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TRÉSOR-ECONOMICS

The Credit Default Swap (CDS) market

- One of the earliest signs of the financial crisis in summer 2007 was the plunge in the indices compiled from credit default swaps (CDSs) on a basket of subprime-backed bonds. Recently, the worsening situation in the emerging countries has been perceptible in the steep rise of CDS spreads on their sovereign bonds.

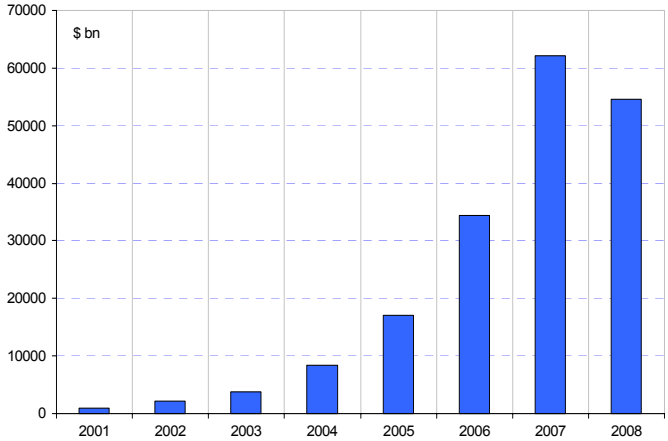
- Credit default swaps protect investors against credit events on reference corporate or sovereign bonds. By guaranteeing against default risk, they also allow banks to reduce their equity requirements. In sum, CDSs are a hedging tool widely used by financial agents such as banks and hedge funds, which explains the CDS market's significant expansion in the past five years.

- As in over-the-counter (OTC) markets, **counterparty risk is high**, for there is no CDS clearing house to underwrite commitments through a system of margin calls and collateral. The failure of a major player such as Lehman Brothers or AIG can thus aggravate systemic risk, although several procedures established by the International Swaps and Derivatives Association (ISDA) have, until now, proven their efficiency for unwinding CDS contracts.

- **The growth of CDSs helps lower banking systems' total equity requirements**, as the reduction in the equity requirement for the CDS buyer (the protection buyer) exceeds the additional equity requirements incurred by the seller.

- **CDS premiums (spreads) serve to estimate default probabilities expected by markets** and are thus a leading indicator of fears over the solvency of corporate or government borrowers. However, the direct use of CDS spreads to determine expected default rates is subject to several biases.

CDS notional outstandings



Source: ISDA

DGTPE
DIRECTION GÉNÉRALE DU TRÉSOR
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1. A contract that protects against default risk on a specific asset or on an asset portfolio

A CDS is a credit derivative. It is a contract that protects against the default risk (credit event) for a given reference entity (such as a firm or a State). The CDS may cover a bond issued by the reference entity or the reference entity itself directly (in which case the contract will be unwound through a cash settlement only). The buyer of the protection acquires the right to sell a specific bond (reference bond issued by the reference entity) at par value if a credit event occurs.[1] In exchange, the buyer pays the seller agreed amounts at regular intervals until the CDS expires or a credit event occurs. In the latter case, the buyer makes a final payment and the swap is unwound either by delivery of the underlying asset or in cash. CDSs are priced in basis points (bps) relative to the notional outstanding. For example, a 5-year 300-bp CDS means that, absent a credit event, the buyer will have to pay the seller 3% of the notional amount every year for five years. A CDS is thus defined by four parameters: reference entity, notional amount, spread, and maturity.

