GLOBAL FINANCIAL CRISIS: SHOULD CREDIT DEFAULT SWAP BE MADE RESPONSIBLE

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[Lax monetary policy, sub prime lending, asset securitization, high leverage, role of credit rating agencies, fair value accounting and credit derivative products in general had been identified as an inclusive list of reasons behind global financial crisis. However, credit default swap (CDS) had been marked as the single most heinous reason by Google, Alan Greenspan, and Warren Buffet. On the other hand financial economists in general have found many advantages of CDS including enhancing liquidity, price discovery mechanisms and others.

On 4th August 2010 Reserve Bank of India has issued the draft report of the Internal Group on introduction of Credit Default Swap for Corporate Bonds for public comments. Keeping global financial crisis in mind we have become apprehensive about this product. Our study has been classified in two parts. In Part-A we have studied the basic concepts of (i) credit risk, (ii) credit derivative products in general and credit default swap in particular and (iii) valuation of credit default swap through mathematical model and numerical example. Based on the famous exploratory study by Rene M. Stutz, we have made a humble attempt to argue whether CDS has aggravated the recent global financial crisis in Part- B.

Keywords: *Credit default swap, global financial crisis, credit risk.]*

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Part A: Concept of Credit Default Swap

Credit Risk

Credit risk implies risk arising from debtors default on financial claim. Credit risk is assessed by the amount of debt or claims on the debtor (exposure) multiplied by the probability of the debtor defaulting before the end of contract with the product adjusted for the hope of recovering from the asset after default. Therefore credit risk=Exposure amount*Probability of default*(1-R). 'R' represents rate of recovery.

There are three types of credit risk. Credit default risk is the risk that the issuer will fail to satisfy the terms of the obligation with respect to the timely payment of interest and repayment of the amount borrowed. This form of credit risk covers counterparty risk in a trade or derivative transaction where the counterparty fails to satisfy its obligation. To gauge credit default risk, investors typically rely on credit ratings.

Credit spread risk is the loss or underperformance of an issue due to an increase in the credit spread. The credit spread is the compensation sought by investors for accepting the credit default risk of an issue or issuer. The credit spread varies with market conditions and the credit rating of the issue or issuer. On the issuer side credit spread risk is the risk that an issuer's credit spread will increase when it must come to market to offer bonds, resulting in a higher funding cost.

Downgrade risk is the risk that an issue or issuer will be downgraded, resulting in an increase in the credit spread demanded by the market. Hence, downgrade risk is related to credit spread risk. The ability of an issuer to make interest and principal payments diminish seriously and unexpectedly because of an unforeseen event. This risk is referred to generically as event risk and will result in a downgrading of the issuer by the rating agencies.

How to Transfer Credit Risk

Loan Syndication: Assignment or Participation

There are various ways that investors, particularly institutional investors can reduce their exposure to credit risk. These arrangements are referred to as credit transfer vehicles. For a bank, the most obvious way to transfer the credit risk of a loan it has originated is to sell it to another party. The bank management's concern when it sells corporate loans is the potential impairment of its relationship with the corporate borrower. This concern is over come with the use of syndicated loans, because banks in the syndicate may sell their loan shares in the secondary market by means of either an assignment or participation. With an assignment, a syndicated loan requires the approval of the obligor; that is not the case with a

participation since the payments by the borrower are merely passed through to the purchaser and therefore the obligor need to know about the sale.

Two credit risk vehicles that have increased in importance since the 1990s is securitization and credit derivatives. It is important to note that the pricing of these credit risk transfer instruments is not an easy task. Pricing becomes even more complicated for lower- quality borrowers and for credits that are backed by a pool of lower quality assets as recent events in the capital markets have demonstrated.

Securitization

Securitization involves the pooling of loans and /or receivable and selling that pool to a third party, a special purpose vehicle (SPV). By doing so, the risk associated with that pool of assets, such as credit risk, are transferred to the SPV. In turn, the SPV obtains the funds to acquire the pool of assets by selling securities. When pool of assets consists of consumer receivables or mortgage loans, the securities issued are referred to as asset-backed securities. When the pool consists of corporate loans the securities issued are called collateralized loan obligations. Lower funding cost and risk management are the two reasons why corporations use securitization as fund raising vehicle. Although entity employing securitization retains some of the credit risk associated with pool of loans, the majority of the credit risk is transferred to the holders of the securities issued by the SPV.

