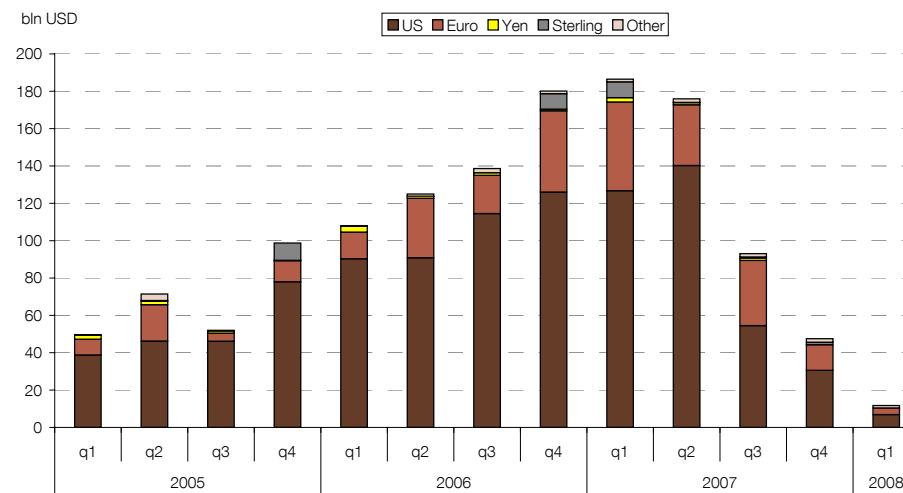
(a) Funded tranches require the deposit of cash to an SPV at the inception of the deal to collateralize portions of the SPV's potential swap obligations in the transaction; losses result in principal writedowns of the issued notes. The unfunded are supposed to be the same amount at least as the funded ones.

Chart 5. Global CDO issuance by underlying collateral



SOURCE: SIFMA.

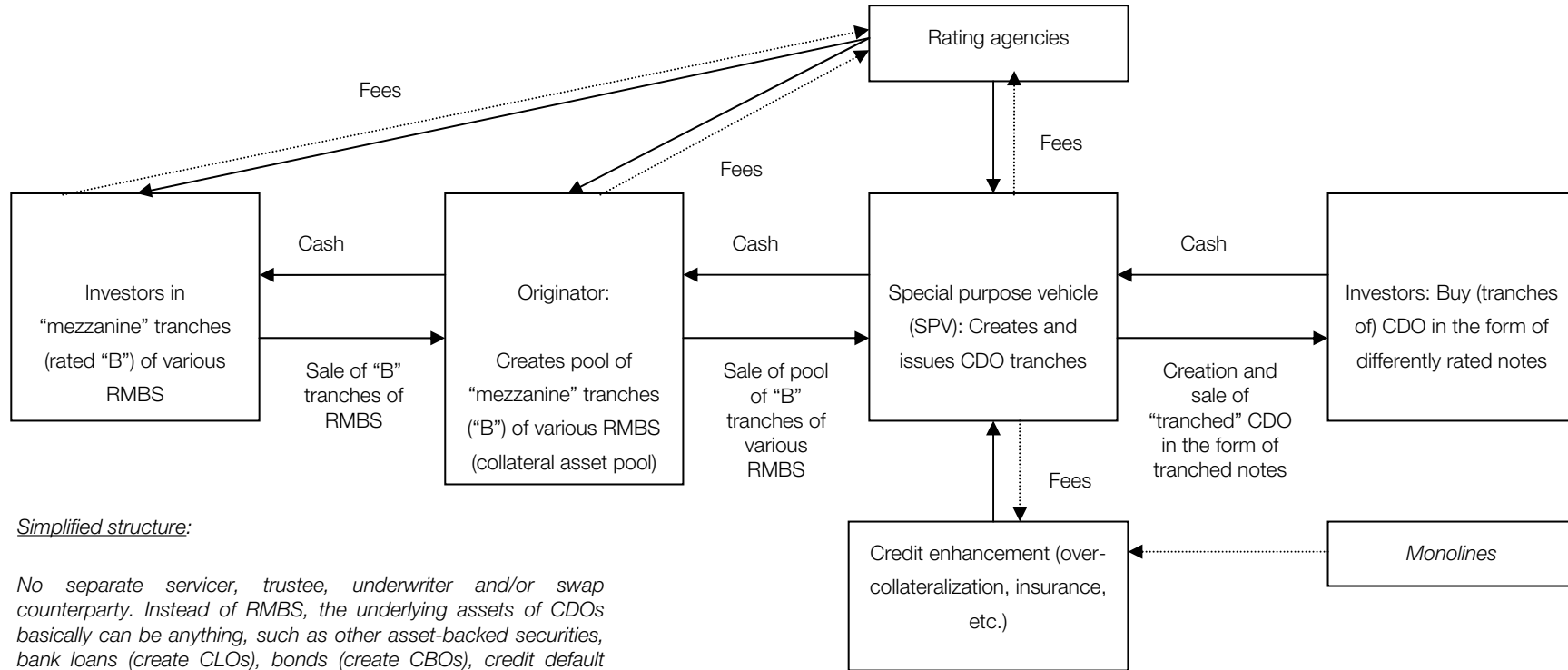
Chart 6. Global CDO issuance by currency



SOURCE: SIFMA.

Figure 5:

Creation of a collateralized debt obligation (CDO) based on “mezzanine” tranches of residential mortgage-backed securities (RMBS) (“Cash flow”, “true” sale CDO)

