Too Interconnected To Fail: Financial Contagion and Systemic Risk From Network Model of CDS and Other Credit Enhancement Obligations of US Banks
(Updates and materials to be found on acefinmod.com)

Presentation for ECB Workshop on "Recent Advances In Modelling Systemic Risk Using Network Analysis" October 5 2009

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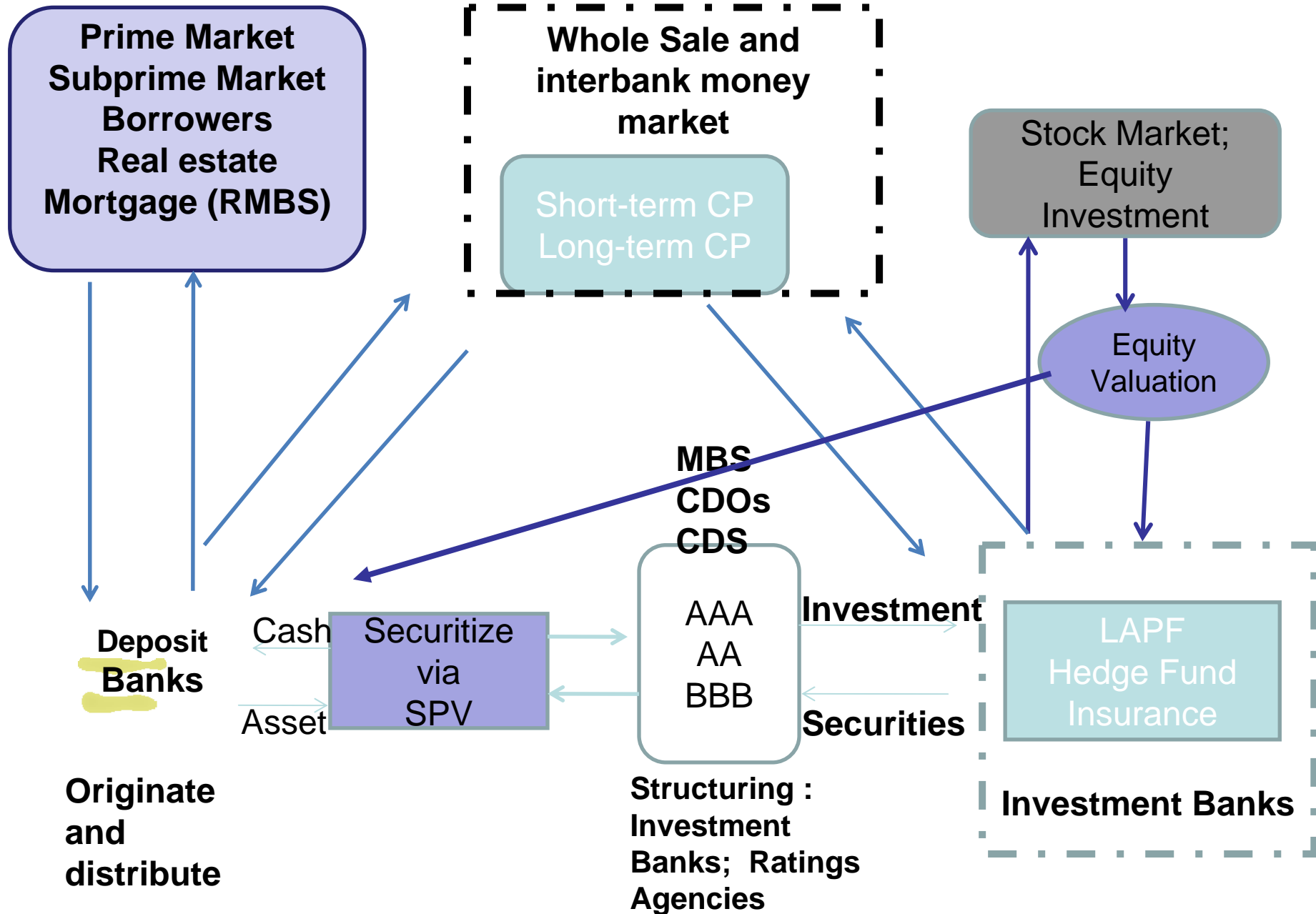
Overview :1

- Credit default swaps (CDS) (98% of credit derivatives) had a unique, endemic and pernicious role in current crisis; Robustness of Basel II Credit Risk Transfer (CRT) Scheme

- Few/No empirical studies of financial network interconnections among banks and between banks and non-banks as CDS protection buyers and protection sellers (Cont *et. al.* 2009 calibrate CDS network using network statistics and exposures of Austrian and Brazilian interbank market;NB concentration risk for banks much higher in CDS market than interbank one).

- Technical insolvency of US banks not just re legacy/toxic RMBS assets but also due to credit risk exposures from the SPV vehicles and the CDS markets

- Dominance of few big players in chains of insurance and reinsurance for credit default risk :idea of "too interconnected to fail" (Eg AIG) Tax payer bailout to maintain fiction of non-failure to avert credit event that can bring down the CDS pyramid and financial system.

- Methodological issues: Complex system Agent-based Computational Economics (ACE) for financial network modeling for systemic risk proposed: 'Wind Tunneling Tests'

- **My crusade is for full digital network mapping of many key financial sectors with live data feeds ; Combine with institutional micro-structure and behavioural rules for agents to create computational agent based test beds**
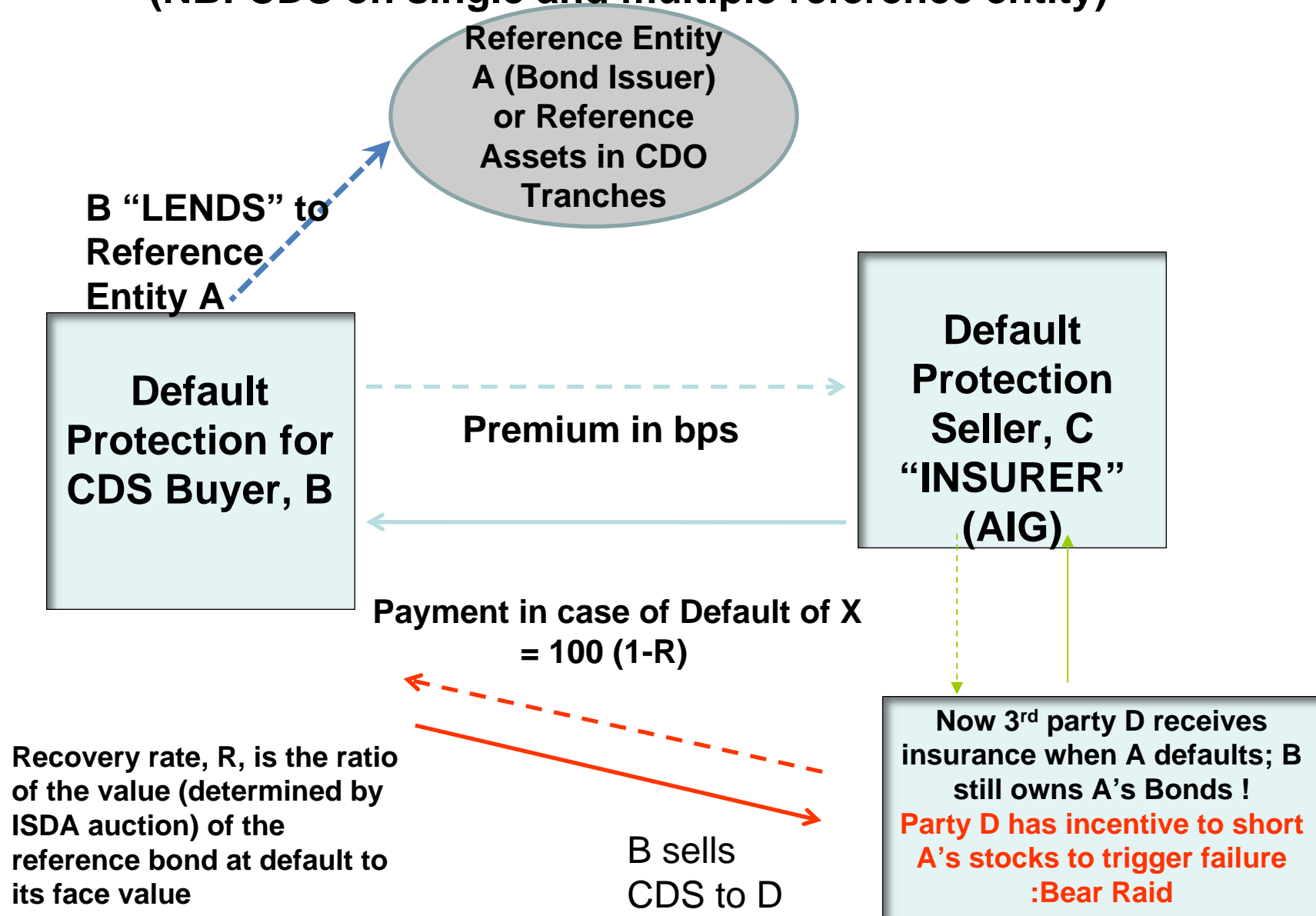
Overview 2

- Empirical reconstruction of the US CDS network (FDIC 08 Q 4 data) for stress tests to investigate implications of fact that top 5 US banks account for 98% of $16 tn of the $37 tn gross notional value of CDS reported by the BIS and DTCC for the end of 2008

