How to improve your risk return profile using credit default swaps

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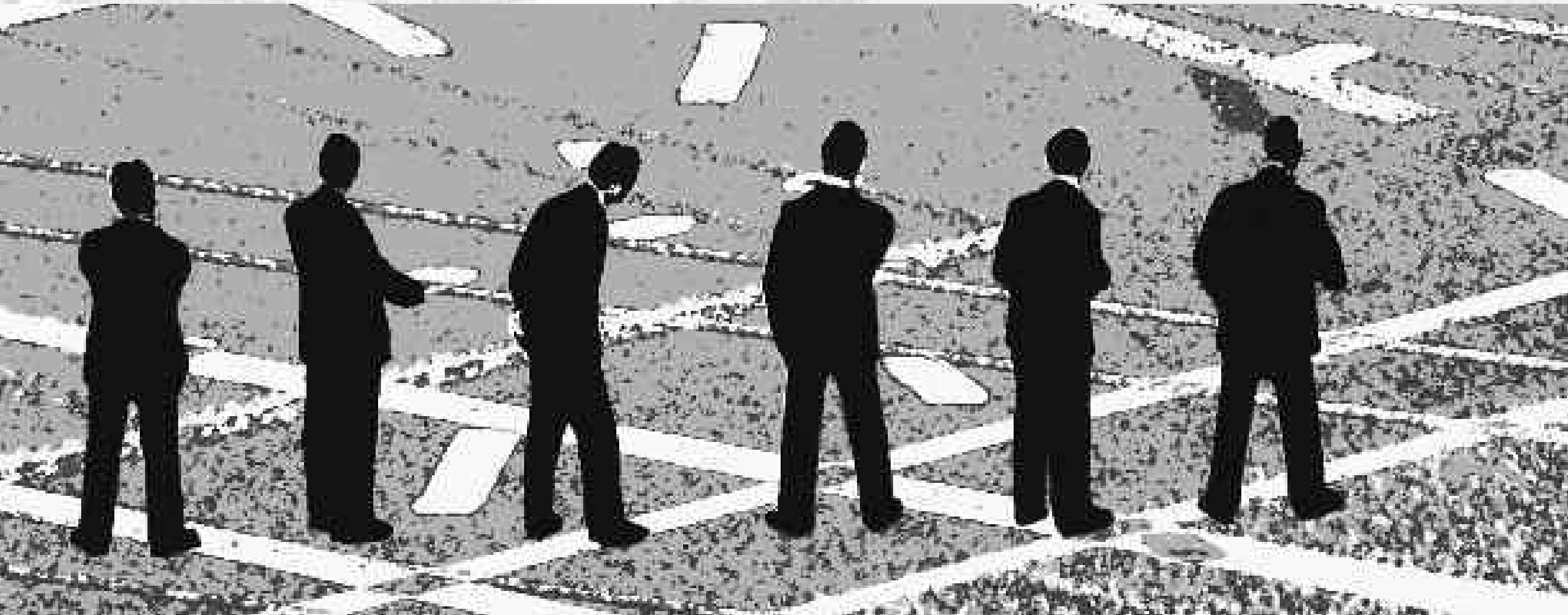

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1. Introduction

The use of derivatives to hedge risk is growing exponentially especially in the over-the-counter (OTC) market. Figure 1.1 illustrates the growth in OTC derivatives trade volume between 2005 and 2006. The volume increase in credit derivatives far exceeded the growth in the other asset categories. The growth was driven by several factors. The financial woes of companies such as Enron and WorldCom has spurred legislation such as Sarbanes Oxley and has reinforced the need for accords such as Basel II to encourage and foster global financial stability. Basel II's focus on risk quantification and measurement has helped propel the use of credit derivatives to move loans off the balance sheet and/or to reduce on-balance sheet credit risk.

This paper illustrates how a credit default swap can be used to hedge the counterparty risk associated with a portfolio of leases and at the same time increase the net present value of uncertain lease cash flows. Asset finance firms will find that the hedge both reduces the variability of cash flows and hence increases the value of the firm. Additionally, the study illustrates a methodology to calculate the risk adjusted price for a lease based on the creditworthiness of the lessee.

The remainder of the paper is organized as follows: Section 2 explores the concept of creditworthiness and credit default swaps; Section 3 constructs a sample portfolio and evaluates the use of credit default swaps to hedge default risk; Section 4 presents a methodology for risk based lease pricing; and Section 5 concludes.

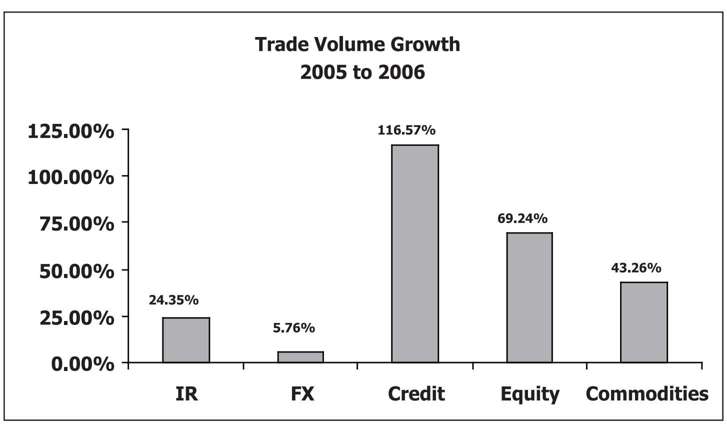

Figure 1.1: ISDA 2007 Operations Benchmarking Survey Trade volume by asset type

2. Financial Creditworthiness

2.1 Measures of Financial Creditworthiness

A 1997 Moody's global credit research report found higher default and loss rates for firms with lower rated debt. This relationship was found to persist over five, ten, fifteen, and twenty year horizons. The study also found that low rated debt investors face a higher level of uncertainty concerning the level of credit risk as reflected by higher default rate and loss rate volatilities for lower rating categories. These studies clearly show that credit ratings have some predictive power but the ratings are primarily reactive to past historical information. Only after a negative financial event is known by all market participants and quarterly financials are released are credit ratings changed. Agencies update firm credit ratings every three to six months and do not reflect the creditworthiness of a firm on a real time basis. The credit default swap market provides a real-time indicator of credit worthiness. In times of financial distress, the credit default swaps market is instrumental in gaining insight into the market's forecast of the timing of default events.

