CDS 101

FICC Credit Strategies
ficc-credit-sales-strats@ny.email.gs.com

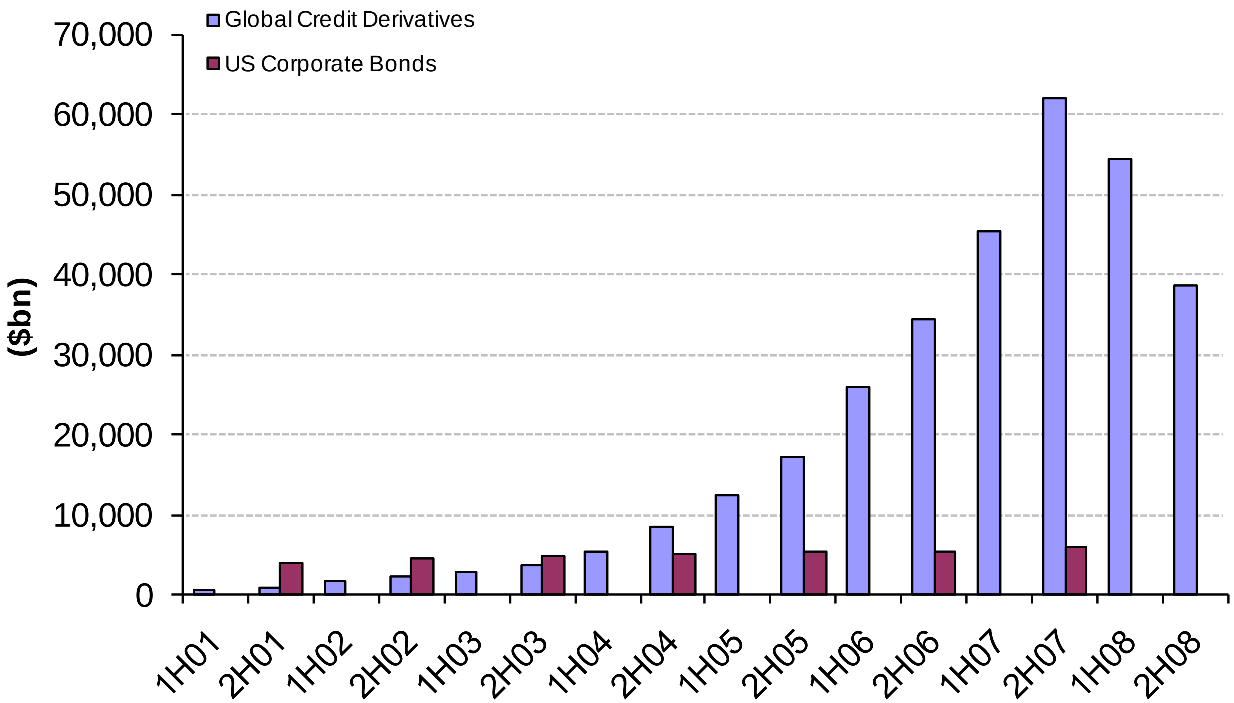
October 2009

Agenda

- Overview of the Credit Derivatives Market
- Credit Derivatives Made Credit Tradable
- Credit Default Swap (CDS) Mechanics
- New Developments in the CDS Market
- Variations on the CDS Contract
- Appendix A: CDS Valuation – Survival Probabilities
- Appendix B: CDS Unwind / Assignment Calculations
- Glossary

Credit Derivatives Market – Over $38 Trillion Notional Outstanding

Credit Derivatives Market at $38 Trillion
Exceeding Eight Times the Size of the US Corporate Bond Market
(Sources: ISDA and BMA)



Initially **highly esoteric instruments**, credit derivatives are now a **mainstream market** with multiple products and broad participation from banks, hedge funds, asset managers and reinsurance companies.

Credit Defaults Swaps (CDS) Made Credit More Tradable

- CDS has enabled investors to short credit easily
  - Given the lack of development of a corporate repo market, the cash credit markets have always been “sticky” – long / “less long” mentality.
  - Credit Derivatives allow investors to express views either way on credit because they are not constrained by the “borrow”.

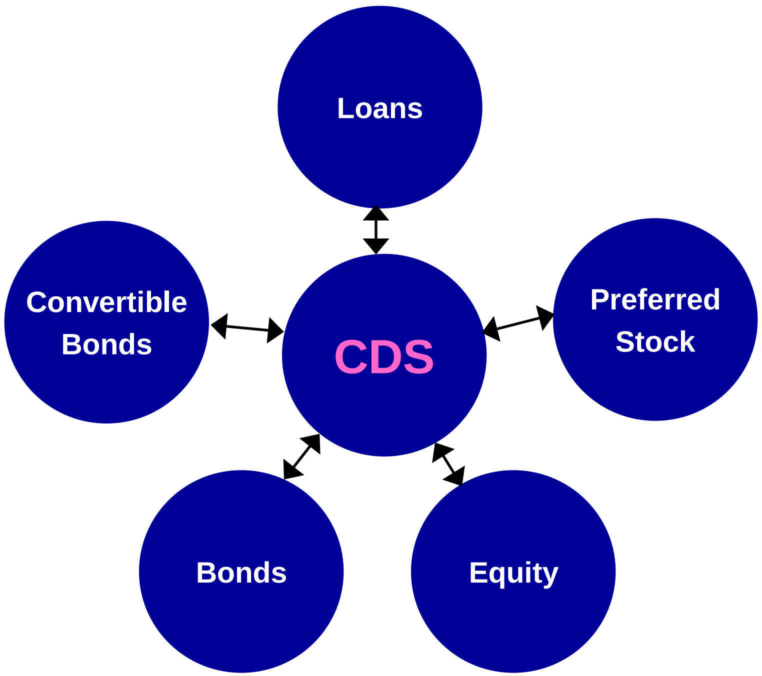
Buy Protection = “Short Credit”

Sell Protection = “Long Credit”

- CDS separate credit risk from other risks inherent in corporate bonds (interest rate risk, volatility etc).
- The CDS market provides a smooth and liquid way of looking at where and how a credit trades.
- Different points on a curve are “fungible”, and technicals prevalent in the bond market are much less of a factor.

CDS Made Credit More Tradable *(Continued)*

- CDS enables investors to exploit relative value opportunities across the capital structure of a firm:



… leading to a proliferation of Capital Structure Arbitrage strategies.

THE CDS CONTRACT

The CDS Contract: Overview

- A Credit Default Swap (CDS) is a bilateral over-the-counter derivative contract
- Transfers the risk of the loss of the face value of a reference debt issuer over a specified period

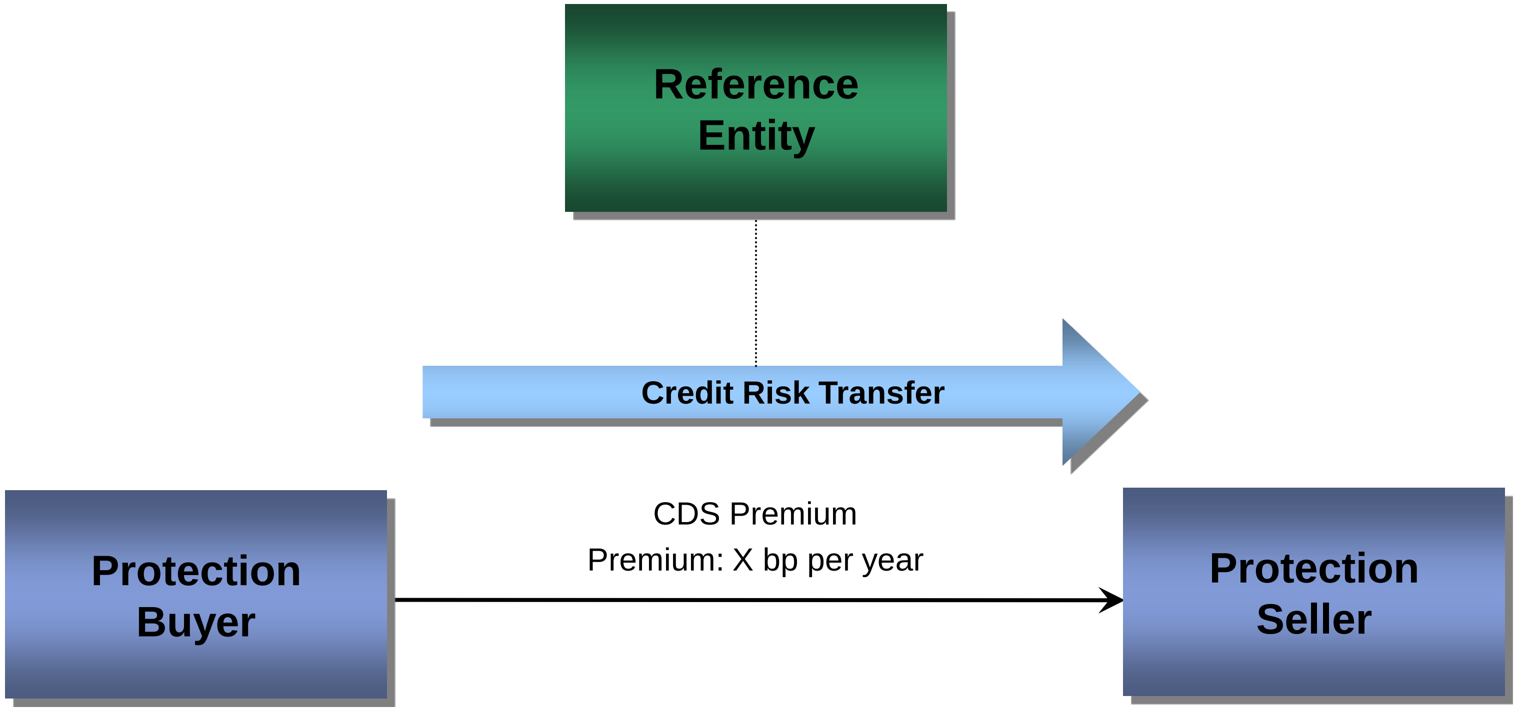
- Two parties
  - Protection buyer (seller of credit risk)
  - Protection seller (buyer of credit risk)