- *ARE WE OUT OF THE CDS WOODS ?* **Empirically based CDS network for 25 US banks (2008 Q 4)data fundamentally unstable by May-Wigner criteria; does not have enough bank capital to prevent system collapse due to failure of a large CDS seller**

- **However, above better than an equivalent random graph which leads to worse consequences**

- **New concepts such as 'super-spreader' fund based on centrality in terms of connectivity of a financial entity in financial system**

- **Systemic Risk Ratio: measures the liquidity loss impact in terms of aggregate bank core capital loss due to failure of a major bank or non-bank player from its activities in CDS and credit enhancement**

- **Super-spreader funds: financial entities have to contribute to for their systemic risk impact.   Over turns current practice where 'big' banks have lenient collateral requirements**
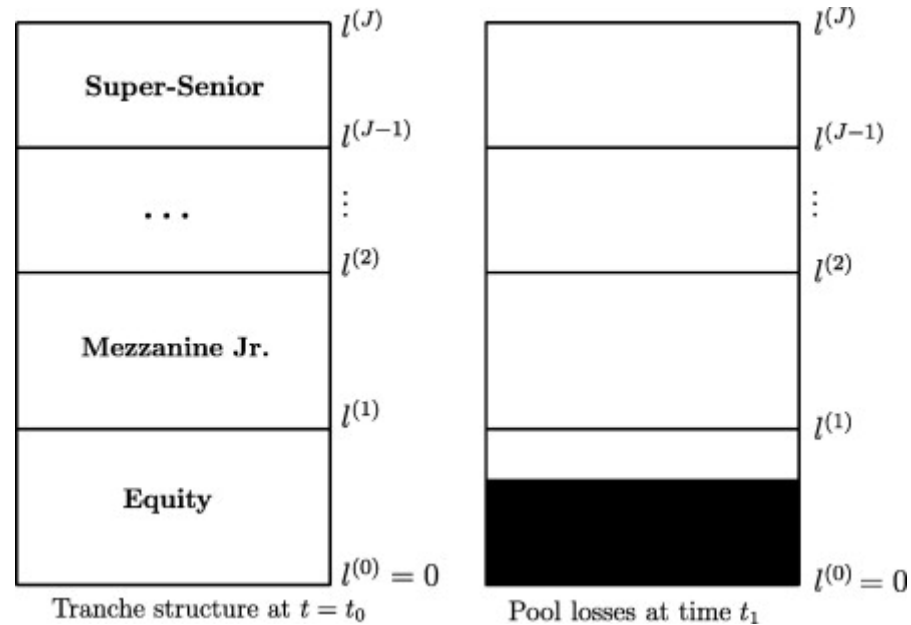
Financial Contagion

**Prime Market
Subprime Market
Borrowers
Real estate
Mortgage (RMBS)**

Whole Sale and
interbank money
market

Short-term CP
Long-term CP

Stock Market;
Equity
Investment

Equity
Valuation

**MBS
CDOs
CDS**

**Deposit
Banks**

Cash

Securitize
via
SPV

Asset

AAA
AA
BBB

Investment

Securities

LAPF
Hedge Fund
Insurance

**Originate
and
distribute**

**Structuring :
Investment
Banks; Ratings
Agencies**

Investment Banks

Credit Default Swap CHAIN Structure (CDS) and Bear Raids
(NB: CDS on single and multiple reference entity)

Reference Entity A (Bond Issuer) or Reference Assets in CDO Tranches

B "LENDS" to Reference Entity A

Default Protection for CDS Buyer, B

Premium in bps

Default Protection Seller, C "INSURER" (AIG)

Payment in case of Default of X = 100 (1-R)

Recovery rate, R, is the ratio of the value (determined by ISDA auction) of the reference bond at default to its face value

B sells CDS to D

Now 3rd party D receives insurance when A defaults; B still owns A's Bonds !
Party D has incentive to short A's stocks to trigger failure :Bear Raid

Collateralized Debt Obligation,CDO
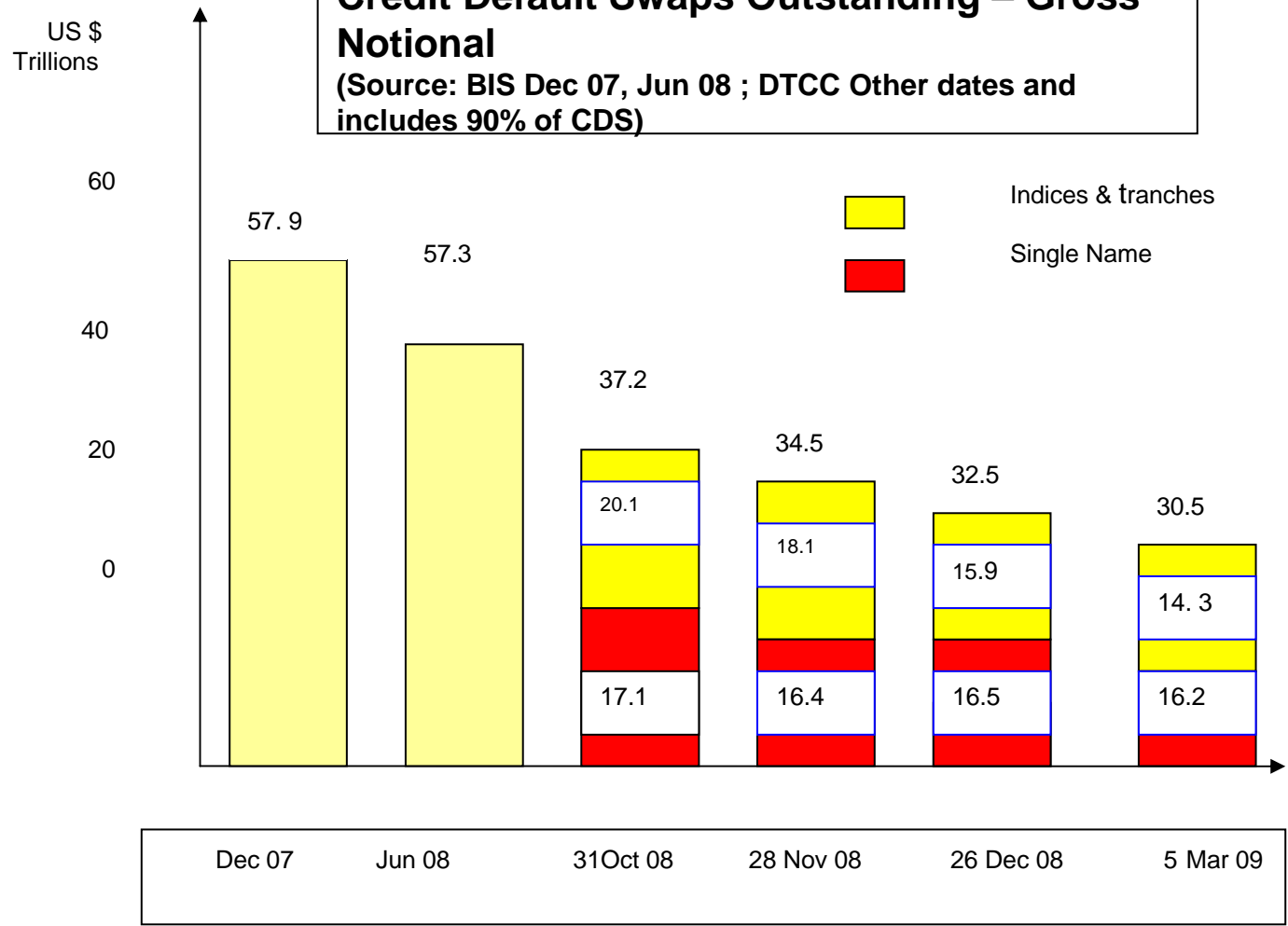# Synthetic CDO combines CDO Tranches with CDS

Tranche structure at time t_0; at time t_1, pool's losses (shaded in black) absorbed by Equity tranche; Mezzanine Jr., Mezzanine, Senior and Super-Senior tranches are not yet affected by pool losses.

Chains of CDS: Individual Rational but systemic risk inducing via gridlock; Also incentive to minimize final settlement and liquidity needed; Gross v Net

- Chains of CDS arise from a practice known as *offsetting*
- Company B buys a CDS from company C with a certain annual "premium", say 3% (See Figure on CDS Chain)
- Condition of reference entity worsens, CDS premium rises, so B sells CDS to company D with a premium of say, 6%, and benefits from 3% difference. Note, in case of no insolvency of counterparty C, B has zero economic obligations due to offset. Otherwise, B has to settle gross.
- If reference entity A defaults, company B depends on its contract with company C to provide a large payout, which it then passes along to company D. However, C as protection seller can be threatened with ratings downgrade as the reference entity degrades and pass on financial weakness to B and D.
- *Closed* CDS chains likely to evolve which minimize settlement obligations through offset and maximize returns from CDS premia (lengthening chains) calling to question whether the CDS market can provide sufficient hedge for the reference assets
- OTC CDS contracts are private, the counterparty chain is not known and so for example company D will not know that its fate is tied to company C if it is only doing business with company B.