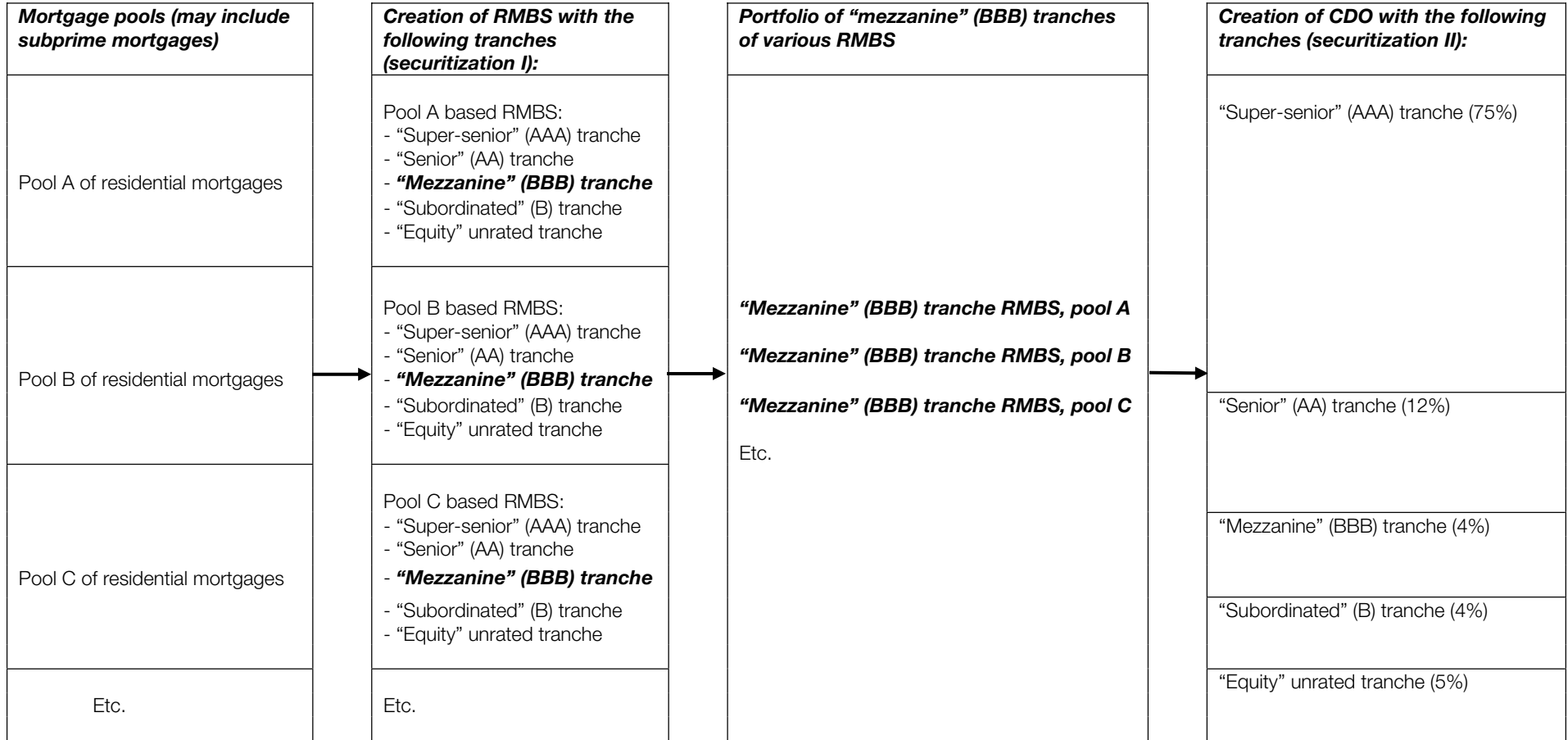


Simplified structure:

No separate servicer, trustee, underwriter and/or swap counterparty. Instead of RMBS, the underlying assets of CDOs basically can be anything, such as other asset-backed securities, bank loans (create CLOs), bonds (create CBOs), credit default swaps and even other CDOs and hybrid portfolios.

SOURCE: Adapted from: ECB (2008a), Criado and Van Rixtel (2007), Renault (2007), IMF (2006), Cousseran and Rahmouni (2005) and Tavakoli (2003).

Figure 6: Example of “double layered securitization” process: Creation of CDOs that are based on residential mortgage-backed securities (RMBS)



SOURCE: Criado and Van Rixtel (2007) and Citigroup (2007).

Table 3: Relationship between structured CDOs and the subprime crisis¹

	Types of CDOs based on various types of asset-backed securities (ABS) as collateral	
	CDOs with "high grade" rated ABS as collateral	CDOs with "mezzanine" rated ABS as collateral
Specific collateral:		
- Subprime residential mortgage-backed securities (subprime RMBS)	50%	77%
- Other residential mortgage-backed securities (RMBS)	25%	12%
- CDOs	19%	6%
- Other underlying collateral	6%	5%
	100%	100%

SOURCE: BIS (2008a), p.3.

¹ Typical composition of underlying assets of CDOs which invest in asset-backed securities (ABS) (so-called "ABS CDOs"). Thus, this example coincides with the example shown in Figure 5, where the creation of a CDO was shown based on residential mortgage-backed securities (RMBS).

4 Credit derivatives

Generally, credit derivatives can be defined as private financial contracts under which an financial market participant buys or sells risk protection in a OTC market against the credit risk associated with a specific reference entity (or specific entities) [IMF (2007)]. The main credit derivatives (which have been typified as “pure” credit derivatives in Figure 1 in section 2) are *credit default swaps* (CDS) and *synthetic collateralized debt obligations* (CDOs), with other instruments existing as well such *credit-linked notes*, *total return swaps* and *credit spread options* [BIS (2004); Mengle (2007); Partnoy and Skeel, Jr. (2007); Morgan Stanley (2008)]. The main types of credit default swaps are *single name CDS* and *CDS index contracts*, whereas an important category of synthetic CDOs are so-called *index tranches-based CDOs*. An overview of the development of these main credit derivatives is presented in Table 4, which shows that CDS index contracts expanded their market share rather significantly in recent years.

Table 4: Composition of credit derivatives market¹

	2000	2002	2004	2006
Single name CDS	38%	45%	51%	33%
CDS index contracts ²	-	-	11%	38%
Synthetic CDO ³	-	-	16%	17%
Others ⁴	62%	55%	22%	12%
	100%	100%	100%	100%

SOURCE: BBA (2006).

¹ This overview does not include “cash flow” CDOs, which do not use credit default swaps to actually transfer credit risk (contrary to synthetic CDOs).

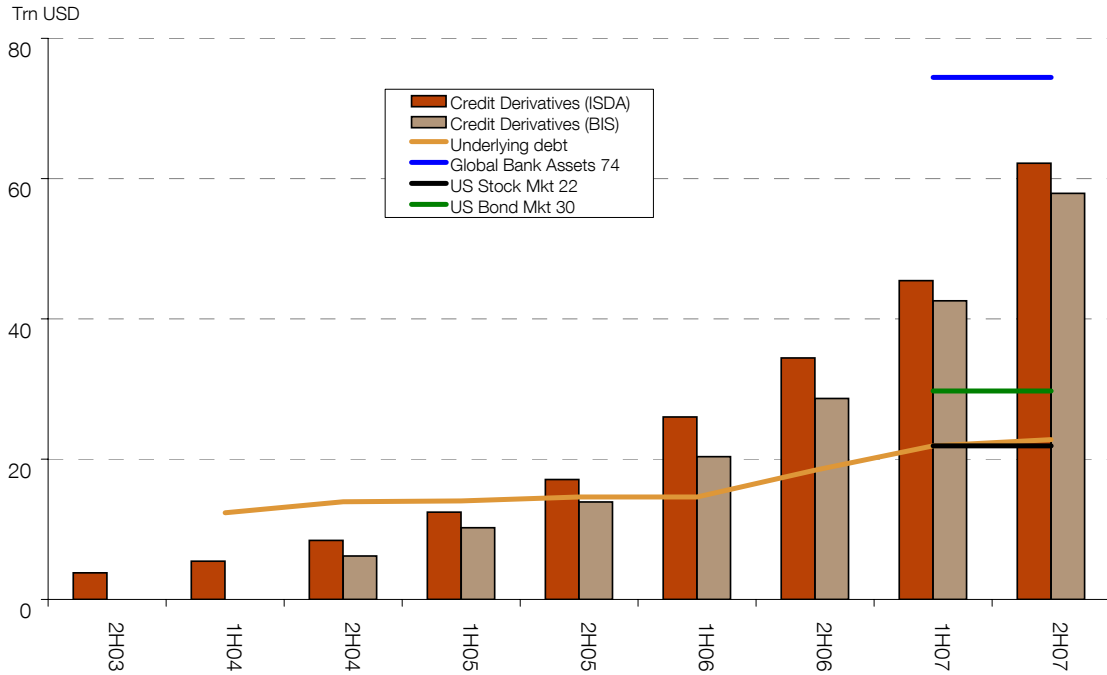
² CDS index contracts consist of CDS linked to indices and CDS linked to tranches of indices.