2.1 Credit Derivatives

A financial derivative is an instrument deriving its value from the value of another asset. Equity options are an example of a financial derivative that is very popular with individual investors and whose value is derived from the price of the underlying stock. The desire to hedge financial risks has led to the creation of a wide array of financial products.

Credit derivatives are specialized financial instruments that facilitate the transfer of credit risk from one party to another. Examples include collateralized mortgage obligations (CMO), mortgage backed securities (MBS), asset backed securities, and credit default swaps. Credit derivatives enable banks and asset finance companies to manage the credit risk exposure of their portfolios associated with changes in creditworthiness.

2.2 Credit Default Swaps (CDS)

A credit default swap is similar to an insurance contract as it protects the buyer for a fee from a risk event. More specifically, a CDS is a bilateral contract whereby the buyer is protected against the loss resulting from the default of securities issued by a specified reference entity. CDS terms are privately negotiated between the "protection buyer" who pays a fee to the "protection seller" to guard against a potential loss originating from a reference asset. For example, LeaseCo Finance Company (protection buyer) is arranging to buy credit protection from Bank of Investments (protection seller) to cover the credit risk on an equipment lease to Widget Manufacturing Company (reference entity). The reference asset in this example is a bond issued by Widget Manufacturing. Ideally, only bonds not callable during the hedge period should be used as reference assets. Figure 2.1 illustrates the relationships in a CDS contract.

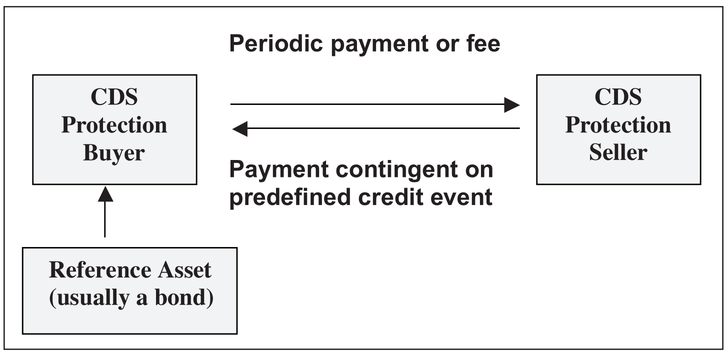

Figure 2.1 Single name credit default swap relationships

Credit default swaps are widely available and can be purchased from Goldman, Merrill Lynch, Bear Sterns, Morgan Stanley, and Bank of America to name a few. Although not all firms have actively traded credit default swaps, one can be made available for purchase if the firm has publicly traded debit. It is unlikely that credit default swaps are available for small, private, or non-U.S. firms.

During times of financial distress, the risk premium for a CDS will increase and the liquidity may be constrained. While this study hedges the entire lease portfolio, it is possible to develop an optimal hedge that only employs a combined strategy of derivatives (CDS, CDX or VIX) hedging and risk-based pricing for the riskiest counterparties, which can allay a higher risk premium.

In a credit default swap, a periodic fee (CDS spread) is paid in exchange for a much larger floating payment should a predefined credit event occur. The counterparties involved in the swap can define the credit event any way they chose. In an effort to simplify the use of CDSs, the ISDA[1] has developed a list of credit events including:

- Bankruptcy filing
- Failure to pay on bonds
- Restructuring

The credit event that triggers the payment from the seller to the buyer is defined in the agreement and is tied to a reference asset such as a bond or other financial liability. Due to the highly flexible nature of CDSs, the equipment finance company can buy a CDS that is triggered by a change in the credit rating or the accidental death of a CEO. However these are exotic products. The most common triggers are a company bond default and bankruptcy. If the credit event never occurs, the seller never makes a payment to the buyer.

The use of CDSs can be influenced by forces in financial markets. For example, in late 2007 problems in the credit market due to defaults in sub-prime mortgages reduced the liquidity of credit derivatives. The liquidity crunch affected the ability of firms to sell the derivatives but did not affect the buy side. This distinction is important as a lease portfolio hedging strategy employing credit default swaps requires the lessor to add long CDS positions as new leases are added to the portfolio. It also needs to be noted that the protection buyer will have to pay a higher risk premium during times of financial distress.

2.3 Credit Default Swaps Examples

Suppose the CDS spread for General Motors Corporation for a five-year contract with a principle of $1 million is 335 basis points per year. The protection buyer pays $33,500 per year. If the reference asset is a bond, the protection buyer has the right to sell General Motor Corporation bonds with a face value of $1

[1]The International Swaps and Derivatives Dealers is an international trade association dealing with OTC derivatives agreements. The organization has created a framework of standardized terms and conditions for OTC derivatives. There are separate ISD documents for U.S., European, and Japanese CDSs. The U.S. document is referred to as U.S. Corporate Credit Default Swap Agreement.

million if the credit event occurs. If General Motors Corporation defaults on their bonds, the recovery rate on the face value of the bonds will not be 100%. The protection buyer will receive a percentage of the face value less than 100%. In this study the recovery rate on the defaulted bonds is assumed to be forty percent.[2] This rate could differ for the industry or company based upon underlying fundamentals but standard pricing formulas are based on forty percent.

2.4 Use of CDSs today and size of market

For many years, credit default swaps were principally used by banks to hedge their exposure to central bank transactions. Over the past four years, the notional amount outstanding for CDSs has increased dramatically as the swaps are being used by hedge funds and securities houses to not only hedge credit risk of bonds, but also as speculative investments to boost the return of their portfolios. CDSs are also used as an element of structured instruments such as collateralized debt obligations (CDOs) and credit linked notes (CLNs).