Figure 1
Credit Default Swaps Outstanding – Gross Notional
(Source: BIS Dec 07, Jun 08 ; DTCC Other dates and includes 90% of CDS)

US $ Trillions

Indices & tranches

Single Name

57. 9

57.3

37.2

20.1

34.5

18.1

32.5

15.9

30.5

14. 3

17.1

16.4

16.5

16.2

60

40

20

0

Dec 07   Jun 08   31Oct 08   28 Nov 08   26 Dec 08   5 Mar 09

Remote Securitization of Bank Loans vs. Synthetic Securitization & CDS

2 Decades of Capital Adequacy Legislation
has resulted in Technically Insolvent banking System
Regulatory Arbitrage

- **Basel I required 8% of equity capital against bank assets**

Consider $1 bn Mortgage Loans

Equity Capital needed $80 million

If $.5 bn securitized and moved off balance sheet ie.50% of securitization

Bank now needs only $40 million of Equity Capital ; further 40 million can be lent out ; securitize again and again ….. *First MONEY PUMP*

- **Synthetic securitization: an originating bank uses credit derivatives or guarantees to transfer the credit risk, in whole or in part**

- **CDS or insurance from AAA rated entities yield low risk weighting for ABS retained on balance sheet**
  Huge bank behaviour changing incentive aggravated by negative carry trade (triple whammy for banks : seemingly risk reduction, capital reduction plus huge leverage opportunities)

- *Second Money Pump: Peak of CDS Dec 07 $57 Tn ; Dec 08 $32 Tn of this $15.64 Tn involved top 5 US banks*

- *Credit Risk transmuted to counterparty risk of bank and non-bank CDS protection sellers and now with tax payer bailout of these institutions post Lehman demise we have increased sovereign risk and the worst case of moral hazard*

Basel II Synthetic Securitization
Copious *Fed Guidance akin to jailers aiding jail break; also below unrealistic terms for banks to 'pretend' no state contingent increase in cost of risk*

In a synthetic securitization it is stated that the terms and conditions in the credit risk mitigants employed *do not* include provisions that:

- **(A) Allow for the termination of the credit protection due to deterioration in the credit quality of the underlying exposures;**
- **(B) Require the bank to alter or replace the underlying exposures to improve the credit quality of the underlying exposures;**
- **(C) Increase the bank's cost of credit protection in response to deterioration in the credit quality of the underlying exposures;**
- **(D) Increase the yield payable to parties other than the bank in response to a deterioration in the credit quality of the underlying exposures; or**
- **(E) Provide for increases in a retained first loss position or credit enhancement provided by the bank after the inception of the securitization.**

Failure to meet the above operational requirements for a synthetic securitization would require the originating bank to hold risk-based capital against the underlying exposures
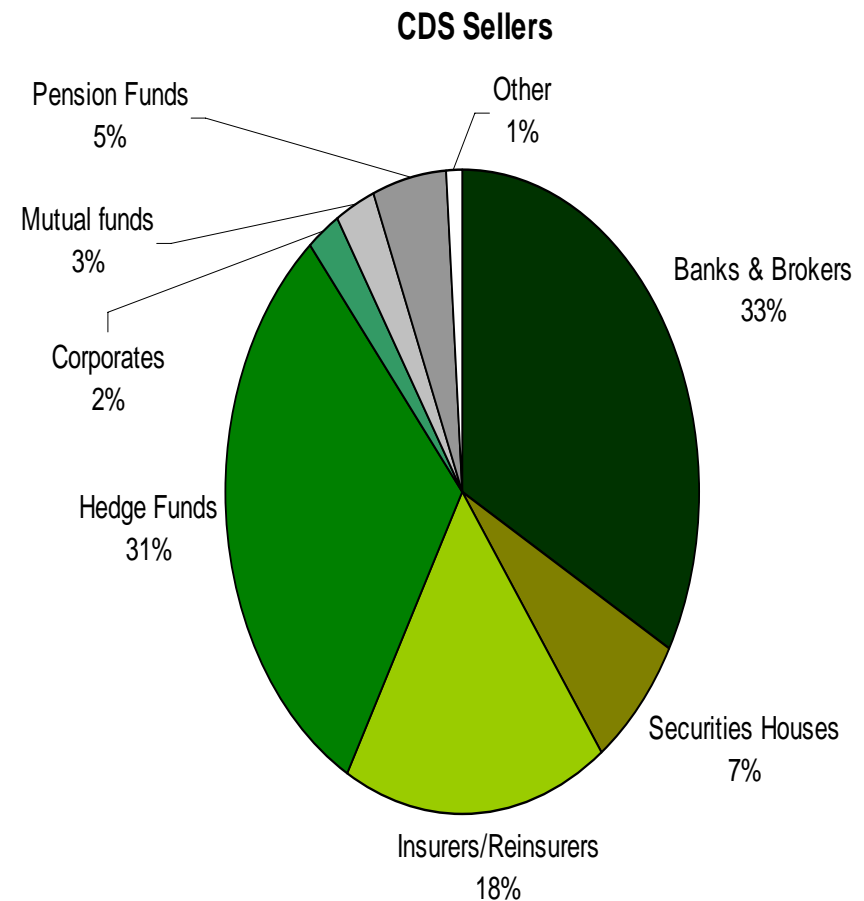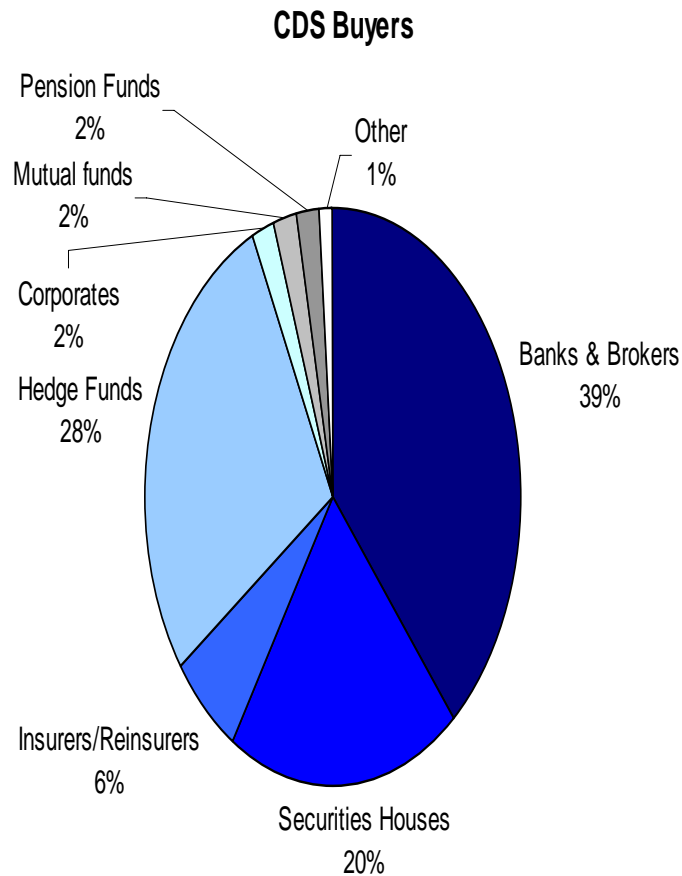
- Notice of Proposed Rulemaking (NPR) and Supporting Board Documents
- Draft Basel II NPR - Proposed Regulatory Text - Part V Risk-Weighted Assets for Securitization Exposures March 30, 2006 **http://www.federalreserve.gov/GeneralInfo/basel2/DraftNPR/NPR/part_5.htm**
- **See also Federal Register Vol 71 No 247**

Q4 2006 : Counterparties for CDS
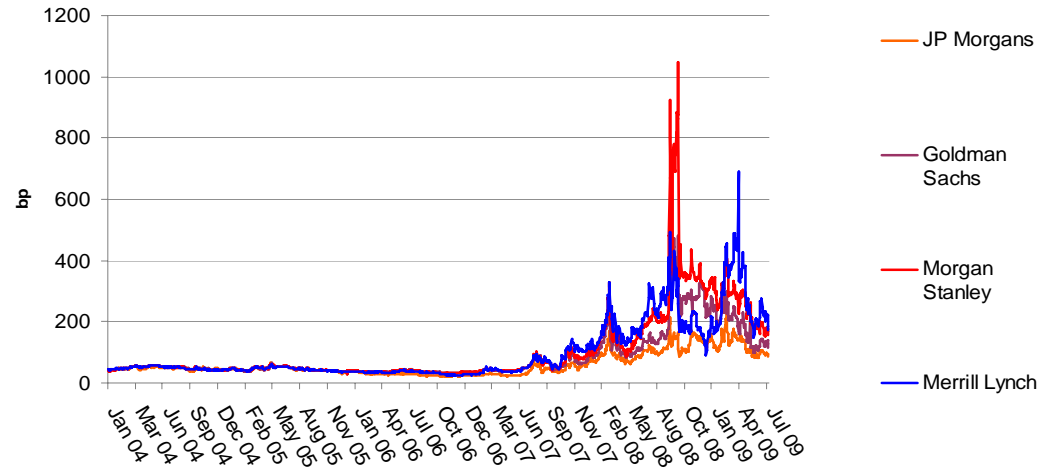
(Source **British Bankers Association)**