³ Include fully funded and partially funded synthetic CDOs.

⁴ Include basket products, credit-linked notes, credit spread options, equity-linked credit products, swaptions and others.

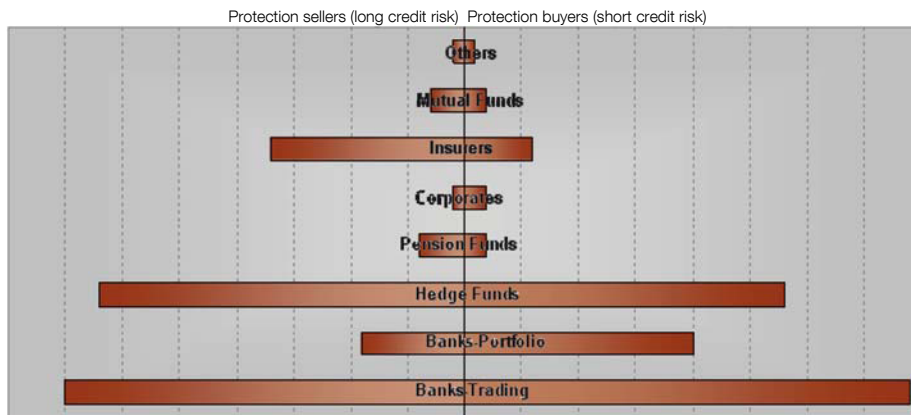
Chart 7 shows the evolution of the total amount outstanding of credit derivatives, which is based on a comparison of different sources. Moreover, it includes for comparative purposes the development of the total underlying debt instruments and the size of the credit derivatives markets as a percentage of total bank assets. Chart 8 provides a breakdown of the main players in the credit derivatives market (buyers and sellers) as mentioned in the most recent market survey available (BBA).

Chart 7. CDS notional outstanding amounts



SOURCE: ISDA and BIS.

Chart 8. Buyers and sellers of credit derivatives



SOURCE: BBA (2006).

% share of each side of the market (5%).

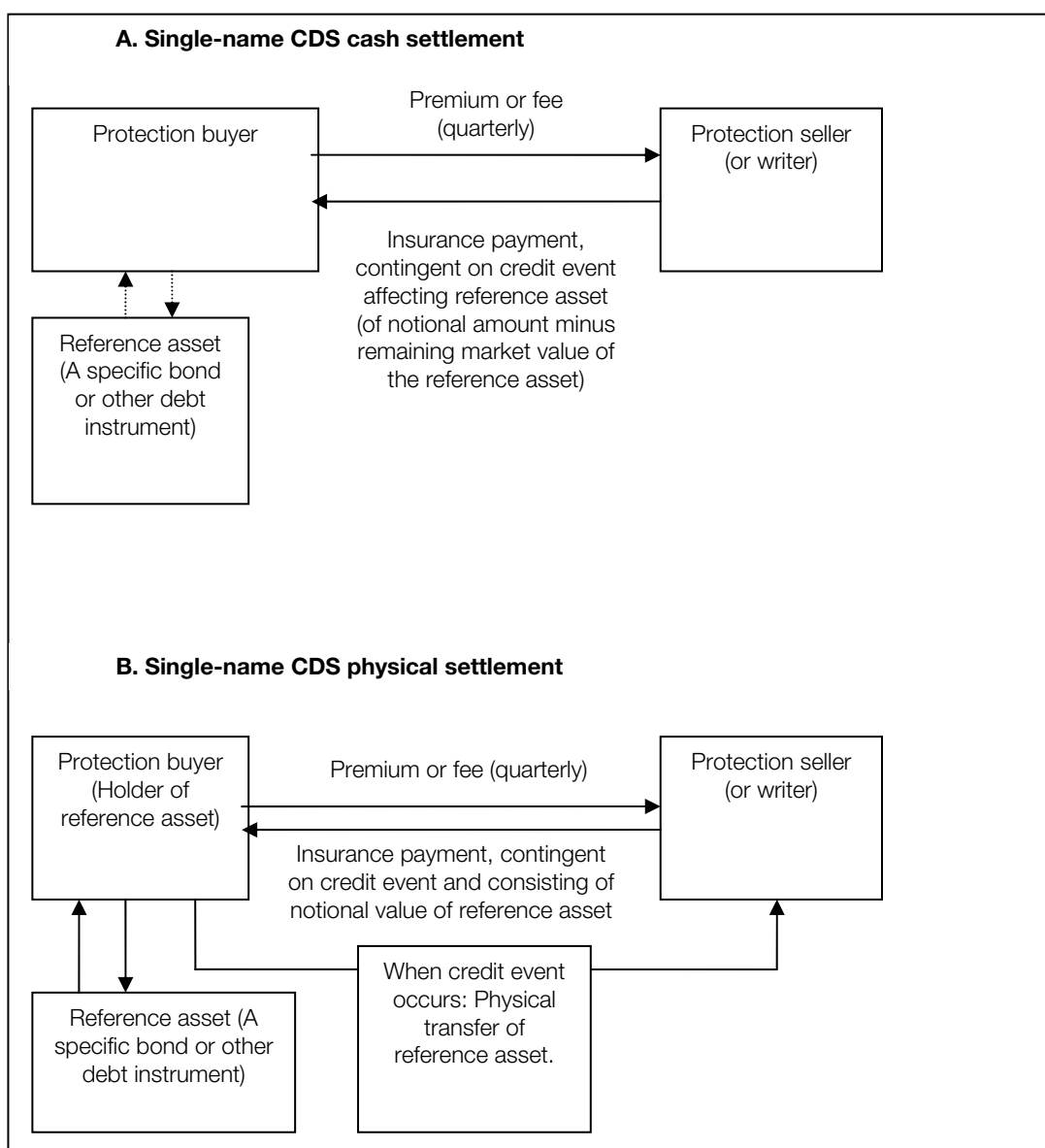
Various credit derivatives have played rather different roles in the 2007-2008 financial turmoil. Whereas “synthetic” CDOs were much more actively involved in the propagation of the subprime mortgage market shock [see ECB (2008b)], credit default swaps played a more indirect role. Nevertheless, these latter credit derivatives are included in this Occasional Paper because they have been instrumental in monitoring and assessing the development of the turmoil. Some examples of this function will be shown in this section, for both the *single name* and *index CDS* contracts. These various instruments will be discussed in respectively Section 4.1 (*credit default swaps*) and Section 4.2 (“synthetic” CDOs).