- The basic CDS contract is a "pure" credit risk transfer mechanism, isolating credit risk from:
  - interest rate risk
  - foreign exchange risk
  - risk of security-specific technicals

The CDS Contract: Building Blocks

- Reference Entity: The entity (corporation or sovereign) whose credit risk is transferred
- Notional Amount: Dollar (or other currency) amount of credit protection traded, e.g. $10mm
- Term: Maturity of credit protection
  Standard contracts mature on IMM dates: March 20, June 20, September 20 and December 20.
- Premium (spread): Compensation paid by the protection buyer to the protection seller
  Paid **quarterly**, but **expressed as an annualized** percent of the Notional
- Credit Events: Eventualities suffered by the Reference Entity that "trigger" the contract
- Settlement: Once the contract is triggered, the process by which the protection seller compensates the protection buyer for the loss caused by a Credit Event

The CDS Contract: Mechanics (No Credit Event)

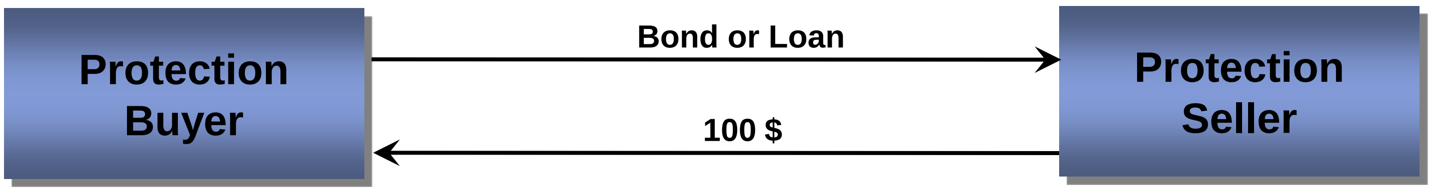


- Between trade initiation and default or maturity, protection buyer makes regular payments to protection seller
- The spread is calculated on the notional amount of protection
- Typically paid **quarterly**
- Payments terminate at maturity or following a credit event

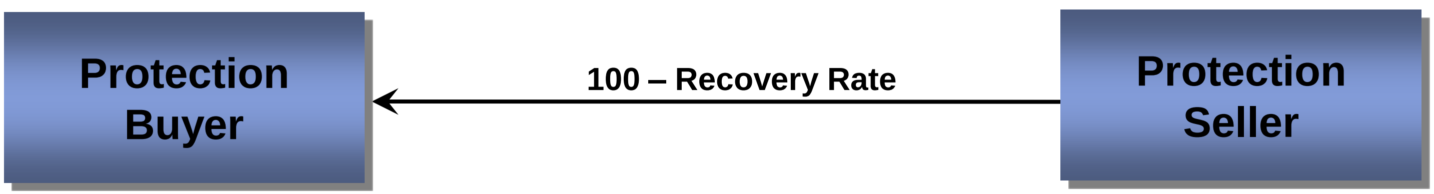
The CDS Contract: Mechanics (After Credit Event)

Payment of insurance following a credit event can occur in one of two ways:

- Physical Settlement



- Cash Settlement



Cash settlement with an option for physical delivery has become the market standard

The CDS Contract: Triggering & Settling

Credit Event Occurs

ISDA defined Credit Events:

- **Bankruptcy**
- **Failure to Pay**
- **Restructuring**
  - **US IG :** No Restructuring[1]
  - **US HY :** No Restructuring
  - **Europe:** Mod-Mod Restructuring
- Obligation Default
- Obligation Acceleration
- Repudiation/Moratorium

Obligations used to determine Failure to Pay:

- Payment
- **Borrowed Money**
- Bond or Loan
- Bond
- Loan
- Reference Obligations Only
- "Derivative Claims"

Settlement Procedure

- **Physical Settlement:**
  Buyer delivers a basket of **Deliverable Obligations** with face value equal to the Notional to Seller in exchange for Notional

or

- **Cash Settlement:**
  Seller pays Buyer Notional minus price assigned to the **Reference Obligation**

[1] See section on New Developments in the CDS market for description of change from Modified Restructuring to No Restructuring as the standard

The CDS Contract: Credit Events

- The standard credit events for **corporate reference entities** are …

Credit Event	Description	Example
Bankruptcy	Corporate becomes insolvent or is unable to pay its debts. The bankruptcy event is, of course, not relevant for sovereign issuers.	Delphi (DPH) Delta Air-Lines (DAL) Northwest Airlines (NWAC)
Failure to Pay	Failure of the reference entity to make due payments, taking into account some grace period to prevent accidental triggering due to administrative error.	Argentina
Restructuring	Changes in the debt obligations of the reference creditor but excluding those that are not associated with credit deterioration such as a renegotiation of more favorable terms.	Conseco Xerox Solutia

The CDS Contract: Restructuring Credit Event

- The protection buyer is long a **cheapest to deliver option**
- This option is only valuable, if different deliverable obligations (which are pari passu) trade at different prices
- Following a **Restructuring** credit event, securities of the company can continue to trade with a term structure
- Example: Following the **Conseco** restructuring, some protection buyers (mainly banks) were able to deliver longer-date bonds trading at $66 while the short-dated assets they were hedging were trading at $80+ and jumped to par as a result of the restructuring
- That led to refining the definition of Restructuring with the **2003 ISDA Credit Derivatives Definitions** – the current standard for trading

The CDS Contract

Restructuring Credit Event – 2003 ISDA Definitions

- **Modified Restructuring (Mod-R)**

  If the owners of the obligations are **<u>materially worse off</u>** from either an economic, credit or risk perspective a restructuring event is said to occur

  - If the reference entity **reduces the rate** or amount of interest payable on an obligation
  - If a **reduction** occurs in the **amount** of principal or premium payable at maturity
  - If the reference entity **defers the payment** date of a coupon or principal
  - If the reference entity **changes the seniority** of an obligation (contractually subordinates obligation)

- **Limitation of the maturity** of deliverable obligation if default is triggered <u>and Restructuring is the only credit event</u>

  – typically: max {30 months, scheduled termination date of the contract}

- **Multiple holders**: Four or more holders of the reference obligation
- Consent of restructuring by a supermajority of bondholders (66.66%)

The CDS Contract
Other Improvements in the 2003 ISDA Definitions

- **Delivery Mechanism**
  - 1999 ISDA: Buyer had 30 days to deliver notice, otherwise contract expired worthless (think Delphi today!)
  - 2003 ISDA: Process occurs until delivery or buy-in occurs
- **Credit Event Upon Mergers, Spin-offs, Consolidations etc** ***("Successor Supplement")***
  - In 1999 ISDA CDS applies to all obligations post merger
  - 2003 ISDA:
    - If one company succeeds to more than or equal to 75% of the original company's relevant obligations, then this will be the entity on which the CDS is based after the event.
    - If one or more subsequent companies succeed to more than or equal to 25% of the company's debt (including the original company itself), each of these will serve as the entity on which the CDS contract is based after the event.
- **Convertibles**
  - In 1999, ISDA documents had a supplement that allowed convertibles as deliverable physical obligations, as long as they were not excluded in the confirmation.
  - 2003 ISDA: These were included in the main ISDA document.