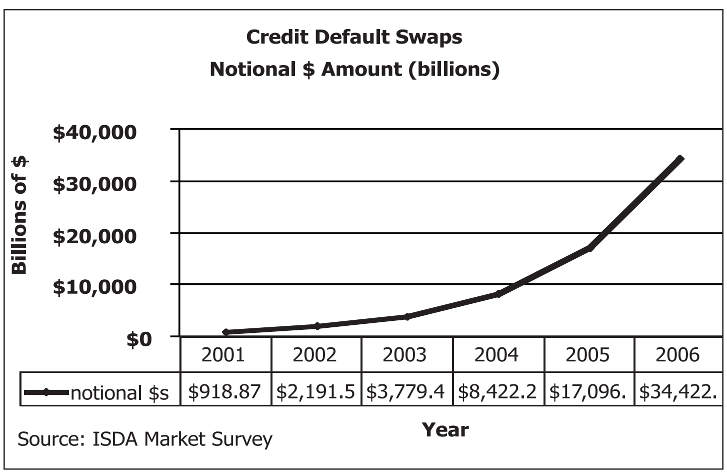

Figure 2.2 Credit Default Swaps Notional Amount in billions of US Dollars

Figure 2.2 illustrates the phenomenal growth in the CDS market. The notional value of CDS contracts more than doubled annually from 2003 through 2006.

2.5 Types of CDSs

Credit default swaps can be structured to cover a single-named entity or a basket (multi-name) of entities. The single-name CDS is very straight forward. When the contract specified credit event occurs, the protector seller pays the protection buyer the notional amount less the recovery rate amount and the contract is fulfilled.

An alternative to using single credit default swaps is to use a basket credit default swap or a multi-name CDS, which are generally less expensive than a sum of the individual CDSs, and thus a more effective hedging tool.

The pricing and structure of a multi-name CDS are more complicated. To price a multi-name CDS requires one to look at all the possible default and non-default possibilities.

3. Lease Portfolio Hedging Evaluation

The hedging effectiveness of credit default swaps was evaluated by comparing the net present value of two identical diversified portfolios, one un-hedged and one hedged with credit default swaps over a forward-looking five-year time frame. The net present value of both portfolios is uncertain because it is not known which firms, if any, will default on their leases. The uncertainty in the lease cash flows and net present values can be incorporated in the simulation by including defaults using the market's expectations provided by a credit default swap.

The net present value of the lease portfolio with a stream of known and certain cash flows is found by discounting the cash flows.[3] For an un-hedged portfolio, when a default occurs, the lease payments stop, the equipment is returned to the lessor and sold at market value (MV).

The Net Present Value (NPV) equation gets rather

[2]Source: Moody's report. "Default and Recovery Rates of Corporate Bonds Issurers, 1920-2004." January 2005, page 34, exhibit 28.
[3]Where cf0,j is the upfront cost at time 0 associated with the lease j
cfi ,j is the lease payment at time i for lease j (i=1 to t) (j=1 to n)
r is the discount rate of interest
t is the lease term in years
MV is the market value of the equipment when it is returned to the lessor.

complex when hedging and defaults are taken into account and will not be stated here. Instead, the changes to the standard NPV equation will be noted. In a hedged portfolio, per period lease payments must be reduced by the CDS premium. The time index, t, must be interpreted as the end of the lease either naturally or via a default. When a default occurs, the notional value of the CDS times one minus the recovery rate (rr) is paid to the protection buyer, which is an additional cash flow that must be included in the NPV.

In the simulation model, all of these factors were taken into account plus a probability component was added to simulate the occurrence of a lease default with a frequency given by the CDS market. For example, the default probabilities derived from the CDS market price for GM are listed in Table 3.1. The probability of a GM bond default in the first year is 1.80%, during the second year the probability climbs to 5.89% and so on. The actual probabilities of default from the market were used in the simulation model to determine when a company defaulted on their bonds.

Table 3.1 GM CDS Default Probabilities

	Year 1	Year 2	Year 3	Year 4	Year 5
GM	1.80%	5.89%	11.64%	18.36%	26.17%

3.1 Sample Portfolio

A sample portfolio of fifty companies was selected from the component companies of the NYSE US 100 index in February of 2007. The fifty companies with the highest two-year probability of default were selected for the sample. Appendix A contains a list of the companies in the sample portfolio and includes the sector and industry of their primary business.

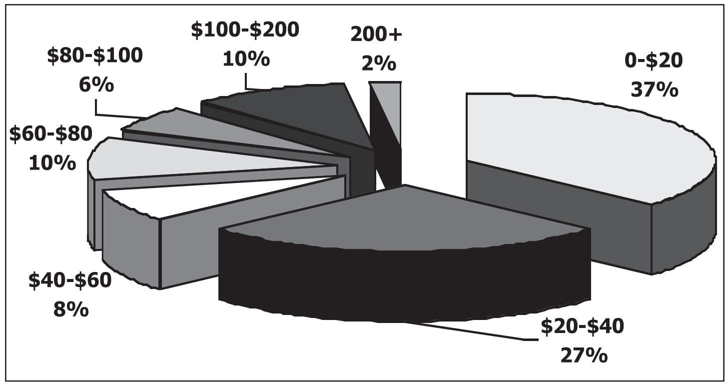

Figure 3.1 Market capitalization (billions of US dollars) of sample portfolio[4]

The distribution of the 2006 market capitalization of the sample stocks is illustrated in Figure 3.1. Thirty-seven percent of the sample companies had a market capitalization for 2006 under $20 billion.

The portfolio beta, using market capitalization, measures riskiness and volatility. The one-year beta of the sample portfolio weighs 1.08, which is slightly more risky than the overall market.