Green : Sellers; Blue: Buyers

Threat to system comes from sellers 49% Hedge Funds and Monolines who

have wafer thin capital base:'Buying Insurance from passengers on Titanic'
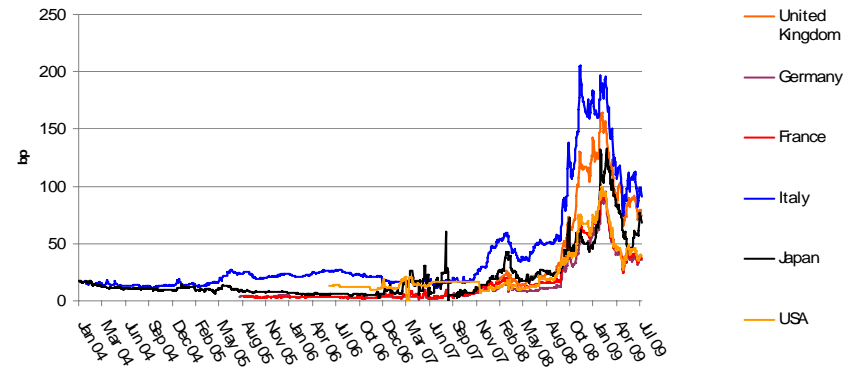

CDS Buyers

Pension Funds 2%
Mutual funds 2%
Other 1%
Corporates 2%
Banks & Brokers 39%
Hedge Funds 28%
Insurers/Reinsurers 6%
Securities Houses 20%

CDS Sellers

Pension Funds 5%
Other 1%
Mutual funds 3%
Banks & Brokers 33%
Corporates 2%
Hedge Funds 31%
Securities Houses 7%
Insurers/Reinsurers 18%

CDS Spreads (Source Datastream)

Buying CDS Insurance from a passenger on Titanic: The Role of the Monolines and Non-Regulated Bank Sector Credit Risk Converted to Counterparty Risk and now to Sovereign Risk

- Monolines (AMBAC, MBIA, FSA) traditionally dealt with municipal bond enhancements to achieve AAA rating; they began to insure prime and subprime MBS/CDOs
- On a $20bn wafer thin capital base, they insure $2.3 Tn; this led to massive loss of market value of the Monolines (see over) as RMBS assets began to register large defaults

  Often the reference entity could have higher rating than the Monoline
- Monolines are predominantly CDS protection sellers to banks: Indeed a major scenario for stress test is to use a 30% collapse ($900 bn) of CDS protection from non-bank likely to be Monolines and hedge funds
- Merrill Lynch takeover arose from a lesser known Monoline insurer ACA failing to make good on the CDS protection for RMBS held by Merrill as assets; Merrill's net subprime exposure from RMBS on its balance sheet became a gross amount when the CDS on it was reckoned to be worthless

AIG: Financial Products Division
Bailout as Too Interconnected to Fail : Due to being dominant CDS selling counterparty

- The current cost to the US tax payer of the AIG bailout stands at $170 bn

- The initial $85 bn payment to AIG was geared toward honouring its CDS obligations totalling over $66.2 bn. These include payouts to Goldman Sachs ($12.9 billion), Merrill Lynch ($6.8 billion), Bank of America ($5.2 billion), Citigroup ($2.3 billion) and Wachovia ($1.5 billion). Foreign banks were also beneficiaries , including Société Générale of France and Deutsche Bank of Germany, which each received nearly $12 billion; Barclays of Britain ($8.5 billion); and UBS of Switzerland ($5 billion).AIG

Lehman Brothers: $150bn total of Lehman debt. vs $400bn of CDS with Lehman as Reference Entity and $5Tn with Lehman as Counterparty

- Extent of the damage:Dexia held €500m of bonds, which may have caused its own need for a Franco-Belgian rescue days later.
- Among the others with declared exposure: Swedbank $1.2bn; Freddie Mac $1.2bn; State Street $1bn; Allianz €400m; BNP Paribas €400m; AXA €300m; Intesa Sanpaolo €260m; Raffeissen Bank €252m; Unicredit €120m; ING €100m; Danske Bank $100m; Aviva £270m; Australia and New Zealand Bank $120m; Mistubishi $235m; China Citic Bank $76m; China Construction Bank $191m, Industrial Commercial Bank of China $152m and Bank of China $76m. Ultimately, some money may be recovered.
- The jump in CDS spreads phenomenal and uncertainty of CDS and other credit obligations led to the drying up of short term money markets

Why Did Dogs not bark?: Methodological issues on Catalogue of Errors

- **Deep Doctrinal Errors; Complacency driven inability of academe and regulators to keep up research on financial innovations and to build models mapping the massive feedback loops (BoE research dept. : not enough forward thinking; Hank Poulsen was aghast at the stone age tools in the US Treasury when he was having to draw up TARP)**
- **Willem Buiter lambasts :** *The unfortunate uselessness of most 'state of the art' academic monetary economics' 6 March 2009, VOX* **: Wrong Pricing Models**
- **Since demise of Keynesian macro econometric models of policy analysis :long standing lack of integrated quantitative models of macro, financial sectors**
- **Lucas Critique of Econometric Models**
- **Unfortunate misunderstanding of Lucas "surprise" inflation; latter is about regulatory arbitrage (Markose 1998, 2000)**
- **Disastrous attempts to tie hands of regulators to precomitment strategies to control money supply (1992 toppling of Sterling and ERM peg by Soros)**
- **Overflow of above into practice of central banking and financial regulation: the idea that central banks can control modern money supply (replete with money substitutes) by a simple quantitative rule is the consequence of a very large academic literature. BoE control of inflation with CPI since 1992**

Complex adaptive systems (CAS) methods:Agent Based Computational Economics (ACE) and Network Models with Feedback Loops

- Andrew Haldane (2009) 'Financial Networks' as CAS. Financial institutions as nodes and obligations to pay (out degrees) and inflows/receipts (in degrees); Literal analogy between epidemiology and financial contagion ; Important insights derived and it is good to know that belatedly Directors of Financial Stability are doing their homework
- Sine Qua non of CAS: 'Surprises'- innovation based structure changing dynamics brought about strategic arms race like Red Queen behaviour; Haldane overlooks how a mutant strain in a virus becomes virulent in the first instance and becomes the source of contagion – ie. only because the host is unable to produce antigens or vaccines or coevolve
- Examples regulatory arbitrage : between regulator and regulatee
- Goodhart's law: target based regulation will be foiled by regulatees;
- Policy design should be based on this complex system premise rather than fixed quantitative rules
- Vigilance, monitoring and design of robust systems that cannot be arbitraged
- Authorities were in dereliction of duty by abandoning the regulatory co-evolutionary game and confining themselves to a fixed quantitative rule

Other Critiques of lack of Systemic Risk Perspective

- Brunnermeir et. al. (2009) on micro-prudential focus ignoring systemic risk implications : *fallacy of composition* Conflation of micro and macro

John Eatwell (Guardian, 19 Sept 2008)

Risks of system collapse are externalities; " their cost to the economy as a whole is greater than the cost to a firm whose actions are creating the risk. But if regulators focus on risks that are recognised by firms already, and neglect systemic risk" .. What does regulation achieve ?

"Regulators must begin to base their approach on the system as a whole. .. while financial firms are encouraged by supervisors to conduct thousands of stress tests on their risk models, few are conducted by the regulator on a system-wide scale. If it is possible to have system-wide stress tests on the impact of Y2K, or of avian flu, why not on liquidity?"

- David Jones (2002)in a rare paper discusses regulatory arb and systemic implications from Basel suggests that lack of literature is due to lack of data for econometric analysis ; but are econometric models up to the task ?
- Recent UK Select Committee critique of Bank of England Dynamic General equilibrium models – no banks in it and no possibility for insolvency so no assessment of systemic risk possible from bank behaviour

ACE/CAS Framework v Others for Systemic Risk

- See, Markose (2002, 2005, 2006) and Markose et. al (2007) : the view of computational incompleteness and bounded rationality ; self-reflexive decision problems which lead to heterogeneity in strategies; 'surprises' or innovation based structure changing dynamics; **network interconnectivity of agent relationships which are prone to non-linear and extreme power law dynamics.**

- Above in marked contrast to extant representative agent analytical models with Gaussian and completeness assumptions of perfect rationality which can not include the type of extreme outcomes recently observed as being likely.

- Econometric model of CDS used by US banks by Minton et. al(2005) regresses CDS (buy/sell) on a number of bank balance sheet items; hampered by enough time series data; systemic risk implications hard to assess

- Complementary approaches to assessing systemic risk (see, Jorge Chan-Lau et al in IMF Report (2009)): include co-risk model (Adrian and Bunnermeier (2008)),   distress dependence approach (Chan-Lau et al (2009)) and the distress intensity matrix approach (Giesecke and Kim (2009)). Useful in a diagnostic way have disadvantages of reduced form models. That is, unravelling and changed behaviour of institutions under stress which set in motion non-linear negative feedback loops are impossible to track in frameworks other than an ACE one.