The CDS Contract: Liquidity

- The CDS bid / offer is in the range of:
  - 2 to 3 bp for names trading below 50bp
  - 5 to 8 bp for names between 50 and 100 bp
  - 8 to 12 bp for names between 100 and 200 bp
  - 15 and 30 bp for names between 200 and 400 bp
- However, a liquid name like Ford may trade with a 15 - 20 bp bid / offer or less even if it is in the 850 – 900 bp range
- Legacy high-yield names are less liquid than “fallen angels” (former IG names).
- The 5 year contract term is by far the most liquid, although 1, 2, 3, 7, and 10 year maturities as well as maturities to a given date are also available
- Typical trade size is $5 to 10 million, although larger notionals are quite common
- Contracts can be closed out with the <u>initial counterparty</u> or <u>assigned to a new counterparty</u>
- Note: Assignment to a different counterparty could be an economic event due to differences in counterparty risk and credit arrangements

The CDS Contract: Quotations On Bloomberg

6/01 7:47:14 edit&fwd by•JASON BRAUTH, GOLDMAN, SACHS & CO.
originated by SARA PUTCHA, GOLDMAN, SACHS & CO.

212-357-7865 cell# 917-297-8524

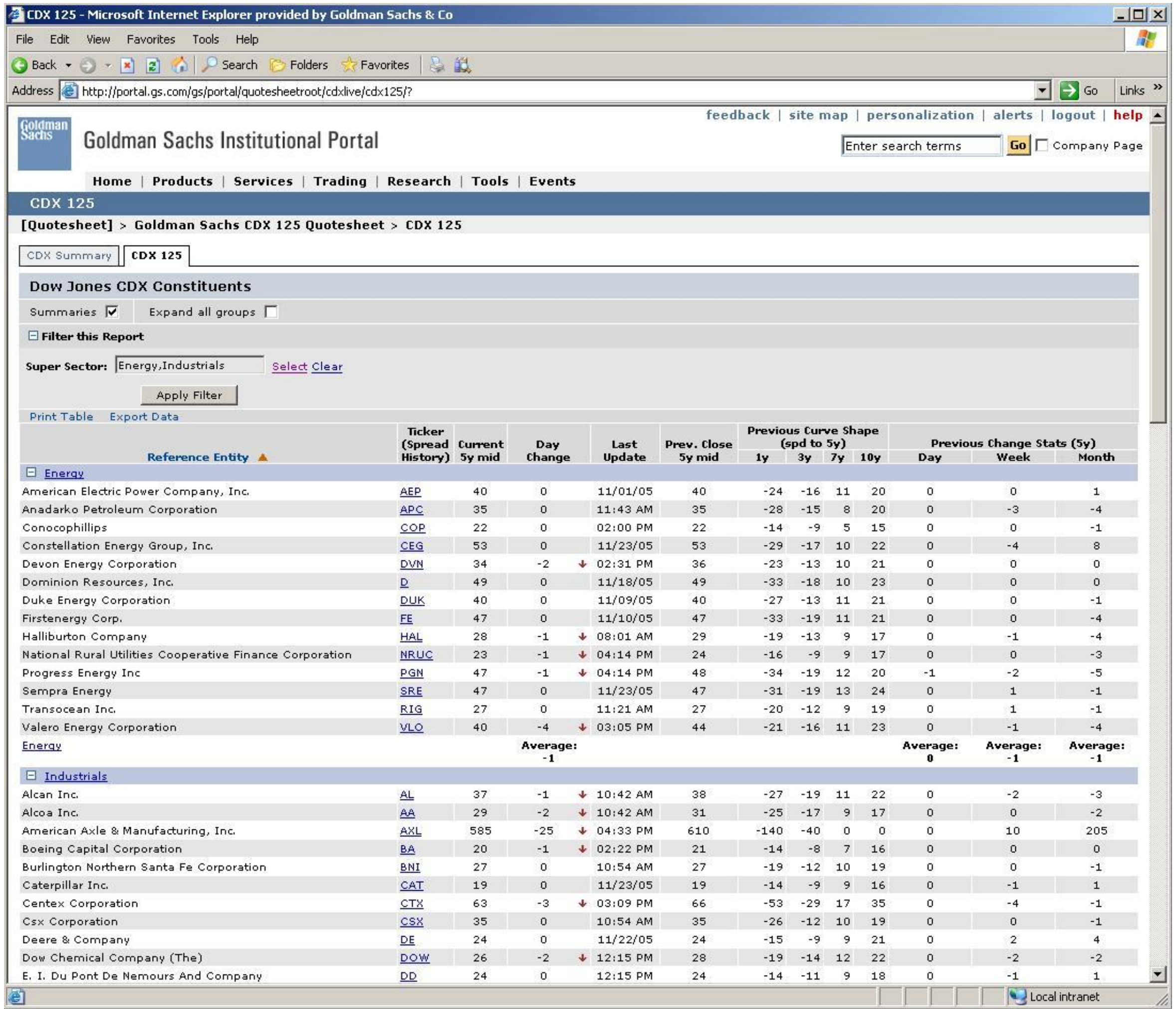
USER INFO

IB

GAMING + LEISURE CDS RUN #1 -

	HET	HLT	HOT	RCL	MAR	CCL
1Y	33-43	16-26	20-30	14-24	3-8	3-8
2Y	57-67	28-38	33-43	25-35	7-12	5-10
3Y	96-106	52-62	60-70	40-48	11-16	8-13
4Y	143-153	81-91	96-106	63-70	18-23	13-18
5Y	196-201	110-115	131-135	85-88	28-30	19-21
7Y	276-286	153-163	178-185	117-123	45-50	27-32
10Y	332-342	194-204	221-229	146-153	61-66	37-42
5/7	80-85	43-48	46-51	31-36	16-20	9-12
5/10	136-141	83-88	90-95	61-66	34-39	18-22

The CDS Contract: Intraday Prices on 360.gs.com


CDX 125 - Microsoft Internet Explorer provided by Goldman Sachs & Co

Address http://portal.gs.com/gs/portal/quotesheetroot/cdxlive/cdx125/?

Goldman Sachs Institutional Portal

feedback | site map | personalization | alerts | logout | help

Home | Products | Services | Trading | Research | Tools | Events

CDX 125

[Quotesheet] > Goldman Sachs CDX 125 Quotesheet > CDX 125

CDX Summary | CDX 125

Dow Jones CDX Constituents

Summaries ☑ Expand all groups ☐

Filter this Report

Super Sector: Energy,Industrials Select Clear

Apply Filter

Print Table Export Data

Reference Entity	Ticker (Spread History)	Current 5y mid	Day Change	Last Update	Prev. Close 5y mid	Previous Curve Shape (spd to 5y) 1y	3y	7y	10y	Previous Change Stats (5y) Day	Week	Month
Energy												
American Electric Power Company, Inc.	AEP	40	0	11/01/05	40	-24	-16	11	20	0	0	1
Anadarko Petroleum Corporation	APC	35	0	11:43 AM	35	-28	-15	8	20	0	-3	-4
Conocophillips	COP	22	0	02:00 PM	22	-14	-9	5	15	0	0	-1
Constellation Energy Group, Inc.	CEG	53	0	11/23/05	53	-29	-17	10	22	0	-4	8
Devon Energy Corporation	DVN	34	-2 ↓	02:31 PM	36	-23	-13	10	21	0	0	0
Dominion Resources, Inc.	D	49	0	11/18/05	49	-33	-18	10	23	0	0	0
Duke Energy Corporation	DUK	40	0	11/09/05	40	-27	-13	11	21	0	0	-1
Firstenergy Corp.	FE	47	0	11/10/05	47	-33	-19	11	21	0	0	-4
Halliburton Company	HAL	28	-1 ↓	08:01 AM	29	-19	-13	9	17	0	-1	-4
National Rural Utilities Cooperative Finance Corporation	NRUC	23	-1 ↓	04:14 PM	24	-16	-9	9	17	0	0	-3
Progress Energy Inc	PGN	47	-1 ↓	04:14 PM	48	-34	-19	12	20	-1	-2	-5
Sempra Energy	SRE	47	0	11/23/05	47	-31	-19	13	24	0	1	-1
Transocean Inc.	RIG	27	0	11:21 AM	27	-20	-12	9	19	0	1	-1
Valero Energy Corporation	VLO	40	-4 ↓	03:05 PM	44	-21	-16	11	23	0	-1	-4
Energy			Average: -1							Average: 0	Average: -1	Average: -1
Industrials												
Alcan Inc.	AL	37	-1 ↓	10:42 AM	38	-27	-19	11	22	0	-2	-3
Alcoa Inc.	AA	29	-2 ↓	10:42 AM	31	-25	-17	9	17	0	0	-2
American Axle & Manufacturing, Inc.	AXL	585	-25 ↓	04:33 PM	610	-140	-40	0	0	0	10	205
Boeing Capital Corporation	BA	20	-1 ↓	02:22 PM	21	-14	-8	7	16	0	0	0
Burlington Northern Santa Fe Corporation	BNI	27	0	10:54 AM	27	-19	-12	10	19	0	0	-1
Caterpillar Inc.	CAT	19	0	11/23/05	19	-14	-9	9	16	0	-1	1
Centex Corporation	CTX	63	-3 ↓	03:09 PM	66	-53	-29	17	35	0	-4	-1
Csx Corporation	CSX	35	0	10:54 AM	35	-26	-12	10	19	0	0	-1
Deere & Company	DE	24	0	11/22/05	24	-15	-9	9	21	0	2	4
Dow Chemical Company (The)	DOW	26	-2 ↓	12:15 PM	28	-19	-14	12	22	0	-2	-2
E. I. Du Pont De Nemours And Company	DD	24	0	12:15 PM	24	-14	-11	9	18	0	-1	1