4.1 Credit default swaps (CDS)

Credit default swaps are the most important credit derivatives and consist of two main categories, i.e. *single name* contracts and *index* contracts.

A *single-name credit default swap* is a bilateral, off-balance-sheet agreement between two counterparties in which one party, the protection seller or writer, offers the other party, the buyer, protection or insurance against credit risk on a specified amount of face value of bonds (the notional principal) against a credit event by a third party (reference entity, reference asset) for a specified period of time, in return for premium payments [Chacko et al. (2006)]. For example, a bank sells protection against the default of a bond (with a notional amount of say \$1,000) issued by Ford Motor Company (i.e. the third party) to an investor who pays a premium or fee to the bank.

Figure 7: Single name credit default swap



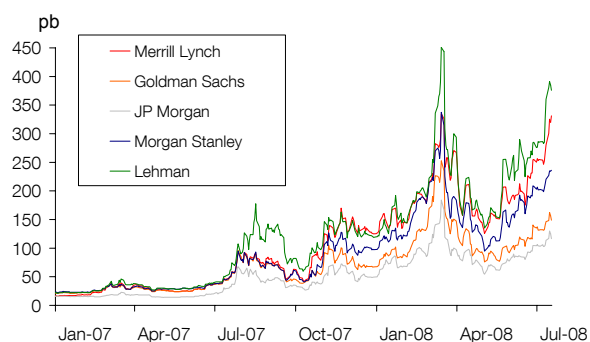
A *credit event* is an event that affects materially the value of the reference asset and which triggers the termination of the CDS contract, as the insurance will have to be paid out.⁴ In the absence of a credit event, the protection buyer will just pay the regular premium each quarter to the protection seller until the expiration of the CDS contract. If a credit event occurs, the buyer of protection pays the last quarterly premium in arrears to the seller. In a so-called “*cash*” settlement, the seller of protection makes the insurance payment to the protection buyer which consists of the notional amount of the bond (here \$1,000) minus its remaining market value (see Figure 7A). In a so-called “*physical*” settlement, the protection seller just pays the notional amount of the bond to the buyer, while the buyer needs to deliver the actual reference asset to the seller (for example here the bond issued by Ford Motor Company) (see Figure 7B).

The *spreads of single-name CDS contracts* related to specific *banks* are extremely useful indicators for both policymakers and market participants regarding market assessments of the soundness and risk-profile of these institutions. Both theoretical and empirical analysis have shown that the development of these spreads provides important information about various risks faced by banks, such as overall *credit risk* and more specific *counterparty* and *liquidity risk*, and even have predictive power [see for example: Di Cesare (2006); Düllmann and Sosinska (2007)]. Econometric techniques exist that can be used to calculate the probability of default of a specific bank as well as its counterparty risk from its CDS spread, such as perceived by financial markets. The actual movement of the spreads of banks’ single name CDS contracts is indicative of specific tensions related to these banks and may be used to monitor how they have been affected by the 2007-2008 financial turmoil. Chart 9 shows the development of the CDS spreads for a number of selected *globally operating banks* in two panels. Panel A provides information on a number of US investment banks (Merrill Lynch, Goldman Sachs, JP Morgan, Morgan Stanley and Lehman Brothers), whereas Panel B shows a mixture of European banks (BNP Paribas, Deutsche Bank, Barclays, UBS, Santander and BBVA). From the development of these CDS spreads, it is clear that the peak of the financial turmoil was reached in March-April 2008, after having started in August 2007. Furthermore, financial markets differentiated substantially in their assessment of individual banks, with the spreads of particularly affected banks such as Lehman Brothers, Merrill Lynch and UBS increasing to much higher levels than other banks. Chart 10 presents the development of the actual CDS spread of *Bear Stearns* (Panel A) and the one and five year *default probabilities* of Bear Stearns derived from this spread (Panel B), which indicate the probability such as perceived by the market that this investment bank would go bankrupt within one year and within five years. Bear Stearns has been the highest profile victim in the financial turmoil and had to be rescued from bankruptcy in March 2008 through a takeover by JP Morgan orchestrated by the Federal Reserve. Panel A shows that the CDS spread of Bear Stearns increased to levels significantly surpassing those of CDS spreads of other banks (see for example Chart 9), whereas Panel B indicates that the one and five year default probabilities of the bank spiked in March to respectively 12% and 45%, which are extremely high compared both with historical levels and those of comparable investment banks.

4. The list of credit events in a CDS contract may include one or more of the following: Bankruptcy or insolvency of the reference entity, failure to pay an amount above a specified threshold over a specified period and financial or debt restructuring.

Chart 9. Single-name CDS of international banks

PANEL A. US Investment Banks



SOURCE: Datastream.

PANEL B. European banks

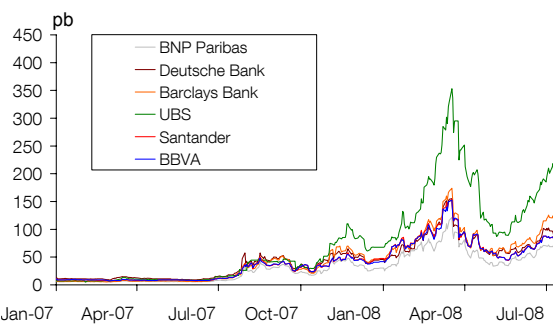


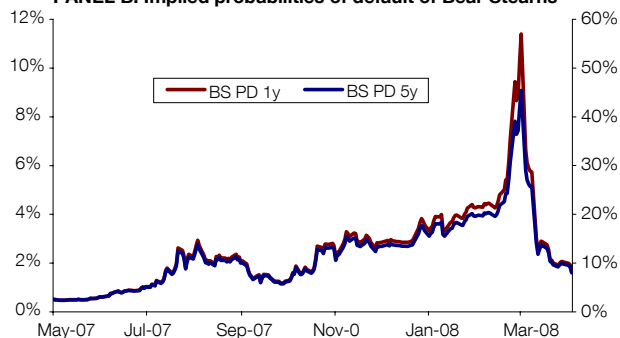
Chart 10. Single-name CDS of Bear Stearns and implied probability default

PANEL A. Bear Stearns CDS spread



SOURCE: Datastream.