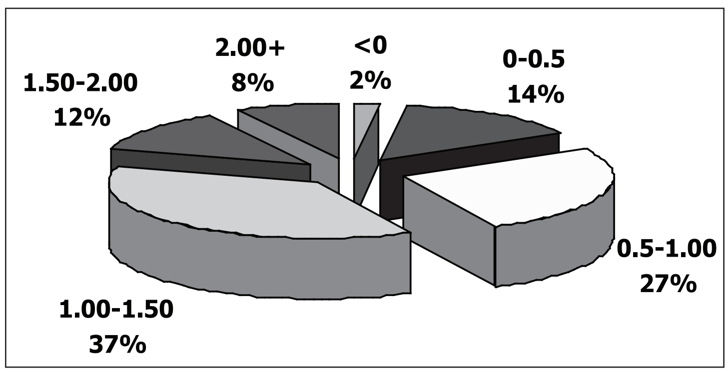

Figure 3.2 Beta distribution of sample portfolio[5]

Forty-three percent of the sample portfolio has a beta less than one and the remaining fifty-seven percent has a beta greater than one. Figure 3.2 illustrates the distribution of beta values within the sample portfolio.

Overall, the sample portfolio is comprised of large capitalization stocks with a moderate amount of credit risk. Although the portfolio beta is approximately equal to one indicating only a slightly higher

[4]Market capitalization from finance.yahoo.com
[5]Betas from finance.yahoo.com

risk than the overall market, a review of Moody's credit ratings indicates more risk.

3.2 Simulation Scenarios

The simulation model assumed each company leased a piece of equipment with an original cost of one million to ten million dollars – the dollar amount was randomly assigned as part of the simulation. The variation in the equipment cost was used to recreate a real portfolio that would have different dollar exposures to different companies verses a portfolio with equal dollar leases per company which was deemed to be too simplistic.

The first set of simulations assumed that in the case of default or at the end of the five year term, the residual value of the equipment ranged from twenty-eight to forty percent of the original value. Defaults were assumed to be independent. Table 3.2 includes a list of the assumptions.

Table 3.2 Simulation Assumptions

Variable	Assumption	Variable	Assumption
Discount Rate for lease pricing	14%	Risk Free Rate	5.25%
CDS Recovery Rate[6]	40%	Equipment cost	Uniform($1M, $10M)
Equipment Residual Value in Year 5	40%[7]	Correlations	Defaults are assumed to be independent.
Non-rolling Basket CDS Pricing	Defaults are assumed to be independent and initially non-rolling.[8]		
Rolling Basket CDS Pricing	Defaults are assumed to be independent. When a default occurs, a new hedge is re-established. The Basket CDS premium remains constant.		

A ten thousand trial Monte Carlo simulation was run for the sample portfolio described in section 3.1. The portfolio NPV was calculated under the following scenarios:

(1) This scenario assumed no defaults over the five-year lease term herein referred to as "No Defaults." This is the ideal scenario. Each lease goes to term without a credit event occurring. At the end of each lease, the market value of the equipment is recovered and incorporated into the NPV calculation. The only variation in this scenario is due to an uncertain equipment recovery rate at the end of the lease term.

(2) The second scenario allows defaults to occur in accordance with the probability of defaults imbedded in the CDS market price. Herein referred to as "Defaults."

(3) The third scenario allows defaults to occur in accordance with the probability of defaults imbedded in the CDS market price and adds hedging through single-name credit default swaps for each lease. Herein referred to as "SCDS."

(4) The fourth scenario allows defaults to occur in accordance with the probability of default imbedded in the CDS market price and adds hedging through multi-name or basket credit default swaps. Herein referred to as "BCDS." The basket CDS is a one-touch, which is structured to cover one credit event occurring among the sample portfolio. If the credit event occurs, the basket CDS pays the protection buyer (1- CDS Recover Rate) x notional amount. The basket CDS notional amount was set at $5 million which is the average value of the leased equipment. Only one credit event is covered by this contract, i.e., when the contract ends, the hedge is not re-established.

(5) All assumptions from scenario (4) apply with the exception that a rolling basket CDS hedge is established. When a credit event occurs, the hedge is re-established using a constant BCDS premium.

[6]The CDS Recovery Rate is the percent of the bond face value assumed recoverable after a payment default. The payment received from the CDS is (1-CDS Recovery Rate)*notional amount.
[7]Equipment residual values vary for different types of equipment. When determining the final hedge, the notional amount can be changed to accommodate different residuals rates.
[8]The non-rolling basket CDS hedge should be interpreted to mean that when a credit event occurs causing the protection seller to pay the protection buyer another hedge is not implemented.

The data for this analysis, specifically the probability of default and CDS spread for each company within the sample portfolio, were derived using the CDS pricing function of the Bloomberg Financial System and the basket CDSs were priced using Fincad.

3.3 Simulation Results for CDS Hedging

Using credit default swaps, single-name or basket, in the portfolio does not change the occurrence of defaults but provides a level of financial protection. Hedging with single name CDSs boosts the average NPV by approximately 4.7% over a non-hedged portfolio. Hedging with a non-rolling basket CDS provides only an average increase of 0.5% but a whopping 9% increase is achieved with a rolling basket CDS hedge.

Summary statistics for the four simulation scenarios are shown in Table 3.3. The “No Defaults” scenario represents the ideal state in which every lease in the portfolio goes to term and every lease payment is received from the lessee. The average portfolio NPV of the “No Defaults” scenario is approximately $209 million with a standard deviation of $14.2 million.

The “Defaults” scenario represents the effect on the portfolio NPV when no hedging is utilized but defaults occur. The no hedging scenario has the highest risk as measured by the standard deviation. The average portfolio NPV for the “Defaults” scenario was approximately $199 million. Hedging with single name CDSs results in a reduction of approximately five percent in average portfolio NPV from the ideal “No Defaults” portfolio.