Local intranet

Go to: 360.gs.com / Products / Credit Derivatives / GS CDX 125 Intraday Quotesheet / CDX 125 Tab

New Developments in the CDS Market

Evolution of the CDS Market

Three major changes to the CDS market are aimed at improving stability and increasing fungibility

- **ISDA 2009 Supplement and the "CDS Big Bang" Protocol**
  - Hardwired cash settlement via auction
  - Event determination via a committee of dealers including buy-side representation
  - Rolling "lookback" window for events, identical across all new and extant trades

- **Standard North American Corporate ("SNAC") contract terms**
  - Removes restructuring as a standard credit event in new US investment-grade CDS trades
  - Fixed coupons of 100 or 500 bps
  - All new trades will include accrued interest back to prior standard coupon date

- **Central Clearing Facility (CCF)**
  - Intermediate dealer-dealer trades, so that failure of one dealer will be isolated

Goldman Sachs

Evolution of the CDS Market: ISDA 2009 Supplement & ‘CDS Big Bang’

Before

- **Effective Date** – Trade Date +1
  - “Offsetting” CDS trades may leave investor with residual risk to events that become known later.
- **Event Determination**
  - Buyer or seller delivers a credit event notice (“triggers the contract”) based on publicly available information
  - Potentially subject to dispute
- **Physical Settlement**: The buyer delivers to the seller defaulted obligations and the seller delivers 100% of the notional of the transaction to the buyer. Physical settlement is the market standard

After

- **Effective Date** – Rolling 60/90-day lookback
  - New and existing positions have the same “rolling” effective date based on a 60- or 90-day lookback.
  - Credit events: “Today” – 60 days
  - Succession events: “Today” – 90 days
- **Event Determination** – Five regional committees
  - 10 dealer and 5 client firms in each location
  - 80% supermajority vote is final
  - 60 to 79%: 3-person external review panel may overturn on unanimous decision.
  - 50+ to 59%: 2/3 vote of panel may overturn
- **Auction Settlement** – Hardwired into the contract

“Supplement” vs. “Protocol”

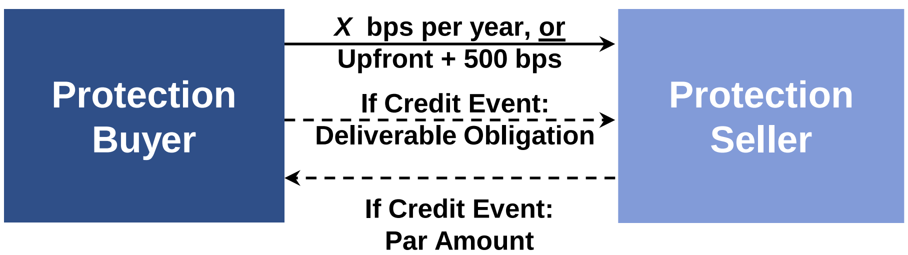
- The “Supplement” is the set of amendments to the 2003 ISDA definitions that will apply to *new trades* beginning April 8, 2009. Event determination/auction provisions will be implemented on April 8, along with 60/90 lookback for CDS trades. For index trades, 60/90 lookback will be implemented on June 20.
- The “protocol” is the agreement to apply the supplement retroactively to *legacy trades*; clients must sign by April 7. Event determination/auction provisions will be implemented on April 8, and 60/90 lookback will be applied on June 20.

Evolution of the CDS Market: ‘Standard North American Corporate’ Terms

Single-name CDS to become more liquid and fungible, a la index products

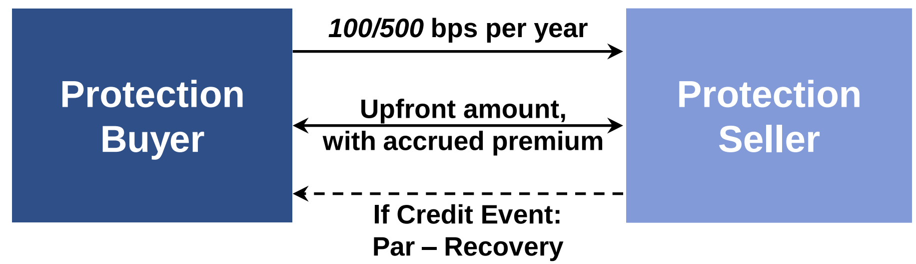
Before	After

Before



- **At-the-money Coupons**
  - For names as wide as ~800 – 1000 bps, trade with no upfront exchange, and full ATM running coupon
  - For wide-spread names, pay upfront points + 500 bps
- **Zero Accrued Interest**
  - New trades begin accruing interest at T+1
- **Credit Events**
  - Bankruptcy, Failure to Pay (IG/HY)
  - “Modified Restructuring” (IG)

After



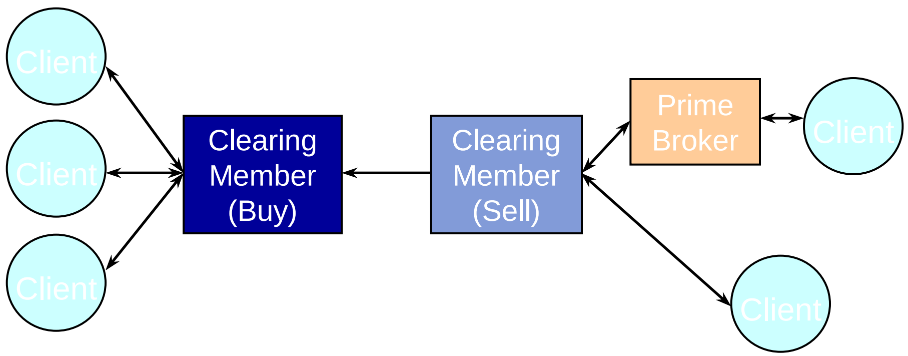
- **Standard Coupons** – 100/500 bps per year
  - 100 bps: Quote an equivalent running spread, convert to upfront + 100 bps.
  - 500 bps: Quote upfront points (as before)
- Non-Zero Accrued Interest
  - Rebate to buyer of protection accrued interest since the prior coupon date
- **Credit Events**
  - Bankruptcy, Failure to Pay
    - *Excludes restructuring – even in IG*
    - *Can still trade w/restructuring (‘MR SNAC’)*

Time Line of Changes

	ISDA 2009 Supplement & 'CDS Big Bang' Protocol	Standard North American Corporate ('SNAC') Terms
	*Primarily **post-trade, event-related** procedures* • Determination Committee (DC) • Auction Settlement • 60/90 Lookback (Rolling Effective Date)	*Primarily **economic** terms* • 100/500 fixed coupon • Trades with accrued (from prior coupon date) • No-R standard (Mod-R optional) • Expiration date must be on an IMM roll date Available only for North American IG/HY corporate CDS
12-Mar-09	Protocol adherence sign-up period begins for clients who want to convert legacy trades	
20-Mar-09		***IMM Roll – Potential early rolling*** • SNAC look-alike (some combination of NR, 100/500 strike, accrual), ***not SNAC documentation***
7-Apr-09	Protocol adherence sign-up period ends	
8-Apr-09	***2009 Supplement is published & effective*** • *All terms apply to new single name trades* • *Only DC and Auction Settlement apply to legacy single name, and legacy and new index*	***SNAC launches*** • New trades include 2009 supplement • Legacy SNAC look-alike trades are ***not*** fungible with new SNAC-documented trades.
22-Jun-09	60/90 lookback now applies to adhering legacy single names, and all (legacy and new) other covered transactions	