PANEL B. Implied probabilities of default of Bear Stearns



In addition to single-name contracts, the CDS market is characterized by the existence of *index* contracts. A *credit default swap index contract* can be interpreted as an insurance contract covering the default risk of the pool of debt instruments issued by the group of companies on which the index is based. Essentially, a CDS index contract is a private OTC transaction that enables investors to take synthetic exposures or protection on a large diversified and standardized basket of reference entities, which may be as many as 125 corporate entities [Citigroup (2006b); Duffie (2007)]. The index contracts are standardized in terms of the index composition procedure, premium payment and maturity, and consequently are more liquid than single-name contracts. Thus, CDS index contracts are traded at a smaller bid-offer spread because it is cheaper to hedge a portfolio of bonds with a CDS index contract than to buy the single name CDS of all bonds included in the index. The composition of the index (i.e. the specific reference entities included in the index) is rebalanced, or “*rolled over*” (on the so-called “*roll*” day), each six months (March and September) based on the vote of participating dealers in accordance with the index rules to ensure that the index is up to date regarding the underlying reference entities. The modified index will be “*on-the-run*” for the next six months, while the “*off-the-run*” CDS index contract (with the “old” composition) remains static for the rest of its lifetime if no defaults occur of the underlying reference entities. There are two kinds of CDS index contracts, i.e. *unfunded* (so-called “*multi-name*” CDS) and *funded* contracts (which are based on so-called Credit Linked Notes) [BIS (2005b)]. The specifics of unfunded and funded contracts are beyond the scope of this paper. For more specific information see for example Chacko et al. (2006), BIS (2005b) and Mengle (2007).

Currently, there are two main families of standardized CDS index contracts that appeared in 2004 and which are marketed by the Markit Group⁵, i.e. the Dow Jones *CDX* and

5. The Markit Group is owned by 16 large investment banks.

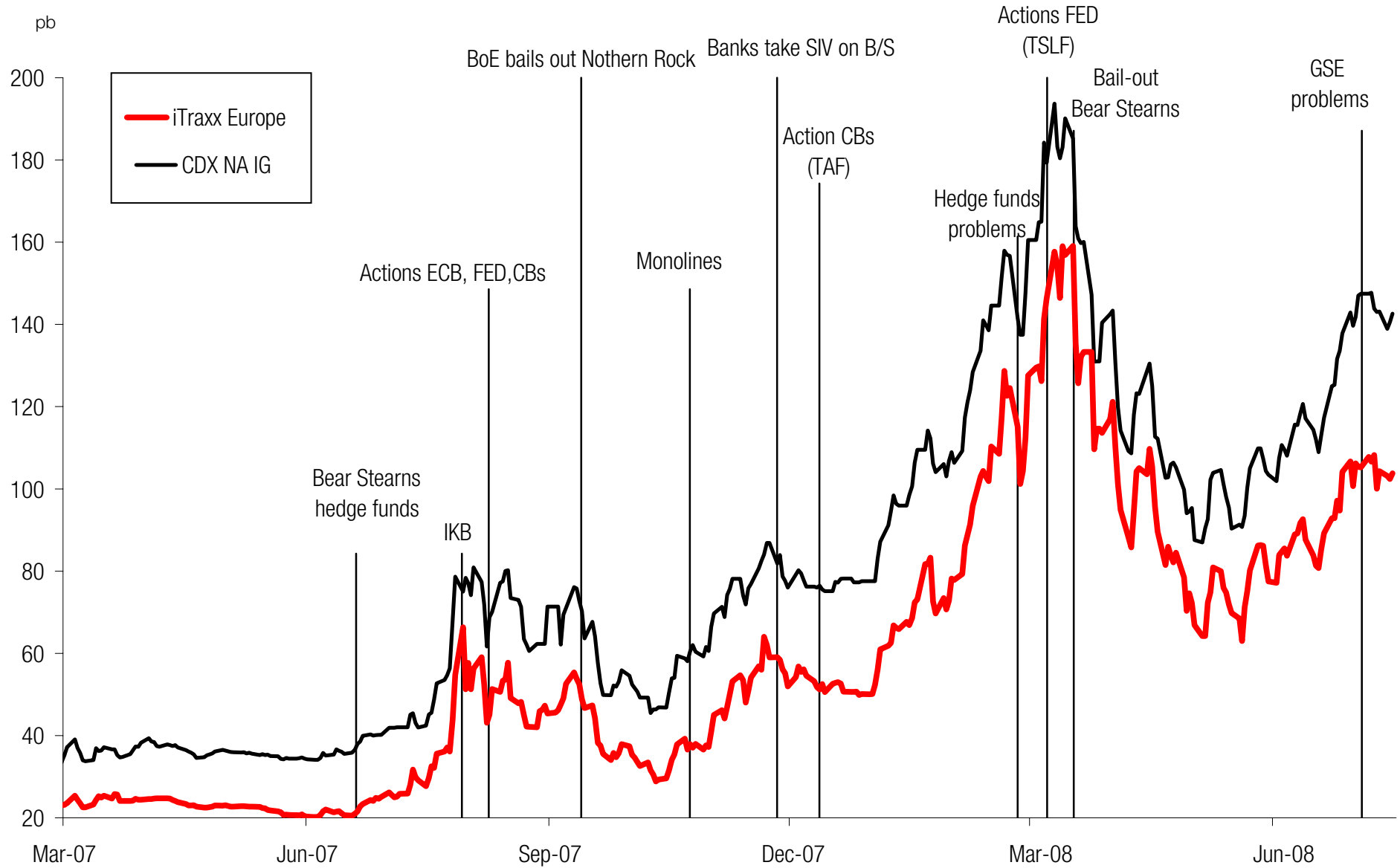
iTraxx families of corporate CDS indices (for an overview see Table 5 in Annex 1). The former includes reference entities in North America and emerging markets, while the latter includes reference entities in the European and Asian markets. The indices are based on active names in the single-name CDS market and a variety of indices is maintained. The two main and most actively traded CDS index contracts are based on a diversified investment grade portfolio of 125 names (the *CDX.NA.IG* for the United States and the *iTraxx Europe* index). For example, the *CDX.NA.IG* contract is essentially a portfolio of 125 five-year single-name credit default swaps, covering equal principal amounts of debt of each of 125 named North American investment-grade issuers [Duffie (2007)].

The development of the spreads of these two main index contracts is highly indicative of the development of the financial turmoil in 2007 and 2008, as they are representative for a broad category of financial and non-financial companies. Chart 11 shows the *CDX.NA.IG* and *iTraxx Europe* spreads, in relation with a number of highly published events which played key roles in the turmoil. These events are the collapse of two Bear Stearn's hedge funds in June 2007, the collapse of the German bank IKB in July/August, the liquidity emergency operations by major central banks in August, the bail-out of the mortgage lender Northern Rock in the UK in September, the increasing problems with the financial guarantors or monoclones in October/November, the absorption of assets of problem SIVs by banks on their balance sheets in November/December, additional central bank actions in December, a widening of the financial market problems to hedge funds and specific credit market segments in February/March, the large scale market supporting actions by the Federal Reserve in March, including the bail-out of Bear Stearns and the uncertainties surrounding Fannie Mae and Freddie Mac (GSE problems) in July. The specific pattern of the two credit spread series shows that the developments in the US and Europe were highly correlated, indicating the truly global nature of the financial turmoil. It is also clear the problems culminated in March 2008 and that the interventions by the Federal Reserve in that month managed to mitigate the tensions.