2. CDS notional outstandings[2] have grown 15-fold in the past five years

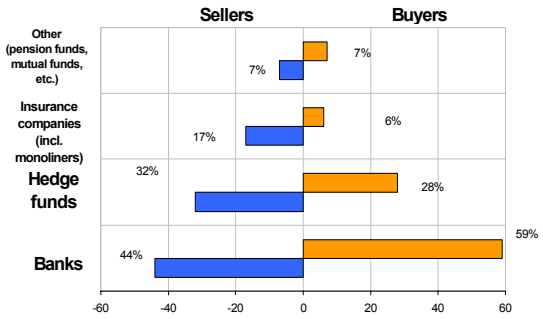
The credit derivatives market, particularly the CDS segment, has enjoyed robust growth in recent years. ISDA reckons that notional outstandings have risen more than 1,500% in the past five years, from $3,780 billion in 2003 to $62,170 billion in 2007. According to the latest three-year survey by the Bank for International Settlements (BIS) dated June 2007, CDSs account for over 90% of credit derivatives versus 10% for credit-security options and almost 10% for over-the-counter market derivatives-versus less than 2% in 2004[3].

According to the BIS, slightly over one half of CDSs (55%) are "single-name" contracts, i.e., concerning only one reference entity, while "multi-name"[4] CDSs accounted for some 45% of the total.[5] Most of the underlying assets are good-quality bonds: 60% are between AAA and BBB. However, the latest British Bankers' Association Credit Derivatives Report (2006) indicates that the share of lower-rated assets rose from 13% in 2004 to 23% in 2006.

The main market players consist of protection buyers (CDS buyers) and protection sellers (CDS sellers):

- **Banks are net CDS buyers**. They accounted for over 59% of buyers and 44% of sellers in 2006. Their predominance is due more to their trading activities (35% for sales, 39% for purchases) than to credit management (9% and 20% respectively).
- **Hedge funds are net CDS sellers**, representing 32% of sellers and 28% of buyers in 2006.
- **Insurance companies are net CDS sellers**, accounting for 17% of sellers and 6% of buyers.
- Other players made up 7% of the market on the selling and purchasing ends. This category notably includes pension funds and firms.

Chart 1: Market breakdown by player category



Source: British Bankers' Association

Since 31 October 2008, the Depository Trust and Clearing Corporation (DTCC) has been publishing weekly data on the CDS market. On the basis of published outstandings ($33 trillion), DTCC data cover more than 50% of the market. They suggest that **the largest category consists of CDSs on sovereigns, particularly emerging countries** (Table 1). **They therefore represent the asset class for which protection demand is currently highest, together with CDSs on banks**. All the countries ranking among the top 20 reference entities on a notional basis are emerging countries-Italy excepted. The second most represented group is financial institutions with GMAC (the General Motors finance corporation), Merrill Lynch, Goldman Sachs, Deutsche Bank, Citigroup, JPMorgan, and Morgan Stanley.

(1) The ISDA defines several credit events including bankruptcy, failure to pay, restructuring, and repudiation by authorities.

(2) Notional outstandings are the sums covered by CDSs. For example, absent a credit event, a CDS listed at 100 bps for a notional $100 million will be booked at $100 million in outstandings, but the buyer will have paid out only 1% of the total.

(3) For information, interest-rate derivatives make up 75% of the market, exchange-rate derivatives over 10%.

(4) Examples of multi-name CDSs include the iTraxx Crossover, computed from a portfolio of CDSs for investment-grade European companies, and the Markit ABX index, which tracks subprime real-estate loans.

(5) The BBA and BIS data are not always consistent. For example, the share of single-name CDSs in 2006 was estimated at 33% by BBA versus 55% by BIS.

Box 1: **Example of CDS**

On 1 March 2007, two firms sign a five-year CDS contract on a notional €100 million in bonds, i.e., one million bonds priced at €100 on the transaction day. The buyer undertakes to pay 90 bps for protection against default by the reference entity.

If the reference entity does not default, the buyer will receive nothing but will have paid out €900,000 (0.9% of the total) on 1 March of every year from 2008 to 2012.

If a credit event occurs on 1 September 2010, the CDS will be settled either in cash or upon delivery of the underlying instrument:

- cash settlement: the seller undertakes to pay the buyer (100-Z)% of €100 million, where Z is the value of the reference bond, listed at a date subsequent to the credit event. If the bond trades at €35 after the credit event, the seller will therefore pay the buyer €65 million.
- settlement by delivery of the underlying instrument: the buyer is entitled to deliver the reference bonds at a par value of €100 million and receives €100 million from the seller.