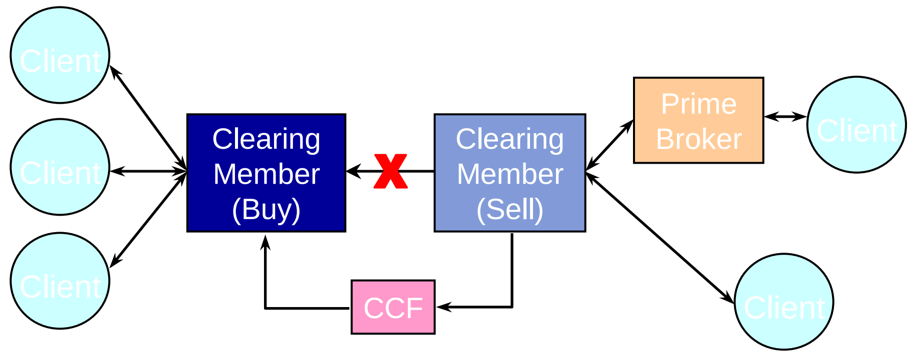
Evolution of the CDS Market: Central Clearing Facility

Before



- **All Trades are Bilateral, OTC Contracts**
  - “Almost” offsetting CDS trades leave investor with residual risk to events that become known later.
  - Unwinding extant positions requires consent of both parties, liquidity costs may be high
  - Only index trades are naturally offsetting, due to standardization/fungibility
- **Systemic Risk**
  - Web of interconnected trades between parties leads to risk that one dealer collapsing may bring down others due to counterparty risk.

After



- **Establishment of ICE Trust™**
  - Central clearing facility (CCF) for dealer-dealer trades
  - Collateral posts to/from CCF
  - Well-capitalized to withstand a dealer collapse
- **Dealer–Dealer Trades Centrally Cleared**
  - Trades between dealers will be novated so that each party faces the CCF
  - Most liquid index tenors initially, to be followed by top 50 single-name CDS
- **Dealer–Client Trades Still Bilateral**
  - Counterparty risk is still a concern, but collapse of one dealer should not lead to a domino effect

Variations on the CDS Contract

LCDS: Standard ISDA Documentation signed June 8, 2006

Credit Events	▪ Bankruptcy ▪ Failure to Pay
Deliverable Obligations	▪ Deliverable Obligations are limited to loans that are **Syndicated Secured** of a **Designated Priority (First lien, Second lien, Third lien)** ▪ Trading definition of Syndicated Secured based on a Dealer Poll and subject to Syndicated Secured Dispute mechanism ▪ Outstanding commitments such as **Revolvers** and **L/C facilities** generally are Deliverable ▪ **No Securities are Deliverable** even if pari passu with Secured Loans
Contract Maturity	▪ Early Termination trigger (at Buyer or Seller Option) only if no Deliverable Obligation exists for 30 Business Days
Markit Dealer Poll	▪ Markit Partners will run Dealer Polls to establish Reference Obligations and, if a Dispute arises, the Deliverability of a specific Syndicated Loan ▪ Vote requires minimum of 3 Dealers with 75% majority vote
Settlement	▪ Settlement documentation “hardwired” into Secured Loan CDS document to avoid negotiation and settlement delay
Trading	▪ **Not** a security and can be traded with Syndicate Level information

Recovery Lock

- **Recovery Lock** is a contract to buy or sell a credit for a **fixed price** if a **credit event** occurs. If **no credit event** transpires by maturity, **no money changes hands**.
  - **Recovery locks** allow investors to **express a zero-cost recovery rate view** and/or hedge recovery **in the case of a credit event**
  - If credit event occurs, seller of recovery delivers bonds to buyer, who in turn pays stipulated recovery rate within 30 calendar days of Event Determination Date
  - The seller of recovery has the **same "cheapest-to-deliver" optionality** that exists in a vanilla CDS
  - Depending on reference entity, credit events may or may not include restructuring
  - Investors can strike the recovery rate at an off-market rate, which would result in an associated recovery lock upfront and/or running premium

From: CHARLES MCGARRAUGH, GOLDMAN SACHS & CO
Subject: Recovery Markets: (GM, Ford, LEA, AXL, RESCAP, GT)
Attachment(s): None

ph:2129026299

Recovery Markets: (GM, Ford, LEA, AXL, RESCAP, GT)

GMAC	MR 5yr	64/67 %		RESCAP	MR 5yr	63/69	2mm
GM Co	MR 5yr	42/45		GT	NR 5yr	54/59	2mm
FMCC	MR 5yr	64/66					
F Co	MR 5yr	44/48					
LEA	MR 5yr	61/65					
LEA	NR 5yr	60/64					
AXL	MR 5yr	61/65					
AXL	NR 5yr	60/64					

US vs. Latin America CDS: Differences in Single-name

Single-Name

- In addition to Bankruptcy, Failure to Pay and Restructuring, LatAm CDS are also triggered by **Obligation Acceleration** and **Repudiation/Moratorium** (reference entity or governmental authority disaffirms/disclaims/challenges the validity of the reference obligation)
- LatAm coupon payments are **semi-annual** (US are quarterly)
- LatAm maturity dates are **monthly** (US are quarterly). Contracts reference the 20th of each month

Appendix A
CDS Valuation: Survival Probabilities

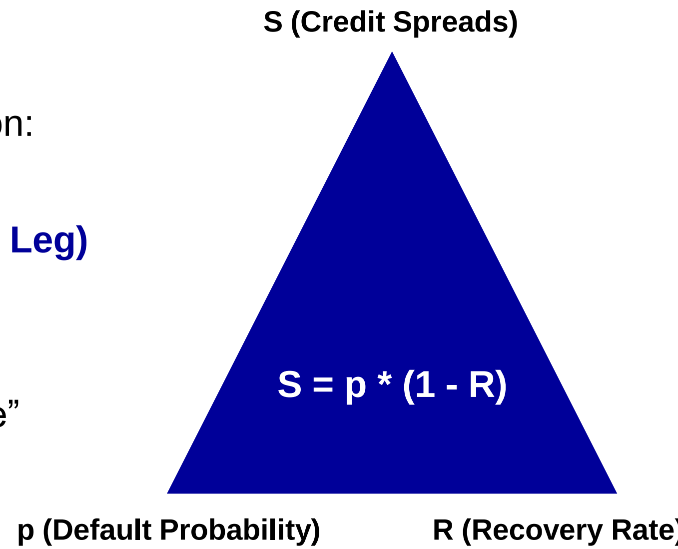
CDS Valuation

- Theory: The CDS premium is determined by the no-arbitrage condition:

PV (Premium Leg) = PV (Protection Leg)

One-period case:

$s = p\,(1-R)$ *aka* "Credit Triangle"



- Practice: The premium of a new CDS contract is determined by supply and demand as well as by arbitrage activities of CDS versus other instruments.

- The value of a new CDS contracts is zero

- Valuing a seasoned CDS contract

CDS Valuation

Back Of The Envelope

- Suppose you buy protection on \$ 10 mm notional at 150 bps.

- Spread widens to 200 bps. **How much money did you make?**

- **Mark to Market = Notional * Spread Change * Spread PV01**

(ignoring the coupon payments)

$$\begin{aligned} MTM &= \$10{,}000{,}000 \times (0.0200 - 0.0150) \times 4.10 \\ &= \$205{,}150 \end{aligned}$$

- Spread PV01 = Change in CDS value caused by a 1bp spread move

- How did we calculate the “4.1” PV01? Bloomberg **CDSW** <Go>

(Bloomberg quotes the number per 10 mm \$ per bps spread change)

CDS Valuation: Theory

- The key concept in CDS valuation is the **SURVIVAL PROBABILITY CURVE**
- The curve gives market-implied probabilities that the Reference Entity does NOT suffer a Credit Event prior to a given future date
- The survival probability curve is the fundamental tool in credit derivatives pricing, like the discount curve in the rates markets.