A CDS index contract is divided in *tranches (CDS index tranches)*, rather similar to other structured finance products (see for example Figure 3 in section 3.1). Each tranche refers to a different segment of the loss distribution of the underlying index. Most CDS index contracts are divided in five tranches. The specific tranches of the most traded (*CDX.NA.IG*) contract are as follows (within brackets the percentage loss on the index contract that the specific tranche absorbs): The *equity tranche* (0-3%), *junior mezzanine tranche* (3-7%), *senior mezzanine tranche* (7-10%), *junior senior tranche* (10-15%) and *super senior tranche* (15-30%). Thus, investors in the "equity" tranche ("0-3%") are the first to pay their counterparties when defaults of the underlying reference entities occur, up to a maximum amount of 3% of the losses on the index contract. If the losses on the CDS index contract are larger than 3%, then the investors in the junior mezzanine tranche (3-7%) need to start paying their counterparties, etc. CDS index tranches are standardized and thus help fostering liquidity in the credit derivatives markets. Technically, CDS index tranches are basically *synthetic CDOs*, which will be discussed in section 4.2.

Scheicher (2008) has conducted an empirical investigation of the determinants of the spreads of *CDS index tranches* during the financial turmoil, both for tranches of the main *iTraxx* and *CDX* index contracts. He finds that liquidity factors played a more important role since the start of the turmoil in the summer of 2007, indicating that the turmoil affected the pricing of these instruments. Thus, also here, the development and decomposition of CDS spreads (in their determinants) provides information on the development of the financial market tensions in 2007 and 2008.

Chart 11: The 2007-2008 financial turmoil as shown by the spreads of CDS index contracts



SOURCE: Datastream.

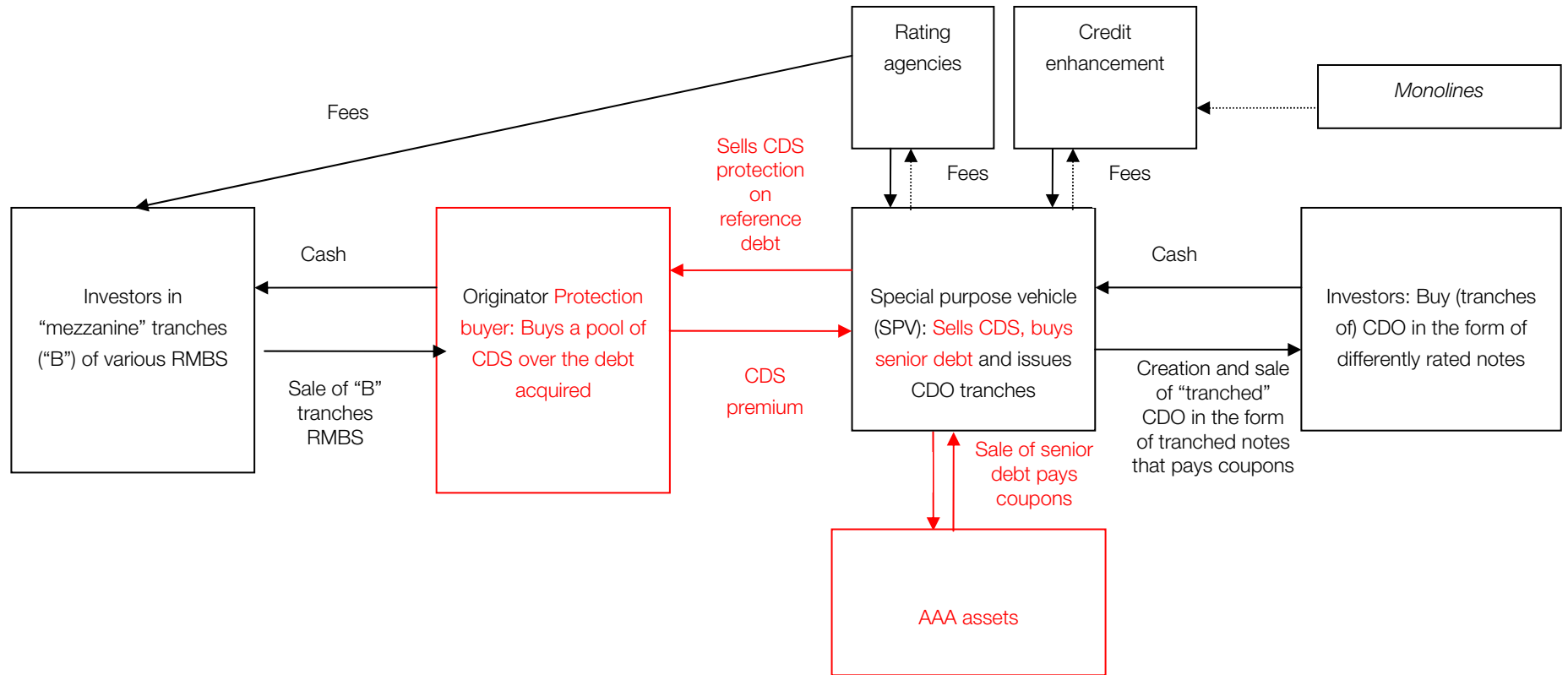
4.2 “Synthetic” collateralized debt obligations (CDOs)

Similar to securitizations, in addition to “cash flow” CDOs (which were discussed in section 3.3), there also exist “synthetic” CDOs, where the SPE/SPV does not buy physically the portfolio of underlying debt instruments, but sells credit default swaps over the same debt instruments underlying the “cash flow” CDO described above. Thus, the SPE/SPV acquires the same credit risk exposure to this underlying debt without owning it, and transfers this credit risk to investors.

An example of a synthetic CDO is shown in Figure 8 (with in red the changes from the “cash flow” CDO). The originator only wants to get rid of the credit risk of the underlying pool of assets and not the physical assets themselves, in this case (similar as above) a pool of “mezzanine” tranches (rated “B”) of various RMBS. The originator buys protection through a CDS contract with the SPE/SPV, which is the seller of protection and gets a CDS premium for the acquired exposure to the credit risk of the reference debt. The SPE/SPV transfers the credit exposure by issuing CDO tranches and selling it to investors (through the same process as in the “cash” CDO). With the cash it receives from its investors, SPE/SPV buys senior low risk debt (rated AAA), receives the interest of that debt (coupons) and transfers a proportion of it to the investors. If a credit event occurs to the underlying debt, the SPE/SPV sells the senior debt in order to pay the CDS protection to the originator. With the profit from the sale of this debt, the SPE/SPV also returns to the investors their principal-back payment. If the SPE/SPV lacks funds to fully repay all investors the principal amount that they invested in the tranching CDO, the order of payment follows the seniority of the tranches.