Tableau 1 : Reference entities ranked by CDS gross notional outstandings (at 31 Jan 2009)

Rank	Reference entity	Gross notional ($ bn)
1	Turkey	168
2	Italy	162
3	Brazil	109
4	Russia	100
5	Morgan Stanley	83
6	GMAC LLC	79
7	The Goldman Sachs Group Inc.	79
8	General Electric Capital Corporation	77
9	Merrill Lynch & Co. Inc.	75
10	Mexico	70
11	Spain	69
12	Philippines	67
13	Deutsche Bank Aktiengesellschaft	66
14	Telecom Italia SPA	63
15	Bank of America Corporation	62
16	Deutsche Telekom AG	61
17	France Télécom	60
18	Citigroup Inc.	59
19	JPMorgan Chase & Co	58
20	MBIA Insurance Corporation	56

Source: DTCC

The DTCC also publishes net outstandings, which measure the financial system's net commitments in regard to a reference entity.[6] This aggregate makes it possible to identify the entities whose payment default would generate the largest transfers of funds in the economic system. Table 2 shows that the highest net outstandings are for contracts on developed countries (in particular Italy, Germany, France, and Austria) and emerging countries (notably Brazil, Russia, and Turkey). The major financial institutions are also over-represented in the ranking. In other words, a default by one of these players would trigger a massive transfer of funds in the financial system.

Tableau 2 : Reference entities ranked by net notional outstandings (at 31 Jan 2009)

Rank	Reference entity	Net notional ($ bn)
1	Italy	18
2	Spain	12
3	General Electric Capital Corporation	11
4	Germany	10
5	Brazil	10
6	Deutsche Bank Aktiengesellschaft	8
7	Greece	7
8	Russia	6
9	Morgan Stanley	6
10	France	6
11	Portugal	6
12	Merrill Lynch & Co. Inc.	5
13	Turkey	5
14	The Goldman Sachs Group Inc.	5
15	Austria	5
16	South Korea	5
17	Barclays Bank PLC	5
18	UBS AG	5
19	MBIA Insurance Corporation	5
20	JPMorgan Chase & Co	4

Source: DTCC

3. The CDS market is an OTC market used to value credit risk and improve bond-market liquidity, but its counterparty risk (default by CDS seller) is high

The CDS market is an over-the-counter (OTC) market: transactions are executed directly between contracting parties, with no clearing house or margin-call mechanism. However, the ISDA has standardized CDSs[7] by setting guidelines for definition of credit events, types of bonds concerned, notional amounts, and settlement procedures in the wake of a credit event. These guidelines were used to assess CDS prices after the Lehman Brothers failure.[8]

In theory, the growth of the CDS market offers several advantages:

- It allows more efficient credit-risk management since the CDS-unlike a bond-focuses exclusively on credit risk and not on interest-rate risk as well.[9] The CDS thus specifically satisfies a demand for insurance that would otherwise be unmet.
- The CDS market improves bond-market liquidity by establishing a buyer of last resort (the CDS seller) in

(6) For example, if a bank sells $100 of a CDS and buys $50 of the same CDS, the gross notional is $150 but the net notional is only $50.

(7) The first agreement, called the ISDA Master Agreement, dates from 1999 and was amended in 2003.

(8) Such procedures had already been used successfully after the failures of WorldCom in 2002, Parmalat in 2005, and Delta Airlines in 2006.

(9) The bond spread depends on the company's credit risk, the bond's liquidity, and the interest-rate risk. For the CDS, the spread largely depends on the credit risk, although there is a residual liquidity spread and a counterparty-risk spread.

the event of default.

However, as the CDS market is not an organized market, it does not enjoy the guarantees provided by a clearing house (such as margin calls[10]) and the counterparty risk-i.e., the CDS seller's default-may thus be very high.