Credit Derivatives

Credit derivative is vehicle of transferring credit risk. It is the contract between two financial market participants for transferring credit risk from one party to another party. Credit derivatives enable the transfer of credit risk from lender to some one else. It provides the lender the possibility to hedge against debtors default.

Credit derivatives also permit banks to transfer credit risk without the need to transfer assets physically. For example in a collateral loan obligation, a bank can sell a pool of corporate loans to a SPV in order to reduce its exposure to the corporate borrowers. Alternatively, it can transfer the credit risk exposure by buying credit protection for the same pool of corporate loans. In this case the transaction is referred to as synthetic collateralized loan obligation.

Alan Greenspan, Chairman, Federal Reserve Bank in a speech on September 25th 2002 mentioned "The growing prominence of the market for credit derivatives is attributable not only to its ability to disperse risk but also to the information it contributes to enhanced risk management by banks and other financial intermediaries. Credit default swaps, for example are priced to reflect the probability of net loss from the default of an ever broadening array of borrowers, both financial and non financial."

Features of Credit Derivative

In general, credit derivative products have following features;

- It is a contract between two counterparties ; protection buyer and protection seller
- The contract is based on reference asset. It could be bank loan, corporate loan, corporate bond and debenture or trade receivables.
- Protection buyer pays premium for exchanging /transferring credit risk to protection seller
- The credit event for which protection is bought and sold is also predefined. It could be bankruptcy, insolvency, payment default, price decline etc.
- The settlement between protection buyer and protection seller on the credit event can be cash settled.

Classification of Credit Derivatives

Exhibit-I illustrates various structural dimensions of credit derivative products with reference to four types of credit events.

Exhibit-I: Classification Credit Derivative Products

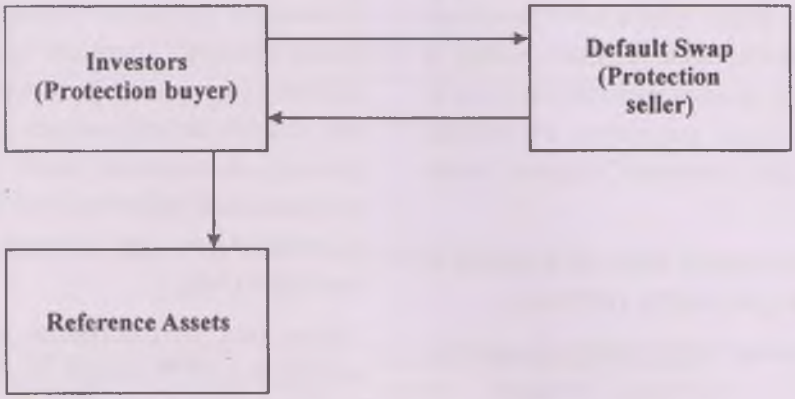
Credit Events	Options	Swaps	Forwards	Structural Notes
Change in Credit Spread	Credit Spread Options	Credit Spread Swap/Total Return swap	Credit Spread Forward	Credit Linked Notes
Changes in Credit Rating	Credit Event Options	Credit Event Swap/Total return Swap	Credit Event Forwards	Credit Linked Notes
Default	Credit Default Option	Credit Default Swap (CDS)		Credit Linked Notes

Credit Default Swap

A credit default swap (CDS) is an agreement in which one party pays protection against losses occurring due to acredit event of a reference entity up to maturity date of swap. It is one kind of insurance against credit risk. The protection buyer pays periodic fees

(premiums) to the protection sellers for this protection up to maturity date. If certain pre-specified credit events occurs.
The protection seller pays compensation to the protection buyer. A credit event could be bankruptcy of a company, called reference entity or default of a bond. If no credit event occurs during the term of the swap, the protection buyer continues to pay premium until maturity. Exhibit-II displays the operational aspect of CDS arrangement.

Exhibit-II : CDS Arrangement



CDS Pricing

Valuation of the CDS can be best understood if we try to understand valuation of a machine. Apart from other ways of valuation one way is to calculate present value of all receipts out of sale of products that will come out of the machine (A) minus present value of all input required to produce those outputs (B). We have attempted to value CDS contracts from protection buyers perspective and used two technical terminologies for A & B. A is contingent leg and B is fixed premium leg for our CDS valuation.

Our basic model of CDS valuation is

Value of CDS to the protection buyer=P.V of Contingent leg–Present value of fixed premium leg.....(1)

Protection buyer makes a series of fixed premium until maturity which is known as fixed leg on the other hand protection seller makes one payment, if the reference credit defaults. It is dependent on notional amount and recovery rate and this payment is totally dependent on a contingent event. For this purpose, it is known as contingent leg.