CDS Valuation Mathematics

- The basic valuation principal in credit derivatives:

NPV = Expected Present Value of Cash Flows

- "Expected" means "probability-weighted"

- "Present value" means "cash flows discounted by the risk-free curve"

- Credit instruments have cash flows in:
  1. survival (premiums, coupons, principal, etc …)
  2. default (recovery)

- The NPV calculation weighs **both** survival and default cash flows by the corresponding probabilities and the risk-free discount factors

Building a Survival Probability Curve using observed CDS spreads

- During every future period *i* after the CDS spread *s* is paid one of two things can happen:
  - Survival: with probability 1 – q_i the Reference Entity survives one more period
  - Default: with probability q_i.a Credit Event occurs with Deliverable Obligations trading at recovery value *R*

Time i - 1	Time i		
	State	**Payment**	**Probability**
Survival	Survival	-s	$1-q_i$
	Default	(1-R) - s	q_i

Building a Survival Probability Curve using observed CDS spreads

Time	**t_0**		**t_1**		**t_2**		**t_3**
Events		$1-q_1$ / q_1	Survival / Default	$1-q_2$ / q_2	Survival / Default	$1-q_3$ / q_3	Survival / Default
Probability of Survival as Seen From Time Zero	$1 = p_0$		$p_0(1-q_1) = p_1$		$p_1(1-q_2) = p_2$		$p_2(1-q_3) = p_3$
Probability of Default as Seen From Time Zero	0		$1-p_1$		$p_1 - p_2$		$p_2 - p_3$

Goldman Sachs

Building a Survival Probability Curve using observed CDS spreads

- The NPV of a CDS contract (bought protection) equals:

$$NPV = \sum_{i=1}^{N} \overset{\text{Cash flows in default}}{(1-R)} \times \overset{\text{Prob. of default}}{(p_{i-1} - p_i)} \times \overset{\text{Risk-free discount}}{d_i} - \sum_{i=1}^{N} \overset{\text{Cash flows in survival}}{s} \times \overset{\text{Prob. of survival}}{p_{i-1}} \times \overset{\text{Risk-free discount}}{d_i}$$

(1-R)	**Assumed** loss in default
$p_{i-1} - p_i$	Prob. of Credit Event in period i
d_i	LIBOR discount factor **(observed)**
s	Periodic CDS coupon **(market level)**
p_{i-1}	Probability of surviving to the (i – 1)st payment date **(computed)**

Building a Survival Probability Curve using observed CDS spreads

- NPV of an at-market CDS is zero:

$$NPV = \sum_{i=1}^{N}(1-R)\times(p_{i-1}-p_i)\times d_i - \sum_{i=1}^{N} s\times p_{i-1}\times d_i = 0$$

- For a single period:

$$\begin{aligned} NPV &= (1-R)\times(1-p_1)\times d_1 - s\times d_1 = 0 \Leftrightarrow \\ &(1-R)\times(1-p_1) = s \Leftrightarrow \\ &(1-p_1) = s/(1-R) \Leftrightarrow \\ &q_1 = s/(1-R) \end{aligned}$$

<= The conditional default probability is spread / loss, a convenient rule of thumb!

- What is the one-year survival probability and default probability rate for a 50 bp credit when recovery R = 50%?
  - q_1 = 0.005 / (1-0.5) = 0.01 or 100 bp / year
  - p_1 = 1 - q_1 = 1 - 0.01= 99%

Building a Survival Probability Curve

- We typically have multiple CDS with different maturities and premiums

- From this market data we can determine a term-structure of survival probabilities:

$$\text{CDS1:} \quad (1-R)\times(1-p_1)\times d_1 - s_1 \times p_0 \times d_1 = 0$$

$$\text{CDS2:} \quad (1-R)\times((1-p_1)\times d_1 + (p_1 - p_2)\times d_2) - s_2 \times (p_0 \times d_1 + p_1 \times d_2) = 0$$

- We can solve for the survival probabilities p_1 and p_2 by starting with CDS1 and working our way through the equations

- $p_0 = 1$

- Use the first equation to solve for p_1

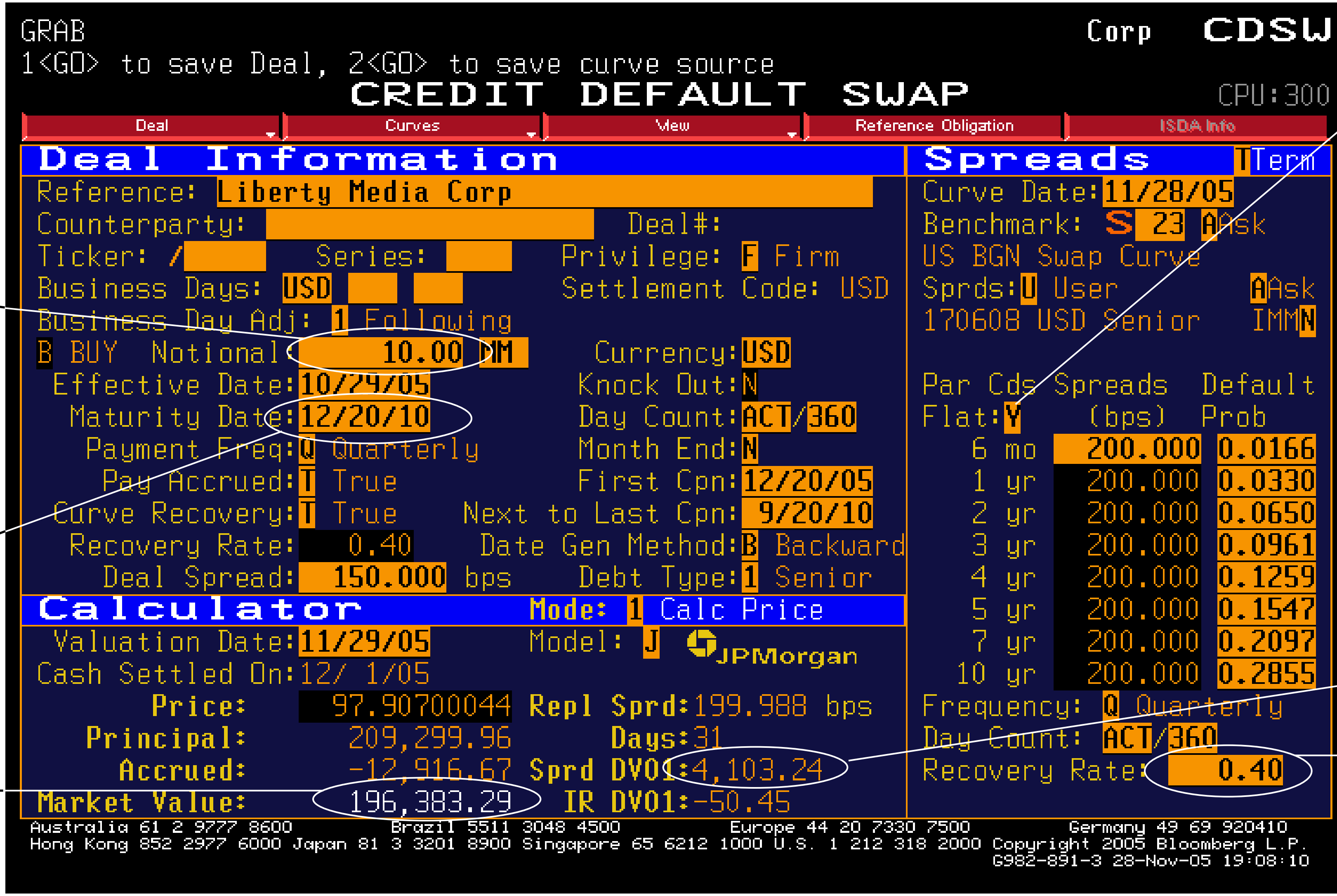
- Use the second equation to solve for p_2

Appendix B
CDS Unwind/ Assignment Calculations

The CDS Unwind / Assignment Calculation

- Trading a seasoned CDS contract means:
  - Unwind with the initial counterparty
  - Assignment to a new counterparty
- In both cases, the NPV of the contract changes hands
- Start with a seasoned CDS contract with premium s' and maturity T
- Take the current market level CDS premium to date T, say s
- Market convention is to build a survival probability curve assuming a flat CDS curve s
- In building the curve, the recovery is usually assumed to be 40%
- Compute the expected present value (NPV) of the seasoned contract using the survival probability curve and the risk-free discount factors implied by the current swap curve

CDS Valuation: Bloomberg CDSW – 40% Recovery and Flat Credit Curve



Set Notional

Use standard maturity dates:

3/20,6/20, 9/20 and 12/20.

Mark to Market

Flat

SDV01

Assumed Recovery

Glossary

Glossary

- ASW — Asset swap spread
- bp — basis point = 0.0001
- CDS — Credit Default Swap
- CDO — Collateralized Debt Obligation (tranche off a portfolio of debt obligations)
- CDX — Family of tradable CDS indices in the US
- CLN — Credit-linked note (synthetic bond engineered using a credit default swap and a AAA note)
- DV01 — Dollar value of 1 basis point change over the life of a credit default swap
- iTraxx — Family of tradable CDS indices in Europe and Asia
- JTD — Jump to default
- Mod-R — Modified Restructuring – current definition of the Restructuring credit event (under the 2003 ISDA)
- No-R — No Restructuring – credits (usually high yield) that trade CDS without restructuring
- Old-R — Old Restructuring governed by the 1999 ISDA Credit Derivative definitions
- PV01 — Present value of 1 basis point move over the life of a credit default swap; Similar to duration
- CDSW — CDS Calculator on Bloomberg
- Z-spread — Shift of the swaps curve which re-prices a given bond

Credit Sales Strategies

ficc-credit-sales-strats@ny.email.gs.com

James Sarvis
james.sarvis@gs.com
(917) 343-1577

Darren Gilbert
darren.gilbert@gs.com
(212) 902-8483

Ariel Amdur
ariel.amdur@gs.com
(212) 357-9715

Thomas Harrop
thomas.harrop@gs.com
(212) 357-9427

Important Disclaimers – Please Read

This message has been prepared by personnel in the Equities or Fixed Income, Currency and Commodities Sales/Trading Departments of one or more affiliates of The Goldman Sachs Group, Inc. ("Goldman Sachs") and is not the product of the Global Investment Research Department or Fixed Income Research. It is not a research report and is not intended as such.