At a United States Senate hearing,[11] SEC (Securities and Exchange Commission) chairman Christopher Cox advocated the establishment of a CDS market oversight system. At present, under the Commodity Futures Modernization Act of 2000, CDSs are not regulated. At the behest of Tim Geithner, then chairman of the New York Fed, two plans for CDS clearing houses were launched: the CME/Citadel plan, modeled on the existing energy-derivatives clearing house; and the ICE/TCC plan, backed by about ten major banks, which would be placed under the dual oversight of the New York Fed and the New York State Banking Department. Both plans are currently awaiting approval by the Fed and SEC.

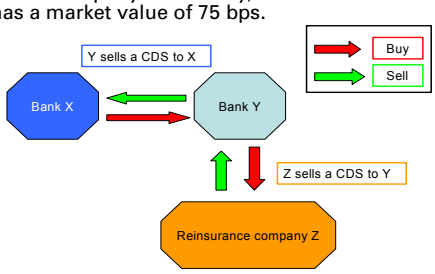
In Europe, the Ecofin Council, the European Central Bank (ECB), and the European Commission have initiated a project to establish a European-based CDS clearing house. The ISDA[12] and the European Banking Federation (EBF)[13] have announced their support for the plan and their intention to adopt the system by end-July 2009.

4. An instrument that reduces equity requirements and increases systemic risk

By purchasing a CDS, a bank reduces its prudential equity requirements, as CDS ownership protects it against the bond issuer's default.

Box 2: **Example of impact of CDSs on equity requirements**

Bank X owns a 10-year bond with a par value of 1,000 issued by a BBB-rated company. It buys a CDS on this bond from Bank Y, which underwrites the risk with a reinsurance company. Ultimately, if the issuer defaults, the reinsurer will make a payment to Y that will ensure payment to X. The CDS has a market value of 75 bps.



Before the CDS purchase, Bank X had an equity requirement of 80:

$$\underbrace{1000}_{\text{bond value}} \times \underbrace{100\%}_{\text{weighting applied to BBB securities}} \times \underbrace{8\%}_{\text{prudential ratio}} = 80$$

where 100% is the weighting that applies to the bond issuer (if the issuer were rated above BBB, the weighting would thus be lower) and 8% is the regulatory capital-adequacy ratio.

After the CDS purchase, the weighting applied to Bank Y (here 20%, as Y is a bank guarantor) replaces the weighting applied to the bond issuer (here 100%, because of the BBB rating), thanks to the guarantee provided by the CDS. The equity requirement is thus reduced to 16:

$$\underbrace{1000}_{\text{bond value}} \times \underbrace{20\%}_{\text{weighting of CDS seller bank}} \times \underbrace{8\%}_{\text{prudential ratio}} = 16$$

As the asset has become less risky, Bank X has reduced its equity requirement from 80 to 16, i.e., by 80%.

Thanks to its strictly identical buying and positions, Bank Y is not exposed to default risk. Its equity requirement in regard to the counterparty risk (vis-à-vis the reinsurance company) is 3.6 (the asset is booked to the bank's trading portfolio).

$$[(\underbrace{75}_{\text{CDS spread}} + (\underbrace{1000}_{\text{notional}} \times \underbrace{1,5\%}_{\text{regulatory surcharge coefficient}})) \times \underbrace{50\%}_{\text{weighting of off-balance-sheet commitments}} \times \underbrace{8\%}_{\text{prudential ratio}}] = 3,6$$

where 75 is the CDS price, 1000 the notional, 1.5% the regulatory surcharge coefficient, and 50% the coefficient assigned to off-balance-sheet transactions involving derivative instruments (regulatory data).

Consequently, at the banking-system level, the equity requirement is reduced by a factor of more than four, from 80 without the CDS to 19.6 with the CDS.