Let's assume S is the total CDS premium payable by a protection seller and di is the accrual days as a fraction of a year. The periodic payment will be S (d_i). This periodic payment is to be made till maturity or until reference credit is not defaulted. For that we need to consider the survival probability. Let's assume $q(t_i)$ represent survival probability at time ti.Since pricing is done at the present moment, we need to convert these payments at present values. D(t_i) represent discount factor at time t_i.

Therefore present value of payment at time ti is t_i is D(ti)*q (ti)*S(di)

Present value of all these payments is

$$= \sum_{1=1}^{n} D(t_i).q(t_i).S.d_i$$

If the reference entity defaults between payment date t i-1 and ti then CDS premium is S d_i/2

For a particular interval, expected accrued payment $\{q_{(t\,i-1)} - q(ti)\}$.Sdi/2

Where.. $\{q_{(t\,i-1)} - q(ti)\}$ represent probability that reference entity survived through payment date but not to next payment date

Present value of all expected payments

$$= \sum_{1=1}^{n} D(t_i).\ q(ti).\ S.d_i/2$$

Present value of the fixed leg

$$= \sum_{1=1}^{n} D(t_i).\ q(t_i).\ S.d_i/2 + D(t_i)\{q_{(t\,i-1)} - q(t_i)\}.Sdi/2$$

The protection buyer will receive the contingent payment of (1-R) where R is the recovery rate. The protection seller makes the contingent payment if the reference credit defaults. Therefore it has to be adjusted $\{q_{(t\,i-1)} - q(ti)\}$. ,the probability that defaults actually occurs in this time period, discounting each expected payments and summing over the term of a contract, we get present value of contingent leg.

When two parties enter in a CDS spread the CDS spread is set so that value of swap transaction is

$$\sum_{1=1}^{n} D(t_i).q(t_i)S.d_i/2 + \sum_{1=1}^{n} D(t_i).\{q - q(ti).Sdi/2\}$$

$$= (1-R)\sum_{1=1}^{n} D(ti).\{q(t_{i-1}) - q(ti)\}$$

$$S = \frac{(1-R)\sum_{1=1}^{n} D(ti).\{q_{(ti-1)} - q(ti)\}}{\sum_{1=1}^{n} D(ti)q.S\ di/2 + \sum_{1=1}^{n} D(ti)\{q_{(t\,i-1)} - q(ti)\}.di/2}$$

Example of CDS Valuation

Let's assume that CDS agreement has been entered into between A & B. A protection buyer and B is protection seller. Annual CDS spread (premium) is Rs160bps Premium is to be paid quarterly. Notional amount of the agreement is Rs.100000

It is assumed that survival probability of the reference entity is given as

Month	0	3	6	9	12	15	18	21	24
Survival Probability	100	99.9	99.6	99.1	98.4	97.5	96.4	95.2	94

Recovery rate is given to 45%.

Solution

Present value of fixed leg (Periodic payment made by A to B)

Month	Quarterly Premium	Survival Probability	Discou nting Factor	Notional amount (,000)	PV of Fixed leg	Default probability	PV of Expected accrued payment
0	0	100	1	100000	0	0	
3	40	99.9	.99	100000	395	0.1	.198
6	40	99.6	.98	100000	390	0.3	.588
9	40	99.1	.97	100000	385	0.5	.097
12	40	98.4	.96	100000	378	0.7	1.344
15	40	97.5	.95	100000	371	0.9	1.71
18	40	96.4	.94	100000	362	1.1	2.068
21	40	95.2	.93	100000	354	1.2	2.232
24	40	94	.92	100000	346	1.2	2.208
					2982		11.318

Present Value of Contingent Leg (Payment by B to A subject to non- survival of reference entity)

Month	Survival Probability	Default probability	Discounting Factor	Notional amount	Recovery	PV of Contingent leg
0	100	0	1	100000	55000	0
3	99.9	0.1	.99	100000	55000	54.45
6	99.6	0.3	.98	100000	55000	161.70
9	99.1	0.5	.97	100000	55000	266.75
12	98.4	0.7	.96	100000	55000	369.60
15	97.5	0.9	.95	100000	55000	470.25
18	96.4	1.1	.94	100000	55000	568.70
21	95.2	1.2	.93	100000	55000	613.80
24	94	1.2	.92	100000	55000	607.20
						3112.45

Value of CDS= PV of expected contingent leg-present value of fixed leg.
= Rs 3112.45-(RS 2982+ Rs11.32) =Rs 119.13

Rs 119.13 is the positive CDS value to the protection buyer.