Too Interconnected To Fail Experiments: Loss of CDS Protection with Multiple Consequences

- **Objective: Build CDS Network and Conduct Stress Tests**
  There is very high correlation between the dominance of market share in CDS and CDS network connectivity ;

Stress Tests: Follow Furfine (2003) Algorithm

- We use 20% reduction of core capital to signal bank failure

- **Experiment 1**: (A) The loss of CDS cover due to the failed bank as counterparty suspending its guarantees will have a contagion like first and multiple order effects. Full bilateral tear up assumed; No possibility for Novation

That is (x_{ij} - x_{ji}) > 20% Core Capital$_j$ (CC$_j$)

- **Experiment 2**: Armageddon Scenario

- Experiment 1 + (B) trigger bank is also a CDS reference entity
 activating CDS obligations from other CDS market participants (zero recovery rate and no offsets)

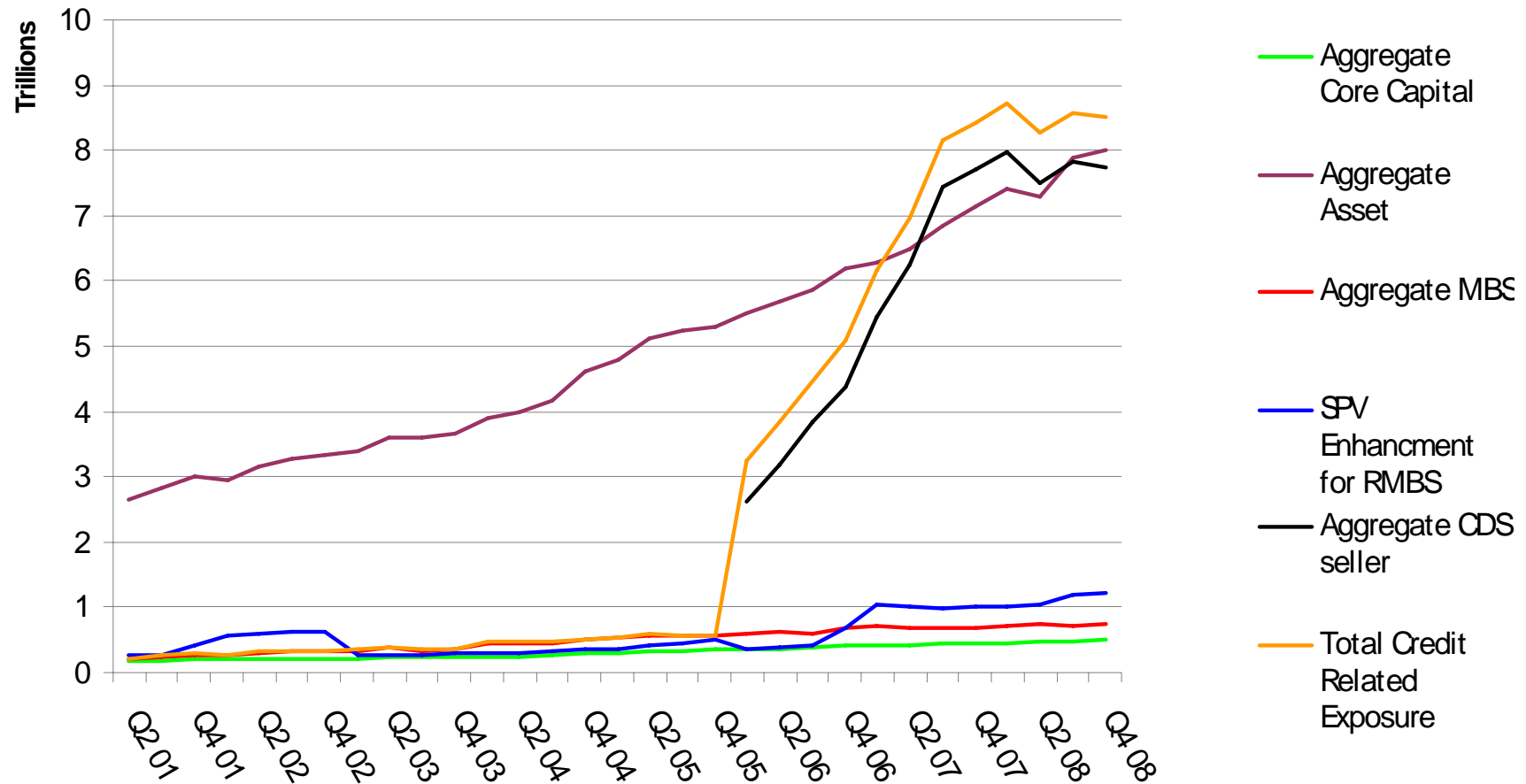- + (C) Loss of SPV cover and other credit enhancement cover from failed bank

US Banks With CDS Positions($bns):2008 Q4 FDIC Data

Namefull	CDS Buy	CDS Sell	Core Capital	Mortgage Backed Securities	SPV Enhancement	Loans & Leases	Charge Offs
JPMorgan Chase Bank	4,166.76	4,199.10	100.61	130.33	3.53	663.90	12.75
Citibank	1,397.55	1,290.31	70.98	54.47	0.11	563.24	10.81
Bank of America Bank / Goldman Sachs Bank	1,028.65	1,004.74	88.50	212.68	0.16	712.32	13.68
USA	651.35	614.40	13.19	0.00	0.00	4.04	0.08
HSBC Bank USA	457.09	473.63	10.81	20.92	0.01	83.25	1.60
Wachovia Bank	150.75	141.96	32.71	32.83	2.44	384.99	7.39
Morgan Stanley Bank / Merrill Lynch Bank	22.06	0.00	5.80	0.00	0.00	14.85	0.29
USA	8.90	0.00	4.09	3.00	0.00	24.59	0.47
Keybank	3.88	3.31	8.00	8.09	0.00	77.39	1.49
PNC Bank	2.00	1.05	8.34	24.98	0.00	75.91	1.46
National City Bank	1.29	0.94	12.05	11.95	0.71	102.40	1.97
The Bank of New York Mellon	1.18	0.00	11.15	29.29	0.00	2.85	0.05
Wells Fargo Bank	1.04	0.49	33.07	60.15	0.59	348.35	6.69
SunTrust Bank	0.59	0.20	12.56	14.85	0.00	131.06	2.52
The Northern Trust Company	0.24	0.00	4.39	1.37	0.00	18.98	0.36
State Street Bank and Trust Company	0.15	0.00	13.42	23.03	0.00	9.13	0.18
Deutsche Bank Trust Company Americas	0.10	0.00	7.87	0.00	0.00	12.86	0.25
Regions Bank	0.08	0.41	9.64	14.30	0.21	98.73	1.90
U.S. Bank	0.06	0.00	14.56	29.34	0.42	183.76	3.53
RBS Citizens	0.00	0.06	8.47	19.75	0.01	92.24	1.77

Note: FDIC Data; All figures in $bn

US FDIC 25 Banks Tier 1 Capital and Credit Risk Exposure: 2006 marks start of technical insolvency of US Banks as CDS plus SPV Enhancement obligations of 25

## US banks involved in credit risk transfer is greater than their assets

Legend:
- Aggregate Core Capital
- Aggregate Asset
- Aggregate MBS
- SPV Enhancment for RMBS
- Aggregate CDS seller
- Total Credit Related Exposure

Source: FDIC Data

Properties of Networks

*Diagonal Elements Characterize Small World Networks*

Watts and Strogatz (1998), Watts (2002) See Markose et. al. (2004)

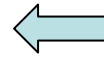| Properties / Networks	Clustering Coefficient	Average Path Length	Degree Distribution
Regular	*High*	High	Equal and fixed In-degrees to each node
Random	Low	*Low*	Exponential/ Poisson
Scale Free/Power Law	Low	Variable	*Fat Tail Distribution*