Source: Revue de la Stabilité Financière, November 2002

(10) For example, to guarantee the proper execution of a swap contract, the contracting parties may have to put up collateral assets as a counterpart. If the value of the collateral decreases, the agent must then provide additional guarantees in the form of cash or collateral: the agent will face a margin call. This mechanism for managing counterparty risk is used in all organized markets. While also applied to some OTC transactions, its use in OTC markets is in no way mandatory.

(11) Banking, Real Estate, and Urban Affairs Committee, 23 September 2008.

(12) ISDA press release, 19 February 2009, available at www.isda.org.

(13) EBF press release, 19 February 2009, available at www.fbe.be.

Several practices in the CDS market are particularly detrimental to financial stability:

Bank intermediation: **CDSs can sharply reduce the banking sector's equity requirements** because different regulatory regimes apply to the buyer (who enjoys a steep reduction in equity requirements) and the seller (who is exposed to a relatively mild increase in equity requirements: see example in box 2).

Mirror transactions: If a bank wants to reduce its equity requirement without lowering its exposure to default risk on its bond holdings, it can buy a CDS from another bank and sell that bank an identical CDS. Economically, the transaction is neutral with respect to the bank's default risk, which remains unchanged, but the equity requirement is lessened.

Systemic risk: Absent a clearing house, the CDS market's systemic risk is potentially high, especially given the lack of mechanisms to hedge counterparty risk (see box 3).

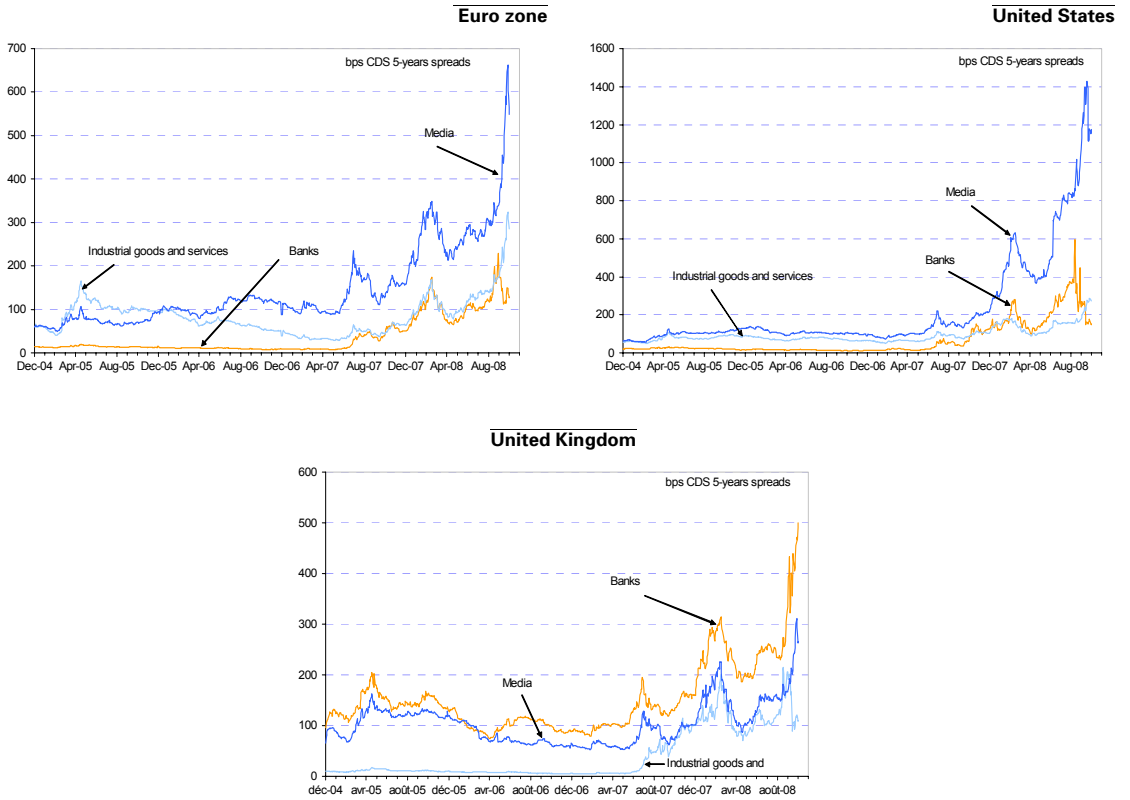
5. CDS spreads up sharply in all sectors since summer 2007

Since the start of the financial crisis, CDS spreads have risen sharply in all sectors (chart 2).