Table 3.3 Simulation Summary for the first four scenarios

	Mean (1)	Median (2)	Standard Deviation (Std) (3)	Median/Std (NPV/Unit of Risk) (4)
No Defaults	$209,214,017	$209,237,739	$14,186,950	14.75
Defaults	$198,603,532	$198,577,661	$15,017,241	13.22
SCDS	$208,126,071	$207,946,010	$14,886,107	13.97
Non Rolling BCDS	$199,533,431	$199,544,980	$14,966,730	13.33

Only taking into account the average portfolio NPV in evaluating the effect of the hedge does not factor in the risk reduction achieved through the hedge. Column (4) of Table 3.3 lists the median portfolio NPV divided by the simulation scenario standard deviation, which can be viewed as the portfolio NPV per unit of risk. The “Defaults” scenario has the highest standard deviation and the lowest NPV per unit of risk. Hedging the lease portfolio with either single-name (SCDS) or basket (BCDS) CDSs improves the NPV per unit of risk as illustrated in Figure 3.3. The single name CDS hedging scenario provides a better return per unit of risk over a non-rolling basket CDS hedge and an unhedged portfolio.

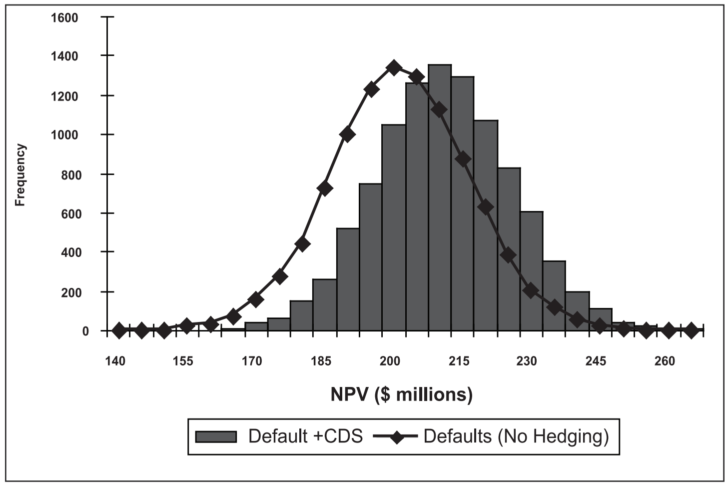

Figure 3.4 Defaults no hedging vs CDS hedging

Figure 3.4 compares the distribution of the two hedging strategies (SCDS and non-rolling BCDS). The figure shows that not re-establishing the basket CDS hedge when a default occurs results in a low cost but an ineffective hedge.

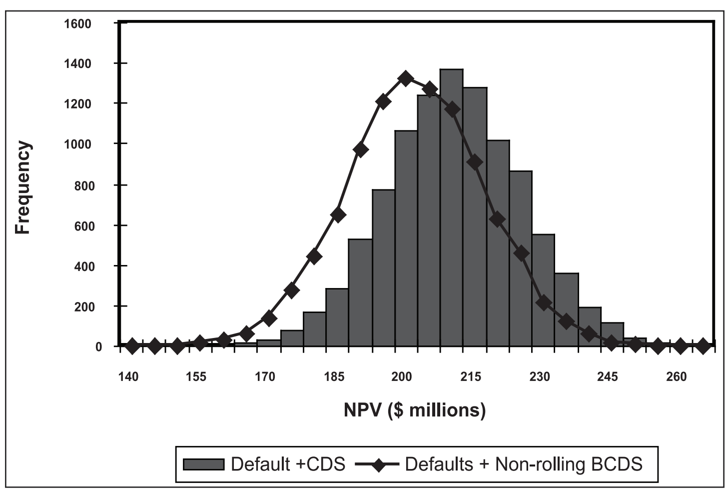

Figure 3.5 Non-rolling basket CDS hedge vs. CDS hedge

An alternative strategy is to re-establish the hedge every time a default or credit event occurs. Table 3.5

shows the summary statistics for the simulation when a rolling basket CDS is re-established every time a firm defaults. The rolling basket CDS hedging strategy results in a higher mean NPV and a higher NPV per unit of risk than any of the other scenarios including the ideal state with no defaults.

Figure 3.6 clearly illustrates the superiority of a rolling basket CDS over a single name CDS hedging strategy. The mean NPV of the rolling basket CDS strategy over the un-hedged strategy is approximately 9% on average and the standard deviation is lower than any of the scenarios.

Mean	Median (1)	Standard (2)	Median/Std Deviation (Std) (3)	(NPV/Unit of Risk) (4)
No Defaults	$209,642,942	$209,565,160	$14,205,836	14.75
Defaults	$198,961,577	$198,954,808	$14,954,233	13.30
SCDS	$208,511,332	$208,297,863	$14,829,521	14.05
BCDS	$217,226,801	$217,315,166	$14,158,596	15.35

Table 3.5 Simulation Summary Rolling Basket CDS Hedging

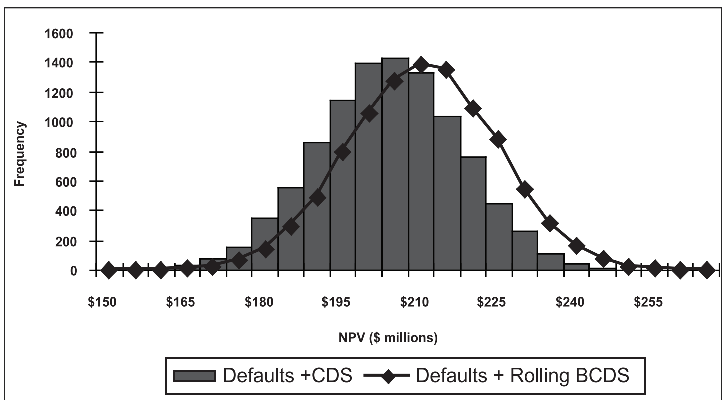

Figure 3.6 Rolling basket CDS hedge vs CDS hedge

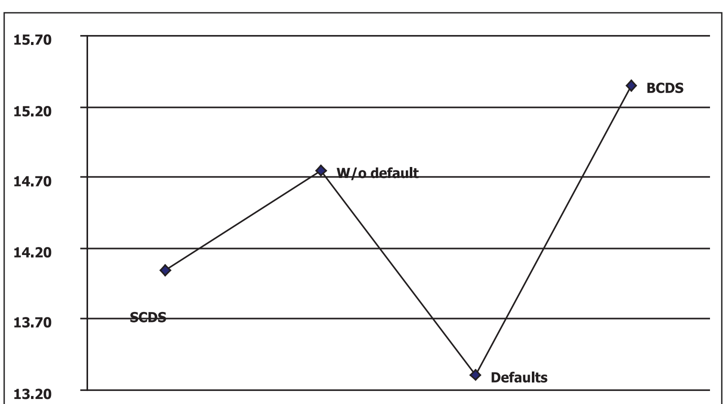

Figure 3.7 NPV per unit of risk (rolling BCDS)