A graphical representation of random graph (left) and small world graph with hubs, Markose et. al. 2004
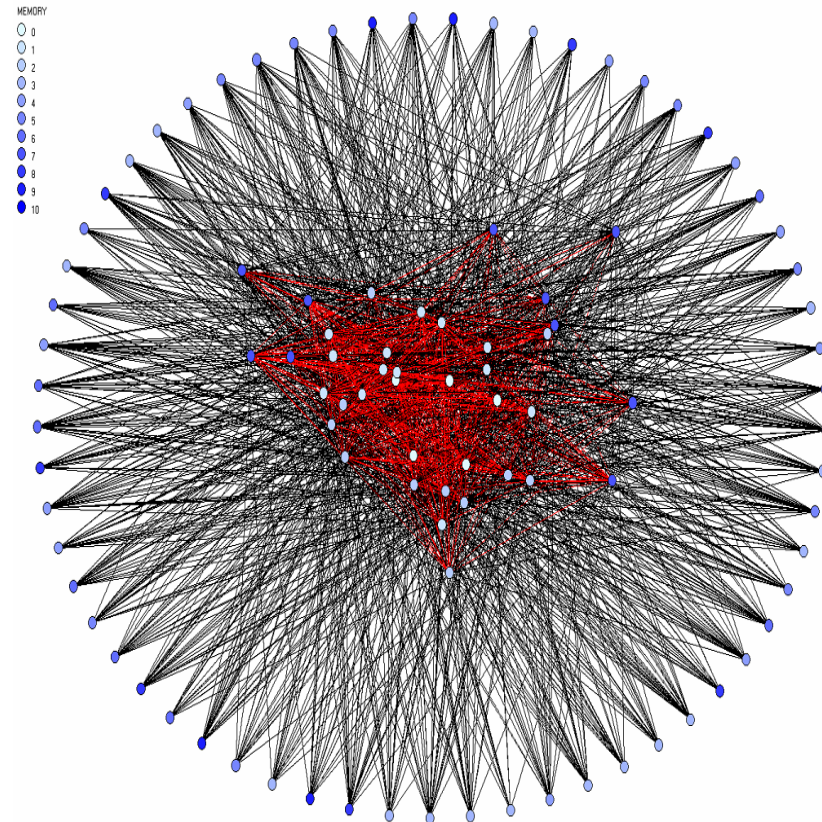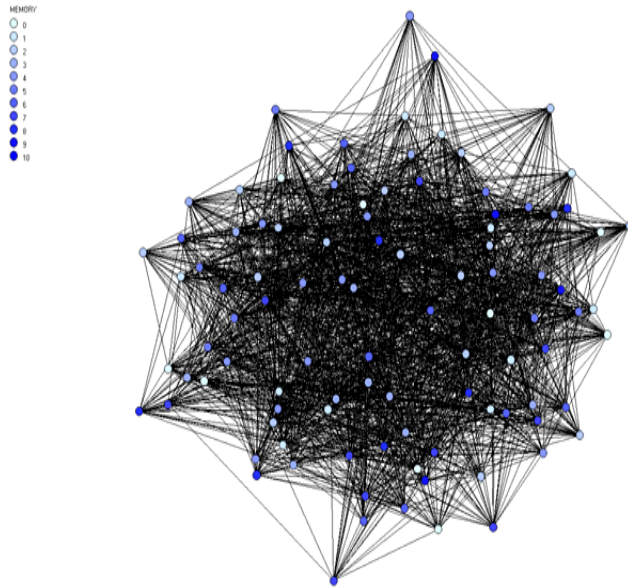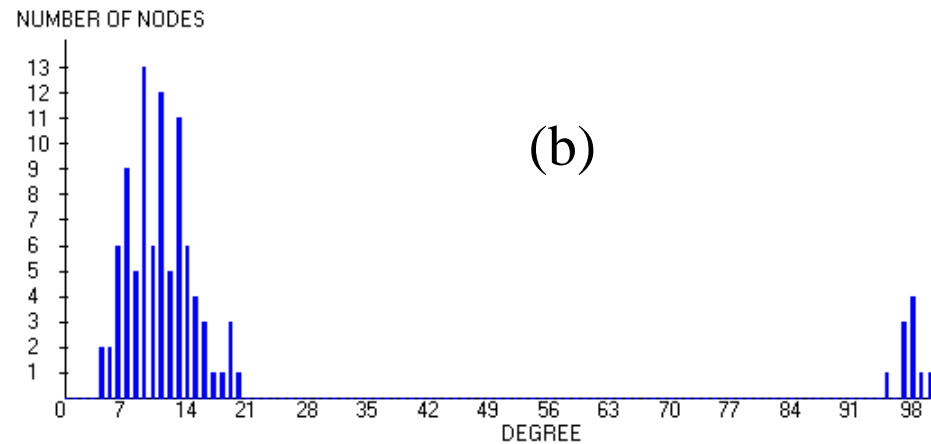
Degree distributions, Markose et al 2004

(a)
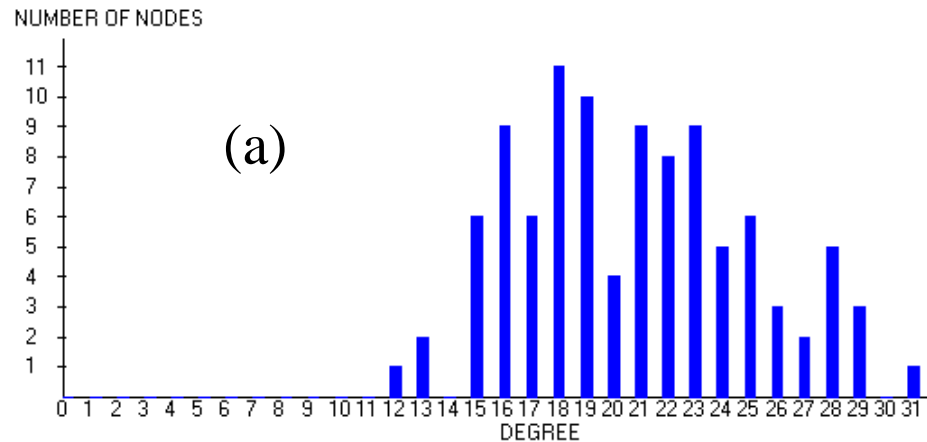
Degree distribution
of the initial
random network

Degree distribution
of the network with
fat tails; 20% has
80% of in degrees

(b)

Clustering coefficient

- <u>Clustering coefficient:</u> average probability that two neighbours of a given node (agent) are also neighbours of one another. The clustering coefficient Ci for agent i is given by:

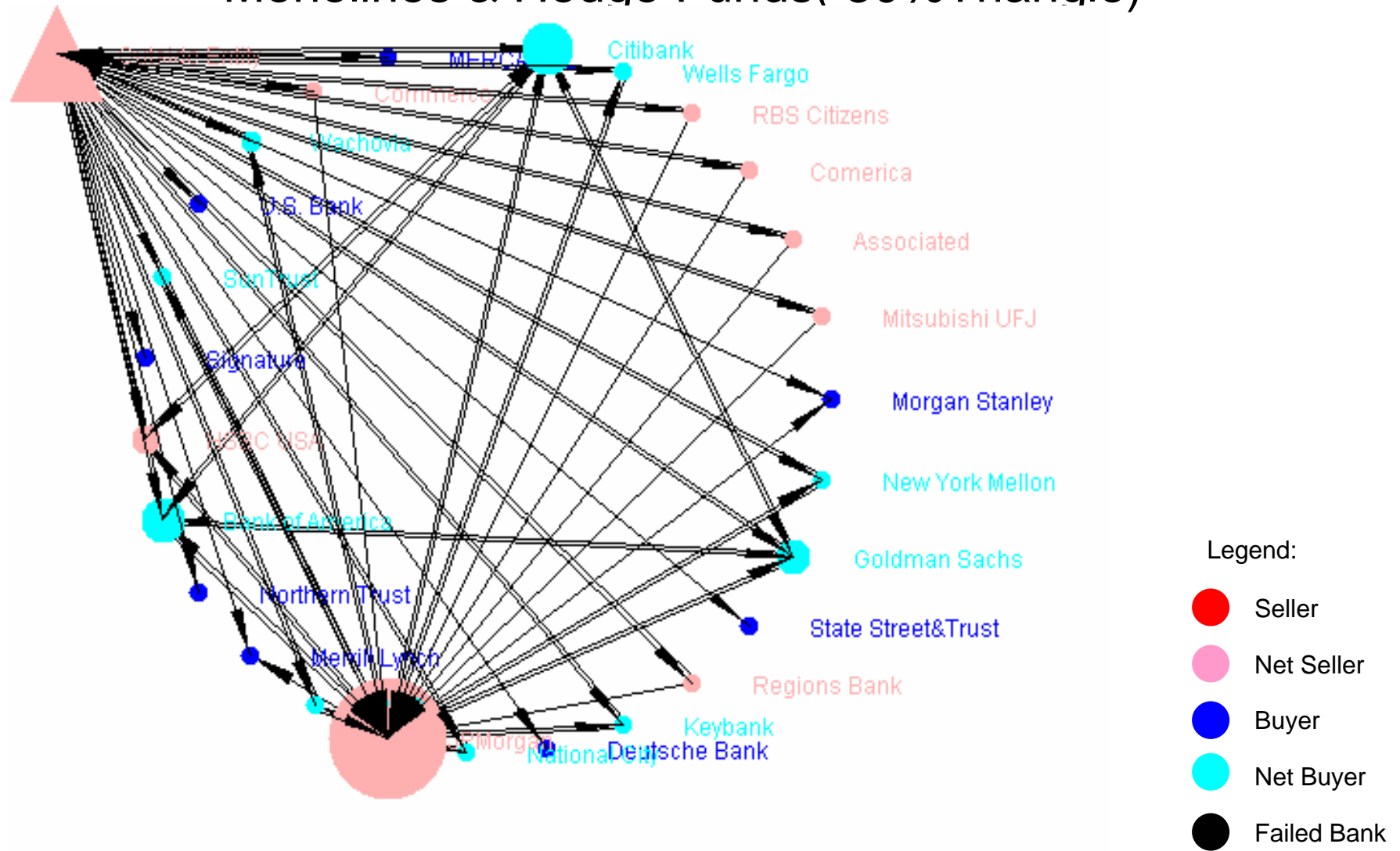$$Ci = \frac{E_i}{k_i(k_i - 1)} \qquad E_i = \sum_{j \in \Xi_i} \sum_{m \in \Xi_i} a_{jm}^{1} \quad , j \neq m$$

.