Broadly speaking, we can distinguish two periods:

- Between 2004 and July 2007: CDS spreads were rather low for all three sectors (banks, media, and industrial goods and services), reflecting a low probability of default by firms in those sectors. Spread movements in each sector seemed unrelated. For example, in the euro zone between 2005 and April 2007, CDS spreads fell in the industrial goods and services sector, rose in the media sector, and held steady in the banking sector.
- Since July 2007, all CDS spreads have risen sharply, reflecting both a higher default risk in each sector and a greater market risk, as CDS spreads in all three sectors are now moving in unison.

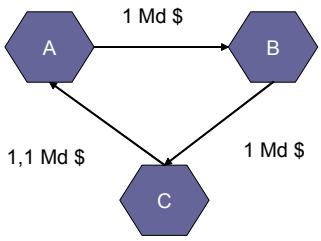
Chart 2: CDS spreads in euro zone, United States, and United Kingdom



Source: Datastream

Box 3: **Systemic risk in the CDS market**

Let us assume three agents, A, B, and C, operating in the mortgage-loan CDS market. If the borrower defaults, A must pay $1 billion to B but will receive $1.1 billion from C. B must pay $1 billion to C.



The notional outstanding is $3.1 billion but the net value of these CDSs is only $100 million.

If agent A disappears (for example, owing to failure), agents B and C are no longer covered. B now has a $1-billion exposure to C if the reference entity experiences a credit event. One agent's failure thus has a tenfold effect on the systemic risk. The establishment of a clearing house would curtail these effects by reducing the net value to just $100 million.

This type of mechanism may exist for various kinds of non-CDS contracts, but it is probably more powerful in the CDS market, because of the capital gains that it offers to all participants.

6. Despite bias, CDS spreads provide a gauge of market expectations

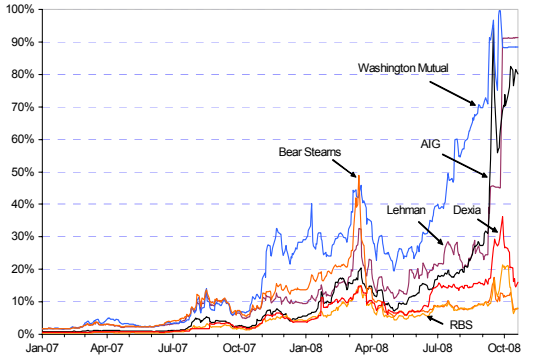
CDS prices are supposed to directly reflect market expectations of default risk. Unlike bond spreads, CDS prices are determined not by interest-rate risk but solely by credit risk. By making assumptions on the recovery rate in the event of default (here 40%[14]) and setting the frequency of possibilities of default during the year (here, only once a year), we can directly estimate the default rates expected by the market.[15] As the CDS market is now large and covers many assets, we can also estimate the probability of default for a specific firm or for government bonds.

One limitation of this approach is that the default probabilities obtained are probabilities expected in a risk-neutral universe; being risk-averse, agents demand a risk premium (spread) linked to the default risk, and the probability of default determined from CDSs is overestimated, particularly when market risk increases. This bias is difficult to correct, for it critically depends on the assumptions about the form and parameters of the investors' utility function.

Another bias, in the opposite direction, stems from the fact that agents may also demand a premium for counterparty risk-namely, the possibility that not only the reference entity but the CDS seller itself may default. The higher the counterparty risk, the lower the CDS premium, i.e., the cost of the insurance. Furthermore, the closer the correlation between the default risks for the reference entity and the seller, the higher the counterparty-risk premium. Let us take the example of a CDS on Lehman Brothers. If the CDS is sold by another bank, the CDS premium may include a counterparty premium that will introduce a downward bias into the estimated probability of a Lehman Brothers default, all the more so as the seller bank's default risk is high.