“Synthetic” CDOs played a rather active role in the propagation of the financial turmoil. In the context of actual and feared further downgrades of various financial guarantors (or monolines) and of CDOs by the rating agencies, a rapid unwinding of “synthetic” CDO positions by in particular *hedge funds* resulted in a further widening of credit spreads, as demand for these products collapsed [ECB (2008b)]. This process spilled over to other structured finance products such as residential and commercial mortgage-backed securities (RMBS and CMBS) and other asset-backed securities.

Figure 8: Creation of a “synthetic” collateralized debt obligation (CDO) based on “mezzanine” tranches of RMBS



SOURCE: Adapted from: Chacko et al. (2006).

5 Conclusions: The specific channels of structured finance and the financial turmoil

The financial turmoil of 2007-2008 has revealed substantial transparency and information shortcomings due to the increasing opaqueness and complexity of the global financial system. This has in particular been evidenced by uncertainty on the size and distribution of the losses resulting from the subprime crisis and on the valuation and related ratings of structured finance products. The aim of this Occasional Paper has been to present an overview of the fundamental characteristics of the main instruments of structured finance and their role in the financial turmoil. It has been shown that in particular various *securitizations* or *asset-backed securities* (in the broad sense), such as (subprime) *mortgage-backed securities* (MBS), *asset-backed commercial paper* (ABCP) and “*cash-flow collateralized debt obligations* (CDOs), and one of the main types of “*pure*” *credit derivatives*, i.e. “*synthetic*” CDOs, played a crucial role in the development and propagation of the financial turmoil. It also has been shown that another credit derivative, i.e. *credit default swaps* (CDS), played a much more indirect role and has been of particular use in monitoring the spreading of the financial turmoil.

As a summary overview, Figure 9 presents in a stylized format the *main channels* through which structured finance instruments played a role in the financial turmoil. Although not all possible channels are shown, the figure depicts the essential interaction between the use of structured finance, the banking sector and the development of the financial turmoil. The specific instruments are chosen as examples and are representative of the underlying mechanisms. Not all structured finance instruments that have been of significance in the turmoil are included; for example, “*synthetic*” CDOs are not shown here. Furthermore, by far not all players involved are taken into account, such as hedge funds, other highly leveraged financial intermediaries and other investors [for this, see for example ECB (2008b), pp.32-33].

Channel 1 involves the *creation of subprime mortgage-backed securities* by a US commercial bank, which are bought by ABCP conduits, for example a SIV belonging to a German bank. The example of a German bank has been chosen as a number of German banks, such as IKB and Sachsen Landesbank, were particularly affected by the turmoil in this way. When due to the subprime crisis the value of these assets declined substantially, the collateral values of the SIV eroded, resulting in major refinancing difficulties.

In a similar fashion, *Channel 2* shows the *creation of “cash flow” CDOs* by a US investment bank which are collateralized by *residential mortgage loans* that also are bought by the SIV of the German bank. Also here, the collapse of the price of these instruments created major problems and losses for the SIV.

Channel 3 involves the *creation of the same CDOs* as in Channel 2, but now the US investment bank needs to *absorb* these instruments on its *balance sheet*. Namely, the financial turmoil eroded completely investor confidence in CDOs and banks were no longer able to sell these instruments to investors. As a result, some SPVs of banks became saddled with CDOs as they could not get rid of them, forcing their sponsoring banks to absorb these instruments. Merrill Lynch has been one of the (investment) banks hit in particular through this channel [see for example The New Yorker (2008)].

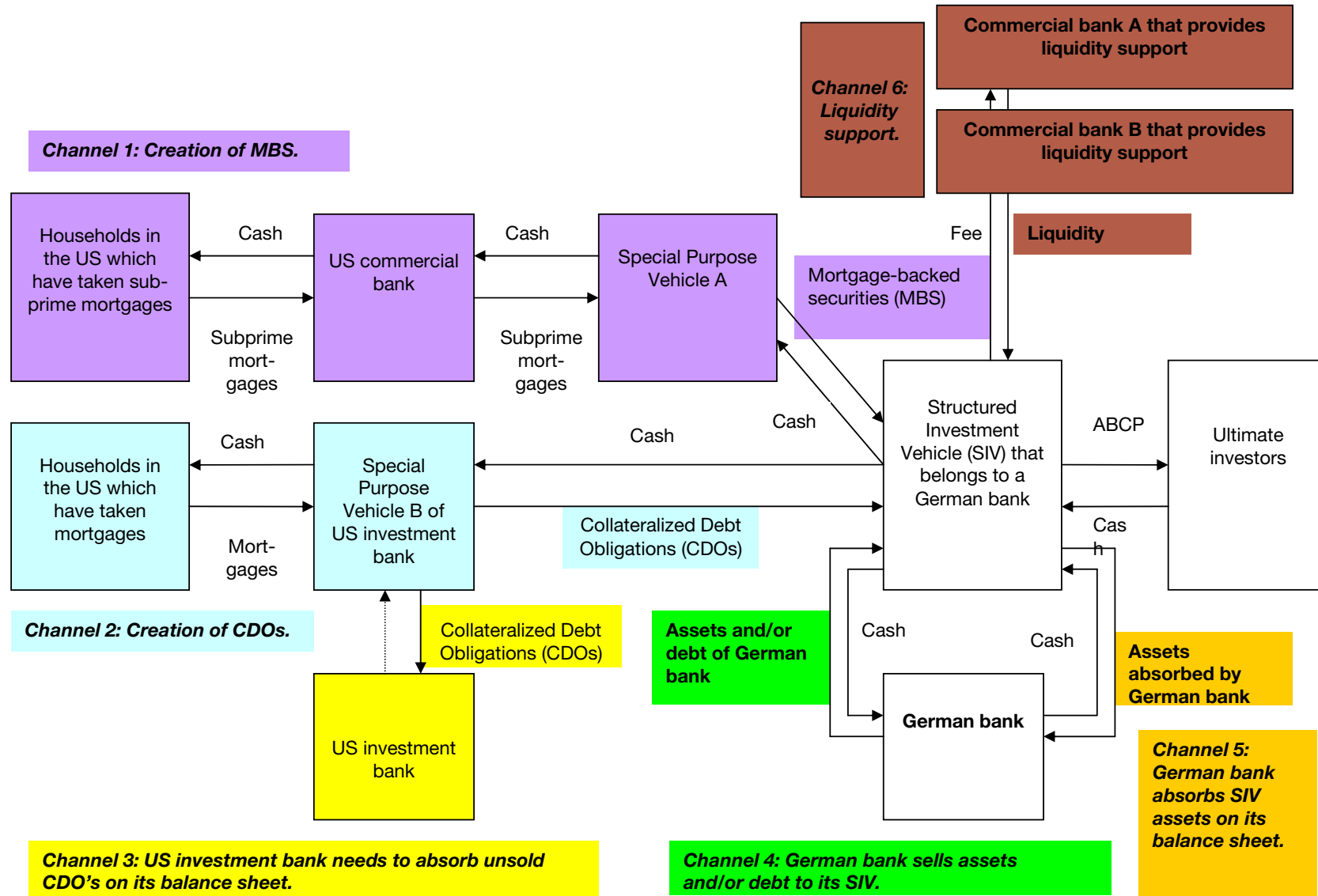
Channel 4 is a channel more directly linked to the *banks and their ABCP conduits*. Numerous banks used these conduits —here the SIV belonging to a German bank— to put specific assets off their balance sheet and/or to absorb debt securities that they issued. Some of these assets proved to be relatively risky when the financial turmoil evolved, generating losses for the SIV. Moreover, when the crisis of confidence in financial markets hit the banking sector, also the debt securities issued by the sponsoring bank that the SIV purchased dropped in value.