- The clustering coefficient of the network as a whole is the average of all Ci's and is given by
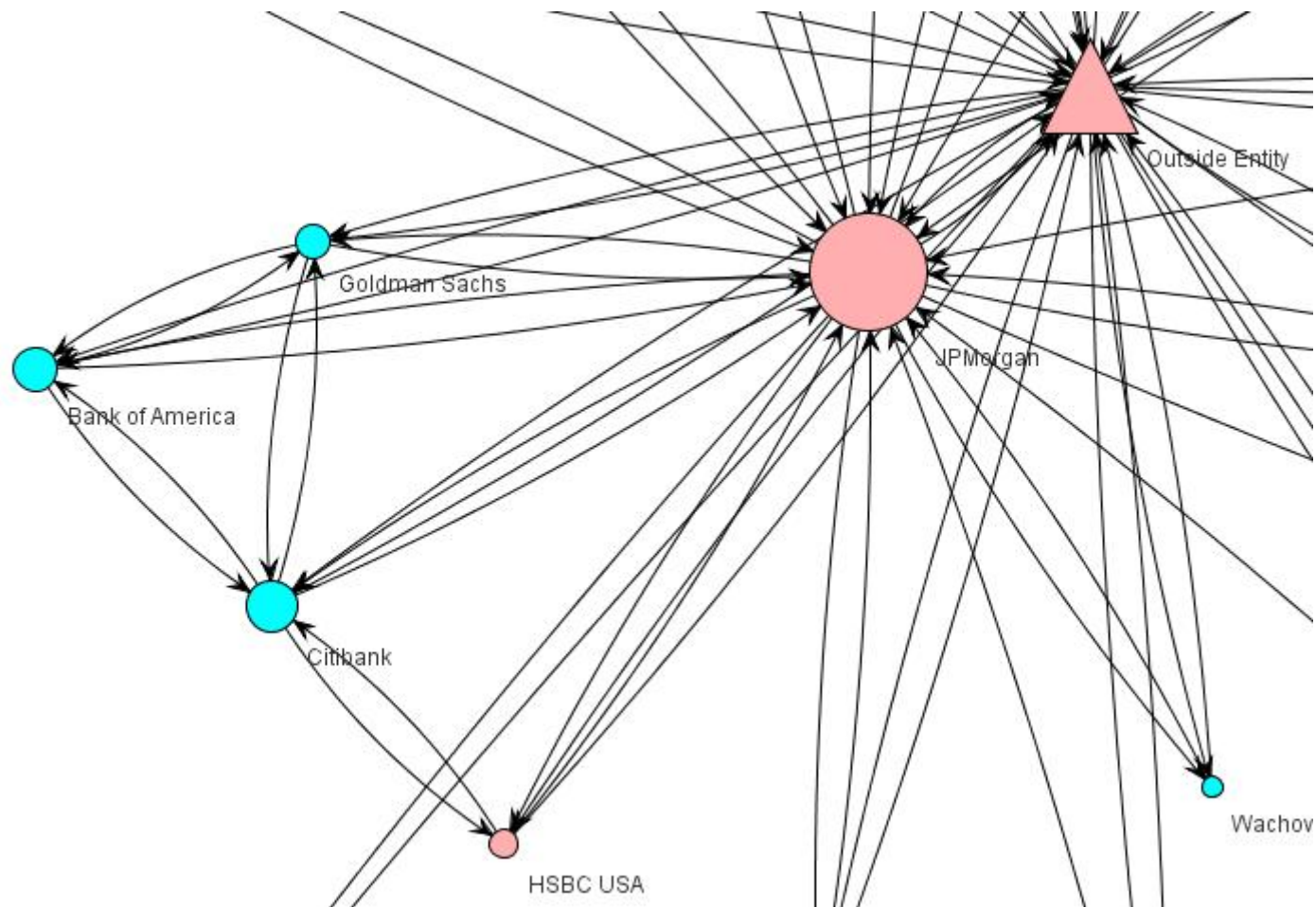
$$C = \frac{\sum_{i=1}^{N} C_i}{N} \qquad ; C_{rand} = p$$

Market Share in US Bank CDS Purchase Bank	CDS Market Share (Among US Banks)
JPMorgan	0.53
Citibank	0.18
Bank of America	0.13
Goldman Sachs USA	0.08
HSBC USA	0.05
Wachovia	0.02
Morgan Stanley	0.003
Merrill Lynch USA	0.001
Keybank	0.0005
PNC	0.0003
National City	0.0002
Bank of New York Mellon	0.00015
Wells Fargo	0.000131
SunTrust	7.41E-05
Northern Trust	2.98E-05
State Street and Trust	1.84E-05
Deutsche Bank Americas	1.27E-05
Regions	9.7E-06
U.S. Bank	8.04E-06
Commerce	2.2E-06
MERCANTIL COMMERCEBANK	1.33E-06
Associated Bank	9.5E-07
Comerica	6.68E-07
Signature	3.8E-07
RBS Citizens	0

Source : FDIC 2008 Q4.

Initial CDS Financial Network for 25 US Banks (2008 Q4): Note Majority of Interconnections are among top 4 banks and Monolines & Hedge Funds(30%Triangle)

Legend:

- Seller
- Net Seller
- Buyer
- Net Buyer
- Failed Bank

Citibank
Wells Fargo
RBS Citizens
Comerica
Associated
Mitsubishi UFJ
Morgan Stanley
New York Mellon
Goldman Sachs
State Street&Trust
Regions Bank
Keybank
Deutsche Bank

Note the clustering between key banks and 'outside' non bank (triangle) http://www.acefinmod.com/cds1.html

May- Wigner Stability Criteria for Networks

$$\sqrt{NC}\ \ \sigma\ <\ 1\,.$$

- Sinha (2005) and Sinha and Sinha (2006) found that the transition point between stability and instability with respect to the given parameters (N:No. of Nodes, C:Connectivity and sigma) does not differ between random and small world networks.

- However, they found that the speed and manner in which these different network systems transited into instability differed.

- An unstable clustered network system will disintegrate in a less pervasive way than an unstable random network system.

Table 5
Network Statistics for Degree Distribution for CDS Network: Small World Network Properties Compared with Random Graph with Same Connectivity

Initial Network Statistics (In Degrees) CDS Buyers	Mean	Standard Deviation σ	Skewness	Kurtosis	Connectivity	Clustering Coefficient	May-Wigner Stability
In Degrees CDS Buyers	3.04	4.44	3.13	9.12	0.12	0.92	7.814
Out Degrees CDS Sellers	3.04	5.34	3.60	14.12	0.12	0.92	9.432
Random Graph	3.48	1.50	0.70	0.04	0.12	0.09	2.64