3.4 Alternative Hedging Strategies - CDX Index and CBOE VIX Index

A CDS Index is similar to a basket CDS except that the pool of companies covered by the contract are standardized and not determined by the protection buyer. The CDS Indices are traded under the name CDX for North America and emerging markets and iTraxx for Europe and Asia. There are sixteen Wall Street market makers for the products: ABN Amro, Bank of America, Barclays Capital, Bear Sterns, BNP Paribus, CSG, Citigroup, Deutsche Bank, Goldman Sacs, HSBC, JP Morgan, Lehman, Merrill Lynch, Morgan Stanley, UBS, and Wachovia. Each index has a five-year maturity at issue and are issued every six-months. CDX Indices are available for the broad market (CDX.NA.IG, CDX.NA.HY, and CDX.NA.HVOL) and for sub-sectors (consumer, financial, energy, industrials, and high volatility).

A CDX Index is issued with a fixed maturity and initial spread. As with the single name CDS contracts, the premium is paid by the protection buyer to the protection seller. The value of the CDX Index changes when the credit spread on the underlying corporate bonds change. The contracts are marked to market and either the protection buyer or seller is compensated when the credit spread changes.

When a credit event occurs for a component company of a CDX Index, the company is removed from the index and the notional value of the contract is reduced by the notional value of the affected company. The protection buyer delivers the notional value of bonds for the affected company to the protection seller and receives the notional value in cash. Because of the credit event (bankruptcy or failure to pay), the market value of the bonds is far less than the par value of the bonds.

The VIX Index was introduced at the Chicago Board Options Exchange (CBOE) in 1993. The index is used as a benchmark for stock market volatility and is commonly used as an indicator of financial turmoil. Historically, the level of the VIX increases during tumultuous times and drops as the market recovers.

Either a CDX Index or the VIX could be used to hedge the counterparty risk in a lease portfolio.The effectiveness of the hedge can only be judged through an analysis of the correlations of the short-

CDX Example

Suppose that protection buyer A buys a $10 million notional amount of CDX.NA.IG which is composed of investment grade bonds for North American companies from protection seller B. The contract matures in five-years and is issued at 50 basis points. Hence the contract pays $50,000 annually and is paid in quarterly installments of $12,500. Suppose a component company, ABC, in the index experiences a credit event. This index is comprised of 125 companies with equal weights so the impact of the credit event on the value of the contract can be determined. The protection buyer A delivers $80,000 par value of ABC bonds to the protection seller and receives $80,000 in cash. The annual premium the protection buyer pays to the protection seller is reduced to $49,600 (50 basis points on $9,920,000).

term default probabilities of the companies in the lease portfolio and the components of the index. Ideally, the default probabilities of the component companies of the lease portfolio are negatively correlated with the component companies of the selected index.

4. Risk Adjusted Pricing

Risk-based pricing is commonly used in the insurance industry. The price of health, auto and life insurance depends on the characteristics of the individual purchasing the contract. The price of these contracts is adjusted to reflect the company's probability of a payout. Risk-based pricing is also available in financial services for some products. The financial services industry is interested in extending the use of risk-based pricing to enhance their returns. A portfolio of loans to high creditworthy customers will reduce the chance of nonpayment but does not optimize the portfolio return given the risk appetite of the firm.

Equipment financing and finance companies can employ the concept of risk-based pricing to increase their returns and manage the risk of their portfolios. A customer with poor credit should be charged a higher interest rate to compensate for the higher risk of nonpayment. In order to implement risk-based pricing, the obvious question is how to determine the appropriate credit spread. Using a credit rating driven spread suffers the weakness that credit ratings lag the market by three to six months. A more viable solution is to use the credit default swap driven spreads or default probabilities that are updated by the market daily. If a CDS is not available, similar firms with actively traded CDSs can serve as a proxy to determine the expected probability of default. When all else fails, there are sophisticated mathematical models available to estimate the default probability for a firm.

A simulation model was used to determine the appropriate lease payment or discount rate to account for the counterparty risk, as measured by the CDS default probabilities. Suppose you are considering a five-year lease for equipment with an original value of one million dollars to IBM, EMC and Ford. The risk of the three companies is very different as reflected by the CDS probability of defaults shown in Table 4.1.

Table 4.1 CDS Probability of defaults

Company/Year	1	2	3	4	5
EMC	1.67%	3.31%	4.92%	6.50%	8.07%
Ford	2.01%	7.16%	15.91%	24.92%	33.63%
IBM	0.09%	0.18%	0.26%	0.49%	0.78%

The credit default market places a probability of almost thirty-four percent on a Ford default within five years while IBM has less than a one-percent probability of default. This higher risk of collecting should be reflected in the lease payment.

The steps in the simulation were as follows:

(1) Simulate defaults for each company across the five-year lease term using the probabilities in Table 4.1. A uniform random variable on the range (0,1] was generated for each of the three companies in each year. If the uniform random variable was less than the default probabilities in Table 4.1, a default was simulated and denoted as a 0.

(2) Ten thousand trials were run for annual lease payments ranging from $225,000 per year to

$800,000 per year for each of the three companies. When a default was simulated it was assumed to occur mid-year and the residual equipment value was set at forty percent of the original value. It was also assumed that the funds for purchasing the original equipment as borrowed at the risk free rate plus two percent. The Treasury bond market was used as a proxy for the risk-free interest rate and the rates appear in Table 4.2. The net cash flows for each period were determined by subtracting the after tax cost of debt from the lease payment.[9] A copy of the risk-adjusted lease payment spreadsheet appears in Appendix C.