Lastly, the CDS premium also incorporates a liquidity premium, which is all the greater if the contract trading volume is modest.

Chart 3: Expected 5-year default rates determined from CDSs

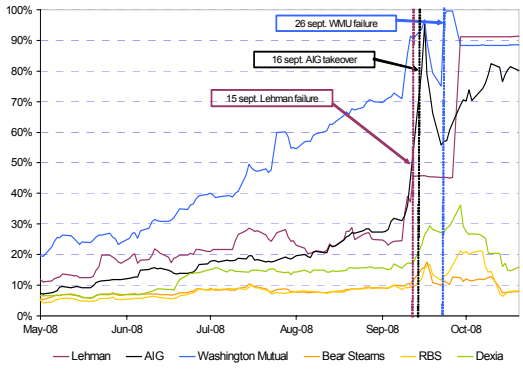


Sources: Datastream, DGTPE estimates

By observing expected default rates, we can nevertheless identify periods of strong fears over bank solvency. This was notably the case with Bear Stearns (the object of an emergency buyout in March 2008), Lehman Brothers (declared bankrupt on 15 September 2008), and AIG (taken over on 16 September 2008). Washington Mutual offers a particularly effective illustration of the usefulness of CDSs in measuring expectations: the expected default rates started rising sharply in December 2007, more than nine months before the bank's failure, peaking at over 40% in late January 2008. The default probabilities estimated from CDSs can therefore provide a leading indicator of the failure of the firms concerned.

(14) See box 4.
(15) See box 5.

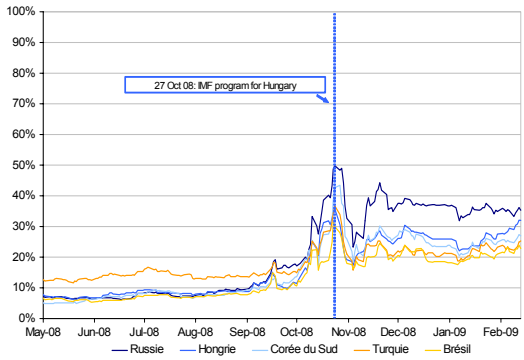
Chart 4: Expected 5-year default rates determined from CDSs



Sources: Datastream, DGTPE estimates

CDSs can also be used to measure default risk on sovereign bonds. If we take the example of emerging countries, particularly Russia and Hungary, we observe a sharp rise in expected default rates in late October 2008. This pattern may reflect stronger concerns over sovereign solvency as well as a general upward revaluation of financial-market risk.

Chart 5: Expected 5-year default rates determined from CDSs



Sources: Datastream, DGTPE estimates

Antoine BOUVERET

Box 4: **Impact of recovery-rate hypothesis on estimated default probabilities**

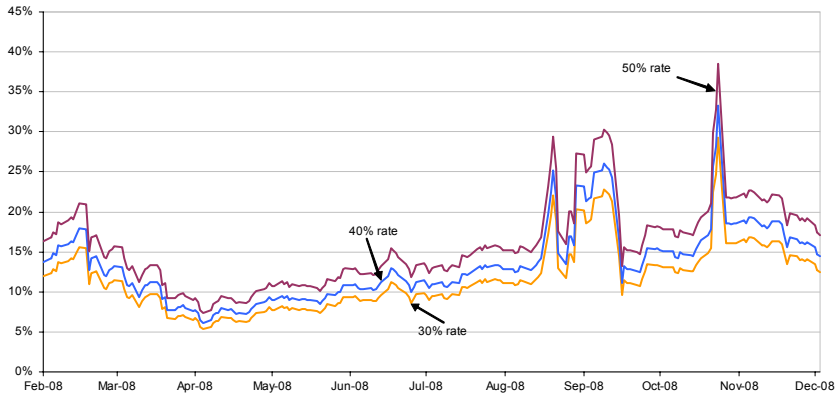
CDS-based estimates of default probabilities assume a 40% recovery rate, which is the average recovery rate estimated for North America by the Moody's rating agency. Empirically, recovery rates vary according to the rank of the debt examined. Moody's has estimated recovery rates for North American and European corporate bonds in the period 1985-2005.[a].