CDS Risk Factors

- Prospective Investors or Counterparties should read the final swap confirmation or Offering Circular, as the case may be, for a more complete description of risk factors relevant to the particular investment. Entering into the Default Swaps or purchasing the Securities involves certain risks. Prospective swap counterparties or Investors should carefully consider the following factors, as well as the risk factors included in the final swap confirmation or final Offering Circular, prior to entering into the Transaction. The following is not intended to be an exhaustive list of the risks involved in the Transaction.
- Risks Associated with Management Rights. The exercise of management rights by the Investor, particularly in the form of Subordination Trades, can potentially (a) increase the risk of the investment by reducing the Credit Enhancement and hence increase the probability of suffering an actual “Incurred Loss” from a subsequent Credit Event (b) cause a rating downgrade of the Portfolio Notes, i.e. if trading results in a reduction in Credit Enhancement such that the Rating Agencies determine that the tranche can no longer maintain its rating or (c) increase the mark-to-market volatility of the Portfolio Notes.
- Additional Credit Risks. In addition to the credit risk of the Reference Portfolio, the parties to the Default Swaps are exposed to the credit risk of receipt of payments from the other party, and the Investors in the Securities are exposed to the credit risk of the issuer of the collateral securing the Securities for the full notional amount of their investment.
- Limited Liquidity of the Transaction. There is currently no market for the Default Swaps or Securities. The Default Swaps represent bilateral contracts that cannot be transferred or terminated without the consent of the other party, which consent may be withheld or delayed for a number of reasons. Goldman Sachs may, but is not obligated to, unwind or terminate a Default Swap under terms acceptable to it in its sole discretion. There can be no assurance that a secondary market for the Securities will develop or, if a secondary market does develop, that it will provide the holder of the Securities with liquidity, or that it will continue for the life of the Securities. Moreover, the limited scope of information available to the swap counterparties and/or Investors regarding the Reference Entities and the nature of any Credit Event, including uncertainty as to the extent of any reduction to be applied to the notional of each class if a Credit Event has occurred but the amount of the relevant reduction in the notional amount has not been determined, may further affect the liquidity of the Default Swaps or Securities, especially the subordinated classes. Consequently, any swap counterparty under the Default Swaps or Investor in the Securities must be prepared to hold such Default Swaps or Securities for an indefinite period of time or until final maturity.
- Mark-to-Market Risk. Investors and swap counterparties are exposed to considerable mark-to-market volatility following changes in any of the following: spreads of the credits in the reference portfolio, comparable CDO spreads, ratings migration in the reference portfolio, ratings migration of the Default Swaps or Securities, and credit events in the reference portfolio (and hence reduction of subordination). These will be reflected in mark-to-market valuations which are likely to be more volatile than an equivalently rated unleveraged investment.
- Additional Risk of Loss due to Definitions of Credit Events. The probability of occurrence of a Credit Event may be higher than the probability of what may be perceived as a “default” (for example, what is tracked by rating agencies in their default studies) because of their broader definitions. This is particularly true with respect to the inclusion of “Restructuring” as a Credit Event in all standard credit default swaps.
- Evolving Nature of the Credit Default Swap Market. Markets in different jurisdictions have also already adopted and may continue to adopt different practices with respect to the Credit Derivative Definitions, particularly, but not limited to, the definition of “Restructuring”. Past events (e.g. Conseco restructuring and Railtrack bankruptcy) exemplify the fact that the Credit Derivatives Definitions may contain ambiguous provisions that are subject to interpretation and may result in consequences that are adverse to the investor.
- “Cheapest-to-Deliver” Risk. Given that Goldman Sachs, as buyer of protection, has discretion to choose the portfolio of valuation obligations used to calculate the severity of losses following a Credit Event, it is likely that the portfolio of valuation obligations selected will be obligations of the Reference Entity with the lowest market value that are permitted to be delivered pursuant to the relevant documentation. This could result in a lower recovery value and hence a larger loss amount.
- Credit Ratings. Credit ratings represent the rating agencies’ opinions regarding credit quality and are not a guarantee of quality. Rating agencies attempt to evaluate the safety of principal and/or interest payments and do not evaluate the risks of fluctuations in market value. Accordingly, the credit ratings may not fully reflect the true risks of the Transaction. Also, rating agencies may fail to make timely changes in credit ratings in response to subsequent events, so that an issuer’s current financial condition may be better or worse than a rating indicates.

Important Disclaimers – Please Read

- Interest Rates. Changes in the market conditions such as the interest rate environment may impact the valuation of structured credit products
- Leveraged Credit Exposure to Reference Entities. Investors and swap counterparties are exposed to leveraged exposure to the credit of a number of Reference Entities because the notional amount of the Reference Portfolio is significantly larger than the notional amount of the note or swap. Following the delivery of a Credit Event Notice by Goldman Sachs in relation to a Credit Event with respect to a Reference Entity and the satisfaction of the other Conditions to Payment, the outstanding notional of the investment or swap may be reduced. Counterparties to a swap will be required to make significant payments and Investors in the securities will suffer significant reductions in their outstanding principal amounts. The maximum loss for swap counterparties and/or Investors is the full notional amount in either case
- No Legal or Beneficial Interest in Obligations of Reference Entities. Participation in the Transaction does not constitute a purchase or other acquisition or assignment of any interest in any obligation of any Reference Entity. The swap counterparty and/or Investors will not have recourse against any Reference Entities. Neither the swap counterparties nor Investors nor any other entity will have any rights to acquire from Goldman Sachs any interest in any obligation of any Reference Entity, notwithstanding any reduction in the notional of the relevant class with respect to such Reference Entity. Moreover, GS will not grant any swap counterparty or Investor any security interest in any such obligation.

Risk Disclosure Regarding OTC Options

- Prior to entering into an OTC Option transaction you should be aware of the general risks associated with OTC Option transactions: Liquidity Risk: There is no public market for OTC Option transactions and, therefore, it may be difficult or impossible to liquidate an existing position on favorable terms; Transfer Restrictions: OTC Option transactions entered into with Goldman Sachs cannot be assigned or otherwise transferred without its prior written consent and, therefore, it may be impossible for you to transfer any OTC Option transaction to a third party; Counterparty Credit Risk: Because Goldman Sachs, or one of its affiliates, may be obligated to make substantial payments to you as a condition of an OTC option transaction, you must evaluate the credit risk of doing business with Goldman Sachs or its affiliates; Pricing and Valuation: The price of each OTC Option transaction is individually negotiated between Goldman Sachs and each counterparty and Goldman Sachs does not represent or warrant that the prices for which it offers OTC Option transactions are the best prices available, possibly making it difficult for you to establish what is a fair price for a particular OTC Option transaction; Proprietary Trading: Goldman Sachs engages in proprietary trading for its own account and the accounts of its affiliates in the same or similar instruments underlying OTC Option transactions (including such trading as Goldman Sachs deems appropriate in its sole discretion to hedge its market risk in any OTC Option transaction whether between Goldman Sachs and you or with third parties) and such trading may affect the value of an OTC Option transaction.
- Note: Options involve risk and are not suitable for all investors. Please ensure that you have read and understood the current options disclosure document before entering into any standardized options transactions. United States listed options disclosure documents are available from our sales representatives or at http://theocc.com/publications/risks/riskstoc.pdf. A secondary market may not be available for all options. Transaction costs may be a significant in option strategies calling for multiple purchases and sales of options, such as spreads. When purchasing long options an investor may loose their entire investment and when selling uncovered options the risk is potentially unlimited. Supporting documentation for any comparisons, recommendations, statistics, technical data, or other similar information will be supplied upon request.
- To understand clearly the terms and conditions of any OTC Option transactions you may enter into, you should carefully review the Master Agreement, including any related schedules, credit support documents, addenda and exhibits. You should not enter into OTC Option transactions unless you understand the terms of the OTC Option transaction you are entering into as well as the nature and extent of your risk exposure. You should also be satisfied that the OTC Option transaction is appropriate for you in light of your circumstances and financial condition. You may be requested to post margin or collateral to support written OTC options at levels consistent with the internal policies of Goldman Sachs.