Table 4.2 Risk-free Interest Rates

	1	2	3	4	5
Risk Free Interest Rate	5.08%	4.94%	4.87%	4.85%	4.82%

The results of the simulation appear in Table 4.3 below. In order to achieve an average annual return[10] of ten percent, the risk adjusted lease payments charged to EMC, Ford, and IBM needed to be $412,000, $450,000, and $357,000 respectively. As the required return increases, the required lease payments also increase.

Table 4.3 Simulation: Risk-Adjusted Return

Company/Return	5%	10%	15%	20%
EMC	$312,000	$412,000	$512,000	$650,000
Ford	$350,000	$450,000	$575,000	$712,000
IBM	$275,000	$357,000	$457,000	$575,000

5. Conclusion

Equipment finance allows corporations to manage and expand their annual capital expenditures and not drain the company's lines of credit while procuring necessary equipment. Through the nature of their business, equipment finance companies accept a fair amount of risk from their counterparty exposures. The traditional method of mitigating risk relies on the benefits of diversification to avoid large negative swings in cash flows. Publicly traded firms are harshly treated by stock market participants by wide swings in cash flows. Triple digit annual growth in the credit default swaps market provides concrete evidence of the expanded use of CDSs for hedging corporate risk.

The research results presented herein show the value of adding single name and basket CDSs to a lease portfolio over an un-hedged diversification strategy. The hedged diversified portfolios had higher expected NPVs and higher expected return to risk ratios than the un-hedged diversified portfolio.

This study assumed that all the equipment leases in the portfolio could be hedged with a CDS. Investment banks such as Goldman, Merrill Lynch, and others have the expertise in-house to create a CDS if one is not currently available. However, even the large investment banking houses may not be willing to accept the risk of issuing a CDS on any small firm. A firm with advanced mathematical knowledge could use a proxy hedge, such as a basket CDS, on the industry sector of the small firm. We consider the mathematics to construct a proxy hedge and the description of the use of such synthetic hedges to be beyond the scope of this research due to the complex mathematics.

Additionally, this research has identified a methodology of risk-adjusted lease pricing incorporating the market's view and estimation of default. Again, if market traded CDSs are not available for the firm, proxy default probabilities can be estimated from like competitors with actively traded CDSs.

This research has not shown what an optimal hedge looks like and is an area of future research.

[9] A tax rate of 35% was assumed.
[10] The geometric return was used in the simulation.

Researcher Biographies

Deborah Cernauskas, Ph.D. is currently a risk management consultant for IBM. Her career includes time spent in both academia and industry. She has taught finance at the graduate and undergraduate levels at several Chicago-area universities, including Northern Illinois University. Her industry experience is multifaceted, including experience in corporate development, operational finance, market research and commodities trading research. Her research is currently focused on hedging operational risks and using Bayesian estimation methods in value at risk (VaR) and portfolio allocation decisions.

Dr. Andrew Kumiega has spent over 20 years automating processes including automotive machining, chemical manufacturing, confectionary, pharmaceutical manufacturing, and financial trading systems in the industry as a Senior Industrial Engineer. He is currently an adjunct professor at the Illinois Institute of Technology's Stuart School of Business and is a member of the Market Technology Committee of the Certified Trading System Developer (CTSD) program.

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Appendix A: Companies in the Leasing Portfolio

Company Symbol	Company Name	Sector	Industry
AA	Alcoa Inc	Basic Materials	Aluminum
ABT	Abbott Labs	Healthcare	Drug Manufacturer-Major
AES	AES Corporation	Utilities	Electric Utilities
AMGN	Amgen Inc.	Healthcare	Biotechnology
AVP	Avon Products	Consumer Goods	Personal Products
BDK	Black & Decker	Industrial Goods	Small Tools & Accessories
BMY	Bristol Myers Sqibb	Healthcare	Drug Manufacturer - Major
BNI	Burlington Northern Santa Fe Corporation	Services	Railroad
BUD	Anheuser Busch Companies Inc	Consumer Goods	Beverages
CBS	CBS Corporation		
CCU	Clear Channel Comm.	Services	Broadcasting, Radio
CI	Cigna	Healthcare	Healthcare Plans
COF	Capital One Financial Corporation	Financial	Credit Services
CPB	Campbell Soup Company	Consumer Goods	Processed & Packaged Goods
CSC	Computer Sciences	Technology	Information Technology Services
CSCO	Cisco System Inc.	Technology	Networking & Communication Devices
DD	Du Pont	Basic Materials	Agricultural Chemicals
EK	Eastman Kodak	Consumer Goods	Photographic Equipment & Supplies
EMC	EMC Corporation	Technology	Data Storage Devices
EP	El Paso Corporation	Basic Materials	Oil & Gas Pipelines
ETR	Entergy	Utilities	Electric Utility
EXC	Exelon Corp	Utilities	Diversified Utilities
F	Ford Motor Company	Consumer Goods	Auto Manufactorer
FDX	FedEx Corporation	Services	Air Delivery & Freight Services
GM	General Motors Corporation	Consumer Goods	Auto Manufacturer
GS	Goldman Sachs	Financial	
HAL	Halliburton Co.	Basic Materials	Oil & Gas Equipment & Services
HNZ	Heinz H J Co.	Consumer Goods	Food-Major Diversified
HON	Honeywell International Inc.	Industrial Goods	Aerospace/Defense Products & Services
IP	International Paper	Consumer Goods	Paper & Paper Products
JPM	J P Morgan Chase Co.	Financial	Money Center Bnking
LEH	Lehman Bros.	Financial	Investment Brokerage
LTD	Limited Brands	Services	Apparel Stores
MER	Merrill Lynch & Co.	Financial	Investment Brokerage
MO	Altria Group	Consumer	Cigarettes