Table 3: Recovery rates estimated by Moody's as percentages of face value

Class	Average recovery rate, 1985-2005	
	Europe	North America
Guaranteed senior	52.7%	62.6%
Non-guaranteed senior	26.0%	38.4%
Senior subordinated	40.6%	32.0%
Subordinated	35.3%	31.0%
Junior subordinated	N/A	23.9%
Total	32.3%	40.1%

The higher the recovery rate, the higher the estimated probability of default,[b] but the differences are relatively small. By way of example, Chart 6 shows the estimated Citigroup default rates for several recovery rates. The differences between the estimates with a 30% recovery rate and those with a 50% recovery rate are, on average, less than 5 percentage points.

Chart 6: CDS-based expected 5-year default rates for Citigroup for different recovery rates



a. See Varma, P. and Bodard, E., "Default and Recovery Rates of European Corporate Bond Issuers: 1985-2005," *Moody's Investors Service*, March 2006.

b. If we take two identical CDS spreads for entities with different recovery rates (A's is higher than B's), an identical price implies that the risk of holding a bond A is equal to the risk of holding a bond B. As the holder of bond A recovers a larger sum (higher recovery rate) in the event of default, A's probability of default must exceed B's to justify the price equality (in other words: if the two entities had the same probability of default, the CDS spread on A should be lower than the CDS spread on B). This result is shown in Chart 6 of Box 4: for an identical Citigroup CDS price, the higher the assumed recovery rate, the higher the default rate required to justify the CDS spread.

Box 5: **Determining probabilities of default from CDS spreads**

We can determine probabilities of default from observed CDS spreads.[a]

For a CDS with a maturity N, we assume that defaults can occur only in mid-year and that CDS payments are made once a year, at year-end. The risk-free rate r is assumed to be constant.

Payment flows for the CDS buyer are given by:

$$\underbrace{S\sum_{t=1}^{N} q(t)e^{-rt}}_{\text{payment in the absence of default}} + \underbrace{S\frac{1}{2}\sum_{t=1}^{N} p(t)e^{-r(t-\frac{1}{2})}}_{\text{residual payment in the event of default}} \qquad (1)$$

where *q(t)* is the probability of survival in *t*, *p(t)* the probability of defaulting in *t* and *S* the CDS spread as a percentage of the notional.

Payment flows for the CDS buyer are given by:

$$\underbrace{\sum_{t=1}^{N} p(t)(1-R)e^{-r(t-\frac{1}{2})}}_{\text{residual payments in the event of default}} \qquad (2)$$

where *R* is the recovery rate, assumed to be constant.

In a risk-neutral universe, the lack of arbitrage opportunities implies equality between terms (1) and (2), from which we determine the CDS spread:

$$S = \frac{\sum_{t=1}^{N} p(t)(1-R)e^{-r(t-\frac{1}{2})}}{\sum_{t=1}^{N} q(t)e^{-rt} + \frac{1}{2}\sum_{t=1}^{N} p(t)e^{-r(t-\frac{1}{2})}} \qquad (3)$$

From the observed CDS spreads, we can estimate probabilities of default using equation (3) and numerical methods.

We assume a constant 40% recovery rate and use the one-year LIBOR as the risk-free rate.

a. See Hull, J. and White, A. 2000, "Valuing Credit Default Swaps I: No Counterparty Default Risk," *The Journal of Derivatives 8, No. 1, 29-40* and J. Hull (2007), *Options, futures et autres actifs dérivés*, pp. 542-546.

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