Part B: Role of Credit Default Swap Market in Global Financial Crisis

Origin of CDS

CDS was invented in 1995 by Blythe Master, a Cambridge graduate who was then head of J.P Morgan's Global credit derivative group. The then fresh university graduate convinced her bosses at Morgan chase to develop a revolutionary product CDS. She is now the CFO of J.P Morgan. Credit default swap was first introduced innocuously as a financial instrument that would help banks transfer bad loan risk by having other well endowed financial institution such as insurance companies to take on risk.

How CDS Market may Suffer Loss

There are at least three ways in which participants in the CDS market may suffer losses. First, if the reference firm underlying the CDS contract defaults,

the protection buyer is then owed a payment from the counterparty. If the default was emancipated, however, then the protection seller could suddenly face a large loss. If the loss was severe enough, then the protection seller could be driven into financial distress. Thus the protection buyer might not receive the promised protection payment.

Second, even if the reference firm underlying the CDS contract does not default a participant in the CDS market could still experiences a substantial loss that the counterparty to the contract entered financial distress. While the CDS contract initiates its value is zero. However, when they are executed their marked to market value may diverge from zero significantly as credit spreads evolve. Specifically consider the case where counter party A has uncollateralized marked to market liability of X to counterparty B, if counter party A were to enter bankruptcy thereby canceling the CDS contract and making the liability immediately due and payable then counterparty B is only recourse would be to attempt to collect its receivable of X from bankruptcy estate.

A third way in which market participants could suffer losses through the bankruptcy of a counter party is through a collateral channel. Consider the case where counterparty A posts collateral with counter party B say because counterparty B is counterpart A's prime broker. Now imagine that the collateral either not segregated from counterparty B'S general assets (as was very typical prior to Lehman default) or that counter party B rehypotheticate counter party A's collateral(also very common prior to Lehman's default). In this context a rehypothecation of collateral is the situation in which counterparty B transfer counterparty A's collateral to third party (without transferring title to the collateral in order to obtain a loan to the third party). Thus, if counterparty B file for bankruptcy after rehypoticating counter party A's collateral or if counterparty A's collateral was not legally segregated, then counterparty A would became a general unsecured creditor of counter party B for the amount of the collateral again resulting in large potential losses.

An even more precarious situation might happen if hypotheticated collateral itself is seized and sold by the third party in response to counterparty B's default on the loan obtained using the rehypothecated securities as collateral. It is pertinent that because of this collateral channel, counterparty A could suffer significant losses from counterparty B's bankruptcy even if counterparty B does not actually have a mark to market liability to counterparty A stemming from the CDS contract.

Sub prime Mortgages

Like other mortgages, subprime mortgages are securitized. Mortgages are pooled in a pool (set up by a trust) and notes are issued against that pool. These notes are often called tranches. The most senior tranche has a first claim on interest payment and mortgage payoff. The lowest rated tranches suffer first from the default losses. As default losses rise it becomes possible for the highly rated securities to suffer from default losses as well.

Though credit default swaps are based on sub prime mortgages provided investors with several valuable benefits, including improved price discovery and an ability to hedge the risk of subprime mortgages. Many questions have been raised about whether the market for these instruments was efficient. Bank of England argued in 2008 that the ABX indices overreacted to the troubles of the subprime market. Future academic research will eventually show whether such overreaction occurred. It is clear from our mathematical model followed by numerical examples that CDS on complicated debt instrument like securitized subprime mortgage can be hard to price.

In principle the hedging benefit of credit default swap should have made it possible for subprime risk to be located with those investors and institutions for which bearing risk was most efficient. However, there are two problems with this simple view. First the sellers of these CDS including AIG ultimately did not have the ability to bear the risks they took on. Therefore some of the hedging benefit of CDS turned out to be illusory

Second, because of their built in leverage, CDS may make it possible for investors to take higher positions than they could take otherwise. To the extent the most optimistic and least risk-averse investors may be those whose investment opportunities are expanded by the availability of these instruments. These instruments may lead to price distortions where risk is underpriced. Before the credit crisis, the compensation required by investors to bear the risk of high yield debt (so called junk bonds) was at historic lows. Future research will hopefully help us to understand whether the price of credit risk was ultimately too low and whether credit default swaps played a role in making it too low if it was. If these instruments contributed to a false sense of safety of investors through hedges that were more imperfect than they thought and lead to prices that underestimated risk that might have lead to an excessive build-up of subprime exposures. Ultimately, however such

arguments rely not on the properties of CDS, but on market inefficiency brought about by limits of arbitrage. Otherwise arbitrageurs could exploit any mispricing of risk