continued

Appendix A: Companies in the Leasing Portfolio *(continued)*

Company Symbol	Company Name	Sector	Industry
NSC	Norfolk Southern	Services	Railroad
NSM	National Semiconductor	Technology	Semiconductor
ORCL	Oracle Corporation	Technology	Application Software
RF	Regions Financial	Financial	Regional-Southeast Banks
S	Sprint Nextel	Technology	Wireless Communications
S	Oracle	Technology	
SLE	Sara Lee	Consumer Goods	Processed & Packaged Goods
TWX	Time Warner Inc.	Services	Entertainment Diversified
TXN	Texas Instruments	Technology	Semiconductor
TYC	Tyco International	Technology	Diversified Electronics
VZ	Verizon Communications	Technology	Telecom Services – Domestic
WB	Wachovia Corporation	Financial	Money Center Banking
WMB	Williams Company	Basic Materials	Oil & Gas Pipelines
WY	Weyerheuser	Industrial Goods	Lumber, Wood Products
XOM	Exxon Mobil	Basic Materials	Major Integrated Oil & Gas
XRX	Xerox	Consumer Goods	Business Equipment

Appendix B: Two-Year and Five-Year Probability of Default and Credit Spread

Company Symbol	2-year Probability of Default	2-year Credit Spread (annual bp)	5-year Probability of Default	5-year Credit Spread (annual bp)
AA	0.0036	10.829	0.0151	17.5
ABT	0.003	9	0.0075	9
AES	0.0373	113	0.1438	175.69
AMGN	0.003	9	0.0075	9
AVP	0.0033	9.829	0.0168	19.25
BDK	0.01	30	0.0444	51.83
BMY	0.0037	11.1	0.0093	11.1
BNI	0.0045	13.38	0.0222	25.52
BUD	0.0035	10.42	0.0151	17.43
CBS	0.0094	28	0.0475	55.069
CCU	0.0238	71.669	0.1567	188.3
CI	0.0048	14.21	0.0181	21.069
COF	0.0057	17	0.0216	25.25
CPB	0.003	9	0.0121	14.06
CSC	0.0077	22.889	0.0418	48.25
CSCO	0.0037	11	0.0092	11
DD	0.0035	10.5	0.0088	10.5
EK	0.0211	63	0.1452	173.279
EMC	0.0331	100	0.0807	100
EP	0.0203	61	0.0898	106.5
ETR	0.008	25.93	0.0216	25.93
EXC	0.0057	17	0.0215	25.09
F	0.0716	216.669	0.3363	446.079
FDX	0.0049	14.5	0.0282	32.33
GM	0.0589	177.5	0.2617	334.67
GS	0.0057	16.889	0.022	25.629
HAL	0.0035	10.539	0.0157	18.129
HNZ	0.0049	14.5	0.0279	32.2
HON	0.0033	9.92	0.0083	9.92
IP	0.0072	21.5	0.0314	36.45
JPM	0.0037	11	0.0138	16.079
LEH	0.0043	12.677	0.0229	26.5
LTD	0.0081	24.129	0.0401	46.52
MER	0.0035	10.43	0.0203	23.479
MO	0.0043	12.649	0.0199	23

Appendix B: Two-Year and Five-Year Probability of Default and Credit Spread *(continued)*

Company Symbol	2-year Probability of Default	2-year Credit Spread (annual bp)	5-year Probability of Default	5-year Credit Spread (annual bp)
NSC	0.0046	13.63	0.0253	27
NSM	0.0331	100	0.0807	100
ORCL	0.0061	18.25	0.0152	18.25
RF	0.0331	100	0.0807	100
S	0.0072	21.579	0.0367	42.5
SLE	0.0073	21.879	0.0345	40.049
TWX	0.0042	12.5	0.0188	21.67
TXN	0.0093	27.829	0.0231	27.829
TYC	0.0067	20	0.0389	44.75
VZ	0.0039	11.5	0.0187	21.559
WB	0.0032	9.43	0.0111	12.939
WMB	0.02	60	0.0875	103.699
WY	0.0072	21.569	0.0338	39.189
XOM	0.0331	100	0.0807	100
XRX	0.0134	40	0.0553	65

Appendix C: Risk Based Pricing

2/2/07	Year							
	0	1	2	3	4	5	7	10
Risk Free Interest Rates		5.08	4.94	4.87	4.845	4.82	4.82	4.83
		0.0508	0.0494	0.0487	0.04845	0.0482	0.0482	0.0483
CDS Probability of Defaults								
EMC		0.0167	0.0331	0.0492	0.065	0.0807	0.111	0.1548
IBM		0.0009	0.0018	0.0026	0.0049	0.0078	0.0168	0.0295
CDS Spread								
EMC		100	100	100	100	100	100	100
IBM		5.21	5.21	5.21	7.219	9	13.5	13.5
EMC	$1,000,000							$229,940
Lease Payment		$229,940	$229,940	$229,940	$229,940	$629,940		
Lessor Interest Expense		-$46,020	-$45,110	-$44,655	-$44,493	-$44,330		
Discounted Cash Flow		$171,487	$160,686	$150,193	$140,162	$412,688		
NPV	$35,216							
IBM	-$1,000,000							$222,539
Lease Payment		$222,539	$222,539	$222,539	$222,539	$622,539		
Lessor Interest Expense		-$46,020	-$45,110	-$44,655	-$44,493	-$44,330		
Discounted Cash Flow		$166,054	$157,015	$148,085	$139,433	$425,564		
NPV	$36,152							
Random Values		0.02	0.2	0.2	0.2	0.2		
EMC Default Indicator *		1	1	1	1	1		
IBM Default Indicator *		1	1	1	1	1		
* 0=default; 1= non-default								

References

Chacko, G., Dessain, V., Motohashi, H. and Sjoman, A. 2006. Credit Derivatives: A Primer on Credit Risk, Modeling and Instruments. Wharton School Publishing, Upper `Saddle River, New Jersey.

Walker, T. 2006. Managing Lease Portfolios. John Wiley and Sons, Inc., Hoboken, New Jersey.

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