Important Disclaimers – Please Read

- **This information includes estimates and projections and involves significant elements of subjective judgment and analysis.** No representations are made as to the accuracy of such estimates or projections or that all assumptions relating to such estimates or projections have been considered or stated or that such projections will be realized. The information contained herein does not purport to contain all of the information that may be required to evaluate such swaps or securities and any recipient is encouraged to read (in the case of the swaps) the final swap confirmation or (in the case of securities) the Offering Circular and should conduct its own independent analysis of the date referred to herein. Goldman, Sachs & Co. and its affiliates disclaim any and all liability relating to this information, including, without limitation, any express or implied representation or warranty for statements contained in and omissions from this information. Neither Goldman, Sachs & Co. nor any of its affiliates nor the issuer of any securities will update or otherwise revise the information contained herein except by means of the final swap confirmation or Offering Circular. The securities and obligations of the Issuer are not issued by, obligations of, or guaranteed by Goldman, Sachs & Co. or its affiliates, or any other organizations. In particular, the obligations of the Issuer are not deposit obligations of any financial institution.
- **Projections, Pro Forma Information and Forward Looking Statements.** These materials contain statements that are not purely historical in nature, but are “forward-looking statements.” These include, among other things, projections, forecasts, estimates of income, yield or return, future performance targets, sample or pro forma portfolio structures or portfolio composition, scenario analyses, specific investment strategies and proposed or pro forma levels of diversification or sector investment. These forward-looking statements are based upon certain assumptions. Actual events are difficult to predict and are beyond the control of the Issuer, Goldman, Sachs & Co. or its affiliates. Actual events may differ from those assumed. All forward-looking statements included are based on information available on the date hereof and neither Goldman, Sachs & Co. nor any of its affiliates assume any duty to update any forward-looking statement. Some important factors which could cause actual results to differ materially for those in any forward looking statements include, among other things, the actual composition of the portfolio (consisting of credit default swaps), any defaults or Credit Events in the portfolio, the timing of any defaults or Credit Events, the timing and amount of any subsequent recoveries, changes in interest rates, and any weakening of the specific credits included in the portfolio. Other risk factors are also described (in the case of the swaps) in the final swap confirmation or (in the case of securities) in the Offering Circular. Accordingly, there can be no assurance that estimated returns or projections will be realized, that forward-looking statements will materialize or that actual returns or results will not be materially lower than those presented. Goldman, Sachs & Co., its respective affiliates and others associated with them may have positions in, and may effect transactions in, securities and instruments of issuers mentioned herein and may also perform or seek to perform investment banking services for the issuers of such securities and such instruments.
- **Non-Reliance and Risk Disclosure:** This material should not be construed as an offer to sell or the solicitation of an offer to buy any security in any jurisdiction where such an offer or solicitation would be illegal. We are not soliciting any action based on this material. It is for the general information of our clients. It does not constitute a recommendation or take into account the particular investment objectives, financial conditions, or needs of individual clients. Before acting on this material, you should consider whether it is suitable for your particular circumstances and, if necessary, seek professional advice. The price and value of the investments referred to in this material and the income from them may go down as well as up, and investors may realize losses on any investments. Past performance is not a guide to future performance. Future returns are not guaranteed, and a loss of original capital may occur. We do not provide tax, accounting, or legal advice to our clients, and all investors are advised to consult with their tax, accounting, or legal advisers regarding any potential investment. Certain transactions - including those involving futures, options, equity swaps, and other derivatives as well as non-investment-grade securities - give rise to substantial risk and may not be available to or suitable for all investors. If you have any questions about whether you are eligible to enter into these transactions with Goldman Sachs, please contact your sales representative. Please ensure that you have read and understood the current options disclosure document before entering into any options transactions. Current United States listed options disclosure documents are available from our sales representatives or at http://theocc.com/publications/risks/riskstoc.pdf. This material is not for distribution to retail clients, as that term is defined under The European Union Markets in Financial Instruments Directive (2004/39/EC) and any investments, including derivatives, mentioned in this material will not be made available by us to any such retail client. Foreign-currency-denominated securities are subject to fluctuations in exchange rates that could have an adverse effect on the value or price of, or income derived from, the investment. In addition, investors in securities such as ADRs, the values of which are influenced by foreign currencies, effectively assume currency risk. The material is based on information that we consider reliable, but we do not represent that it is accurate, complete and/or up to date, and it should not be relied on as such. Opinions expressed are our current opinions as of the date appearing on this material only and only represent the views of the author and not those of Goldman Sachs, unless otherwise expressly noted.

Important Disclaimers – Please Read

- **Conflict of Interest Disclosure:** We are a full-service, integrated investment banking, investment management, and brokerage firm. The professionals who prepared this material are paid in part based on the profitability of The Goldman Sachs Group, Inc., which includes earnings from the firm's trading, capital markets, investment banking and other business. They, along with other salespeople, traders, and other professionals may provide oral or written market commentary or trading strategies to our clients that reflect opinions that are contrary to the opinions expressed herein or the opinions expressed in research reports issued by our Research Departments, and our proprietary trading and investing businesses may make investment decisions that are inconsistent with the views expressed herein. In addition, the professionals who prepared this material may also produce material for, and from time to time, may advise or otherwise be part of our trading desks that trade as principal in the securities mentioned in this material. This material is therefore not independent from our proprietary interests, which may conflict with your interests. We and our affiliates, officers, directors, and employees, including persons involved in the preparation or issuance of this material, may from time to time have "long" or "short" positions in, act as principal in, and buy or sell the securities or derivatives (including options) thereof in, and act as market maker or specialist in, and serve as a director of, companies mentioned in this material. In addition, we may have served as manager or co manager of a public offering of securities by any such company within the past three years.
- Legal Entities Disseminating this Material: This material is disseminated in Australia by Goldman Sachs JBWere Pty Ltd (ABN 21 006 797 897) on behalf of Goldman Sachs; in Canada by Goldman Sachs Canada Inc. regarding Canadian equities and by Goldman, Sachs & Co. and/or Goldman Sachs Execution & Clearing, L.P. (all other materials); in Hong Kong by Goldman Sachs (Asia) L.L.C.; in Japan by Goldman Sachs Japan Co., Ltd.; in the Republic of Korea by Goldman Sachs (Asia) L.L.C., Seoul Branch; in New Zealand by Goldman Sachs JBWere (NZ) Limited on behalf of Goldman Sachs; in Singapore by Goldman Sachs (Singapore) Pte. (Company Number: 198602165W); in India by Goldman Sachs (India) Securities Private Limited, Mumbai Branch; in Europe by Goldman Sachs International (unless stated otherwise); in France by Goldman Sachs Paris Inc. et Cie and/or Goldman Sachs International; in Germany by Goldman Sachs International and/or Goldman, Sachs & Co. oHG; in Brazil by Goldman Sachs do Brasil Banco Múltiplo S.A.; and in the United States of America by Goldman, Sachs & Co. (or when expressly noted as such, by Goldman Sachs Execution & Clearing, L.P.) (both of which are members NASD, NYSE and SIPC). You may obtain information about SIPC, including the SIPC brochure, by contacting SIPC (website: http://www.sipc.org/; phone: 202-371-8300). Goldman Sachs International, which is authorized and regulated by the Financial Services Authority, has approved this material in connection with its distribution in the United Kingdom and European Union. Unless governing law permits otherwise, you must contact a Goldman Sachs entity in your home jurisdiction if you want to use our services in effecting a transaction in the securities mentioned in this material.
- Reproduction and Re-Distribution: No part of this material may be (i) copied, photocopied or duplicated in any form by any means or (ii) redistributed without our prior written consent. Notwithstanding anything herein to the contrary, and except as required to enable compliance with applicable securities law, you (and each of your employees, representatives and other agents) may disclose to any and all persons the U.S. federal income and state tax treatment and tax structure of the transaction and all materials of any kind (including tax opinions and other tax analyses) that are provided to you relating to such tax treatment and tax structure, without Goldman Sachs imposing any limitation of any kind.
- Information Not for Further Dissemination. To the extent this communication contains Goldman, Sachs & Co. or its affiliates ("Goldman Sachs") pricing information, such pricing information is proprietary and/or confidential and is provided solely for the internal use of the intended recipient(s). You are notified that any unauthorized use, dissemination, distribution or copying of this communication or its contents, including pricing information, in whole or in part, is strictly prohibited. Further, unless prohibited by local law, any use, review or acceptance of this information is subject to and manifests your agreement with Goldman Sachs to use such information only in accordance with the terms set forth above. Goldman Sachs has caused its proprietary information to be delivered to you in reliance upon such agreement.