Channel 5 is related to the previous channels and essentially involves the *absorption of the impaired assets from the ABCP conduits by the sponsoring banks*, again here by the German bank that owns the SIV. Ultimately, the problems spilled over to the banks arising from the fact that they had to bail out their SIVs, for example by taking over the impaired assets which had declined significantly in value, a process that resulted in major write-downs and losses for the banks involved. Some banks that have been hit via this channel are HSBC, Citigroup and WestLB.

Finally, *Channel 6* is also related to the first four channels and consists of the process that the *liquidity facilitating banks* actually needed to provide *liquidity support to the ABCP conduits*. As the ABCP issued by the conduits is of very short maturity, they almost constantly are in need of new funding. Thus, when a crisis hits and no investor wants to buy ABCP, almost immediately conduits face major funding problems and need to sell their assets and/or need to obtain liquidity support from the liquidity facilitating banks. Of course, in a collapsing market, it is very difficult to sell assets or only at a substantial loss, so in fact many SIVs had no choice than to recourse primarily to liquidity support when the subprime crisis hit the market. This resulted in major liquidity strains for the banks involved, as they had not anticipated that they would have to provide such large amounts of liquidity and consequently the process resulted in considerable disarray in interbank markets.

We want to conclude this Occasional Paper with a short discussion of the role of the *rating agencies* in structured finance and the financial turmoil. Although this aspect can only be touched upon briefly, it is highly important to understand some of the mechanisms underlying the problems with structured finance during most of 2007 and 2008. Essentially, the financial turmoil highlighted strong doubts on the *ratings methodologies* for structured finance products in general and their *robustness* in particular. These doubts further increased by substantial ratings' *downgrades* both in *number* and *severity* in the course of 2007 and 2008m which resulted in major *valuation losses* of the structured finance instruments involved. All in all, the turmoil revealed intrinsic problems with the *valuation* of structured finance products and various *incentive problems* involving the rating agencies [see: Mason and Rosner (2007a and 2007b); BIS (2008d)].

Figure 9: The channels of contagion involving structured finance in the financial turmoil



SOURCE: Own elaboration.

Annex 1: Overview of CDS index contracts

In addition to the CDX.NA.IG and iTraxx Europe index contracts, numerous other contracts exist (see Table 5). For example, other contracts are based on diversified high yield portfolios of 100 names (CDX.NA.HY) and on subsets of 10-30 names of sector portfolios and sub-investment grade portfolios (CDX.NA.HY.B, CDX.NA.HY.BB, CDX.NA.HY.BBB). The iTraxx HiVol index is based on a subset of the main investment grade index consisting of what are seen as the most risky 30 constituents at the time the index is constructed. The iTraxx Crossover index is constructed in a similar way, but is composed of 30 sub-investment grade credits that consist of the most liquid non-financial companies rated BBB/Baa3 or lower, thus mainly junk or below-investment grade status, and on negative outlook.

All names in these indices are equally weighted and contracts with 3, 5, 7 and 10 year maturities are available. Recently, three new different types of CDS index contracts have appeared which belong to the CDX and iTraxx families, but which are different in terms of the underlying debt (see Table 5). The CDX.EM index is based on CDS contracts with as underlying debt instruments the sovereign bonds issued by 14 emerging market economies, while the CDX.EM. "diversified" index comprises exposure to 20 CDS of both sovereign and corporate debt instruments of emerging market economies. The LCDX and LevX indexes track CDS over a pool of respectively 100 and 35 specific leveraged loans in North America and Europe. The emergence of structured products has resulted in the introduction of related CDS index contracts in North America, which are the ABX.HE, TABX and CMBX index contracts (see Table 5). The ABX.HE (i.e. "Asset Backed Index of Home Equity") is a CDS index contract launched in January 2006 based on 20 recently issued US sub-prime residential mortgage-backed securities (i.e. subprime residential mortgage-backed securities or RMBS). The TABX is a CDS index contract based on tranches of the ABX.HE. Finally, the CMBX is a CDS index contract launched in March 2006 referenced on 25 commercial mortgage securitizations (CMBS) [see IMF (2008)].

Table 5: Overview of CDS Index contracts

Undelying Debt		North America	Europe	Asia-Australia
Corporate debt	Prime	CDX.NA.IG (125) CDX.NA.HY (100)	iTraxx Europe (125) iTraxx Europe HY (100) itraxx Sterling D (75)	iTraxx Japan(50) iTraxx Australia(25) iTraxx Asia exJap IG(50) iTraxx Asia exJap HY(20)
	Sub-indices	CDX.NA.XO (35) CDX.NA.IG.HVol (30)	iTraxx Crossover (30) iTraxx HiVol (30)	Japan HiVol (10)
	Sub-sectors	Financials (24) Consumers (34) Energy (15) Industrials (30) TMT (22)	Senior Financials(25) Sub Financials (25) Non-Financial (100) Consumers (30) Cyclicals (15) Non-cyclicals (15) Energy (20) Industrials(20) TMT (20) Autos (10)	Japan Financials(10) Japan Tech(10) Japan Capital goods(10)
	Sub-grades	CDX.NA.HY.B (variable) CDX.NA.HY.BB (variable) CDX.NA.HY.HB (variable)		
	Other	CDX.EM diversified (40) CDX.EM (14)		
Sovereign debt				
Leveraged Loans	→	LCDX(100)	LevX(35)	
Structured finance	{	ABX.HE (20) TABX CMBX (25)		

Number of reference entities in bracket

SOURCE: Markit and own elaboration.

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