The Size of the CDS Market

Back in the mid-1990s one of the first CDS provided protection on Exxon by the European Bank for Reconstruction and Development to JP Morgan. It took months to negotiate. By 1998, the total size of the CDS market was relatively small. It was just $180 billion. The CDS markets have grown enormously since then, although there is no definitive measure of how much. Based on the survey data from the Bank for International Settlement (BIS) the total notional amount of the CDS market was $6 trillion in 2004, $57 trillion by June 2008 and $41 trillion by the end of 2008. CDS contracts that insure default risk of a single firm are called single- name contracts. In contrast, contracts that provide protection against the default of many firms are called multi- name contracts.

In 2004 80 % of the CDS contracts were single name. In 2008 the percentage came down to 58%. Based on the data from DTCC, the size of the CDS market was $29 trillion on May 22, 2009.

It is possible that the survey measure from the BIS inflates the size of the market somewhat by leading to some double counting. It is also likely that because not all contracts are registered with DTCC, the DTCC underestimates the size of the market to some extent. Of the $29 trillion of CDS registered with DTCC on May 22, $15 trillion were single name swaps. Exhibit-III shows the evolution of the market value of CDS contracts from 2004 to the end of 2008. Exhibit-III displays the position of CDS Notional & Market Values Outstanding.

Exhibit:III : Outstanding Positions of CDS Contracts (billions of $)

Period	Single name CDS	Multi name CDS	All CDS	Single name CDS	Multi name CDS	All CDS
31.12.2004	5117	1279	6396	112	22	133
31.12.2005	10,432	3476	13,908	171	71	243
31.12.2006	17,879	10,771	28,650	278	192	470
31.12.2007	32,246	25,648	57,894	1143	859	2002
30.06.2008	33,334	23,991	57,325	1,889	1283	3172
31.12.2008	25,730	16,138	41868	3,695	1957	5652

(Data Source: Bank for International Settlements)

From the table it appears that in 2008 the market value of CDS fell when measured using the total notional amount of the contracts but it almost tripled when measured using the market value of the outstanding swaps. Such an evolution is not surprising because default risks increased for many companies in 2008.

How CDS Market Performed During Crisis

CDS market performed well during crisis. Despite huge and unexpected losses in underlying mortgage securities and near chaos in the financial sector at times, CDS market remained fairly liquid for long periods over the last two years. Further, the market handled extremely large defaults efficiently. A good example of how well it processed is the default of Lehman.

The notional amount of protection bought on Lehman was unclear at the time of the bankruptcy. Estimates for total notional amount of CDS written on Lehman ranged from $72 billion to $400 billion. While the figure is from the report of DTCC, $400 billion is the reported figure from the Financial Times on October 6, 2008 quoting a Citi analyst stating that "there could be $400 bn of credit derivatives referenced to Lehman "Protection sellers had to pay 91.375 cents on the dollar to settle the contracts. The settlement for these contracts went smoothly. As mentioned before, not all contracts are registered through DTCC and surely some additional contracts referencing Lehman existed, but there is no evidence that the additional contracts were especially difficult to settle either or that parties defaulted on these contracts.

If CDS market worked well, why has it considered dangerous? CDS were clearly part of the story of how banks and other financial institutions ended up holding mortgage securities on which they made large unexpected losses. Financial institutions largely believed that it was advantageous for them to hold super senior tranches of securitizations on their books if they insured them with CDS. Regulators across countries allowed financial institutions to set aside less capital because these institutions had bought protection through CDS. Therefore there was a large demand for insurance of super senior tranches that was partly met by CDS from AIG. Losses on CDS referencing subprime mortgage securitizations came about because of defaults on subprime mortgages and because of disappearing liquidity for such securitizations. CDS market neither caused mortgage defaults nor the disappearances of liquidity.

Many observers have focused on problems caused by counterparty risk in arguing that derivatives and specially CDS made the credit crisis worse. The arguments have two parts.

First, derivatives lead to a huge web of exposures across financial institutions. If an institution fails in this web of exposures, it can lead other institutions to fail as they make losses on their exposures. As a result this web of exposures could lead to a collapse of the financial system and to considerable uncertainty about the solvency of the financial institutions in the event of the failure of a major financial institution. Second, CDS heighten this concern because their value jumps and often by large amounts, when a default occurs.

Conclusions

Economists have generally believed that financial derivatives increase welfare by facilitating risk-sharing among investors, by improving price discovery and by making the allocation of capital more efficient. These arguments certainly apply to CDS. However, as we have seen repeatedly in this paper, there are legitimate reasons to be concerned about problems that can be created because of exposures to derivatives and because of the trading of derivatives. In the aftermath of the financial crisis, CDS and other financial derivatives have clearly lost any presumption of innocence that they once enjoyed among economists and they probably never had such a presumption with general public. But it would be premature and quite misguiding to turn 180 degrees from a presumption of innocence of guilt. There is dearth of serious empirical studies on the social benefits and cost of CDS and other derivatives not just in last two years, but in the last several decades.

Our own sense is that the deep dramatic problems of the financial credit crisis were not caused by credit default swaps or by other financial derivatives. Neither Bear Sterns nor Lehman failed because of derivatives. AIG lost money by selling unhedged CDS but it also lost money in all kinds of other ways, including by borrowing money to buy super senior AAA rated trenches of sub- prime mortgage backed securities. The common denominator of the large losses of AIG was that they occurred on sub prime exposures and hence brought about by a dramatic unexpected unexpected fall in house fall in house prices.

In our opinion financial crisis was primarily driven by two factors. First, investors and financial institutions generally did not expect that real estate prices would fall dramatically. This

dramatic fall in real estate prices led to large defaults on sub prime mortgages and large falls in securitizations of sub prime mortgages. The fall in value was especially dramatic for AAA rated trenches of sub prime securitizations even though few of these trenches have suffered from defaults so far. AAA rated trenches of securitization called collateralized debt obligations have suffered default losses.

The second factor is that many financial institutions were operating with extremely high leverage and held large investments in sub prime securitizations so that significant unexpected losses on these investments could quickly lead market participants to question their solvency, which led to cash hording by these institutions to fire sales of assets to bring about decreases in leverage and to contraction in there willingness to lend.

As these events unfolded, financial derivatives like CDS were associated with losses and uncertainties at some institutions, but also enabled other institutions to hedge and hence to reduce the impacts of the fall in sub prime mortgage and other securities. Rather than blaming derivatives markets such as the CDS market for being too large, it might make as much sense to regret that derivatives markets were not larger. For instance, it may well be that most robust derivatives markets in housing would have produced useful information for investors that would have changed the evolution of housing markets and averted or minimized the effects of a crash by enabling investors to hedge against drops in house prices.

However, until a significant empirical literature develops on the costs and benefits of CDS and other derivatives on the costs and benefits of CDS and other financial derivatives in the last few decades, it will be difficult for financial economists who view derivatives to be valuable to convince their colleagues and large share of the public that such derivatives have contributed to social welfare and played positive role in the robust economic growth in the last 30 years.

References :

- Ali, Petal, Investing in Credit Derivatives Investment Managemet: A Modern Guide to Security Analysis and Stock Selection, Springer- Verlag Heidelberg, 2009.
- Angbonou Sila Jean, Contingent Credit Default Swaps: How to Manage contingent Credit Risk.,http://ssrn.com/abstract = 1208122.
- Aslanertik Banu Esra, 'Fair value Consideration during the Financial Crisis', Anadolu International Conference in Economics, Eskisehir, Turkey, 2009.

- Credit default Swap,wikipidia.
- Dubofsky, David A and Miller Thomas W.' Derivatives: Valuation and Risk management
- Hull John C, Options ,Futures and Other Derivatives, Pearson Education (Singapore) Pte Ltd, Delhi,India.
- Jaggi, Bikki, "Fair Value Accounting and Global Financial Crisis" Indian Accounting Review,Vol14 No1, 2010.
- Naveet Arora et al, 'Counterparty Credit Risk and the Credit Default Swap Market', 2010.
- Skora, Richard K, 'The Credit Default Swap', Credit Derivatives, 1998.
- Stulz, Rene M, 'Credit Default Swaps and the Credit Crisis' Journal of Economic Perspective' Vol24, Number 1. 2010.
- Tripathy, Petal, 'Triggers of Global Financial Crisis and its impacts on Indian Service Centre (Unpublished).
- Woo K I , 'Credit Default Swaps almost bring down global financial crisis' GH Bank Housing Journal.