Random Graph with Same Connectivity and Gross CDS Buy/Sell
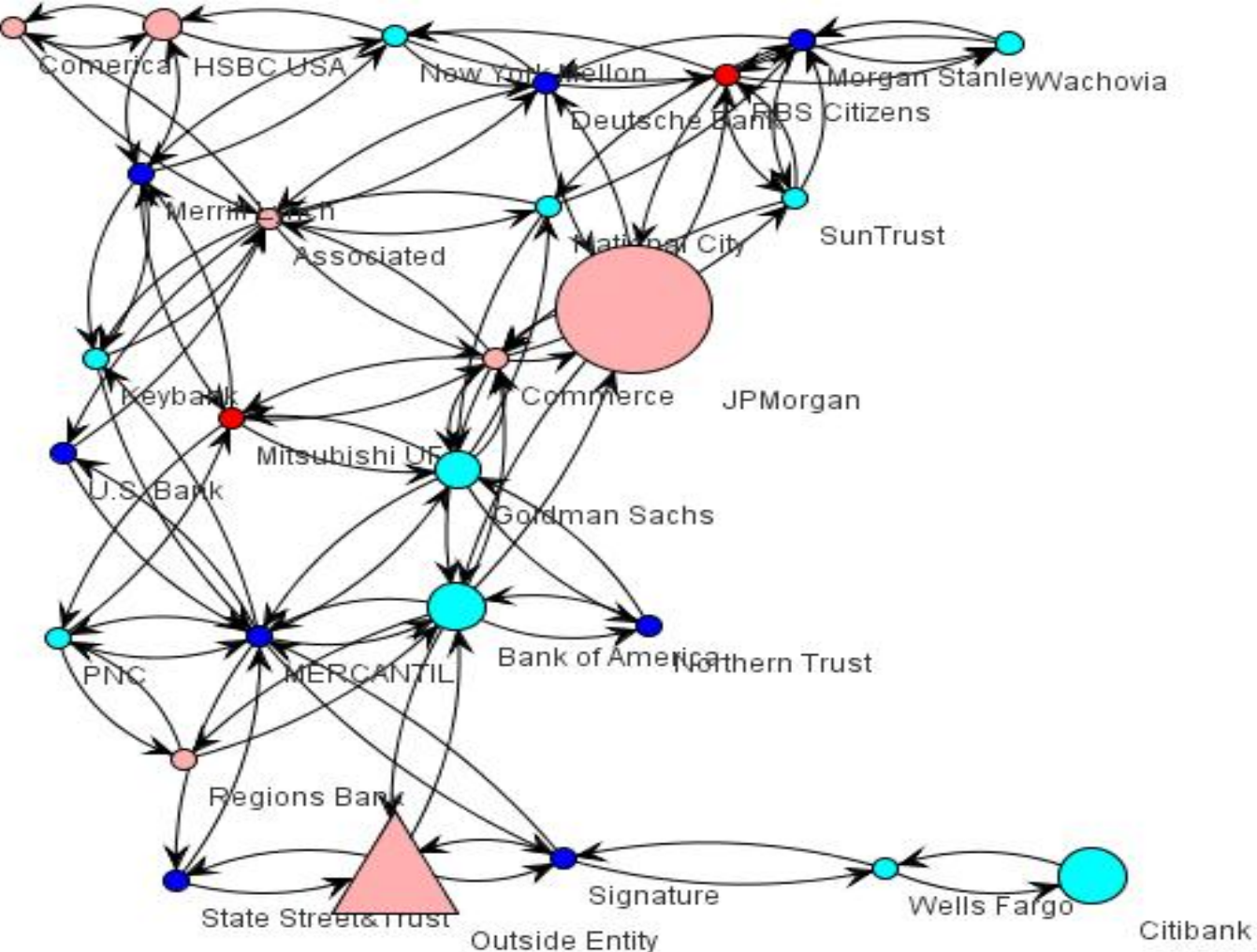
Contagion when JP Morgan Demises in Clustered CDS Network (Left 5 banks fail in first step and crisis contained) v In Random Graph (Right 22 banks fail !! Over many steps)
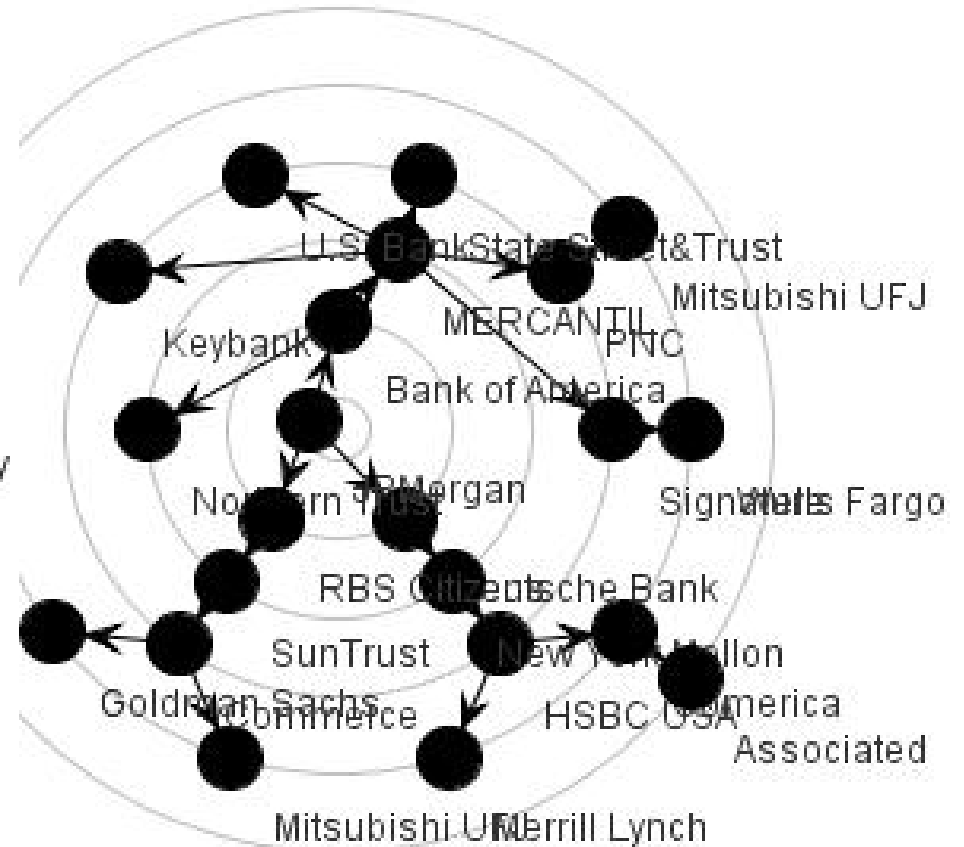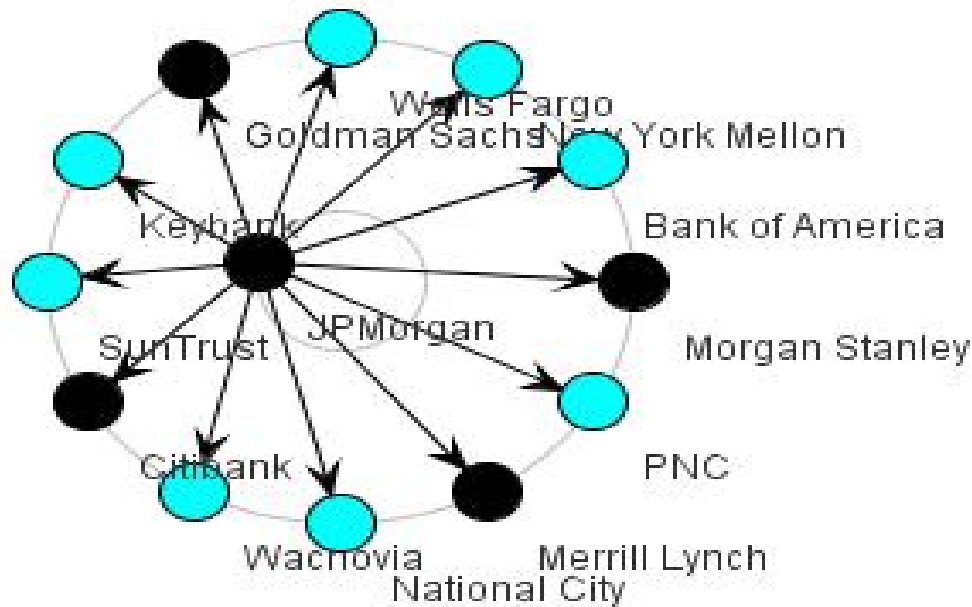
Systemic Risk Ratios

- JP Morgan has a SRR of 46.96% implying that in aggregate the 25 US banks will lose this percentage of core capital with Citibank, Goldman Sachs, Morgan Stanley and Merrill Lynch being brought down.

- The highly likely scenario of the demise of 30% of a non-bank CDS protection seller (such as a Monoline) has a SRR of 33.38% with upto 7 banks being brought down.

- Bank of America has an SSR of 21.5%, followed by Citibank at 14.76% and then Wells Fargo at 6.88%. The least connected banks in terms of the CDS network, National City and Comerica have SSRs of 2.51% and 1.18%.

- The premise behind too interconnected to fail can be addressed only if the systemic risk consequences of the activities of individual banks can be rectified with a price or tax reflecting the negative externalities of their systemic risk impact to mitigate the over supply of a given financial activity.

Conclusions and Future Work: Mapping CDS Network with digital updates a *must* for stress tests

- Premise that CDS concentration and hence losses will fall on the top banks that can bear them is a misguided one.   It is the sheer size of the loss of CDS cover to banks due to any big provider failing – that is instrumental in this

- 'Super-spreaders' currently hold far too little capital/liquid assets relative to their CDS contagion spreading effect

- CDS network unstable ; subtle issues relating to changing network topology

- In view of the role as CDS sellers of Monolines and Hedge funds: reserve regulation must apply

- Ofsetting and CDS Chains: Far too little is settled for CDS to be useful as a credit risk mitigant as proposed by Basel II; Recommend immediate suspension of the use of CDS to reduce capital requirements on bank assets
  - Naked CDS positions and bear raids to be investigated further using agent based framework

- Include EU data on CDS; behavioural model of banks on synthetic securitization and CRT

-New Developments : Centralized Counterparty and Clearing : Does not work for non-standard/bespook CDOs and CDS on them

- Amount of capital proposed for CDS clearing system seems too little for task at hand ; network framework can provide better estimates

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  [1] Amadeo Alentorn and Serafin Martinez have a Phd from the Centre for Computational Finance and Economic Agents (CCFEA), University of Essex.

SCAP and Case 2 Stress Test Loss with Explicit CDS Exposure with 30%Monoline/Hedge Fund failure

	Amount of capital needed	Area with largest potential loss	Projected loss		
	$ Billions				
	SCAP		SCAP	Charge-offs FDIC	Case 2 Stress Test from CDS
GMAC	11.5	Other	9.2	-	-
Regions Financial	2.5	Commercial real estate loans	9.2	1,9	3.88
Bank of America	33.9	Trading and derivatives	136.6	13,7	690.94
KeyCorp	1.8	Commercial real estate loans	6.7	1,5	3.31
SunTrust	2.2	Second mortgages	3.1	2,5	4.30
Wells Fargo	13.7	First mortgages	32.4	6,7	5.6
Fifth Third Bancorp	1.1	Commercial real estate loans	2.9	-	-
Citigroup	5.5	Trading and derivatives	22.4	10,8	86.64
Morgan Stanley	1.8	Trading and derivatives	18.7	0,3	12.50
PNC Financial Services	0.6	Second mortgages	4.6	1,5	4.34
Bank of New York Mellon	None	Securities	4.2	0,05	4.39
MetLife	None	Securities	8.3	-	-
BB&T	None	Commercial real estate loans	4.5	-	-
Capital One Financial	None	Other	4.3	-	-
Goldman Sachs	None	Trading and derivatives	17.4	0,8	4.03

Chosen quotes for spreads on CDS with underlying banks or monolines and the value of the contracts written 2009 June

Bank	# of CDS Contracts Outstanding	Net Notional CDS	Price	Price Type
JPMorgan	12,329	$6,029,868,411	116	Spread (bps)
Citibank	5,197	$4,028,234,319	450	Spread (bps)
Bank of America	11,035	$6,838,768,981	6	Upfront+100bps
Goldman Sachs USA	6,4	$5,283,462,681	3	Upfront+100bps
HSBC Bank PLC	2,043	$2,118,164,662	80	Spread (bps)
HSBC Fin Corp	2,594	$1,912,550,318	440	Spread (bps)
Morgan Stanley	6,792	$6,138,349,565	6	Upfront+100bps
Merrill Lynch USA	8,027	$5,273,482,103	8	Upfront+100bps
Wells Fargo	10,092	$5,164,620,928	3	Upfront+100bps
Deutsche Bk AG	6,098	$7,304,531,832	116	Spread (bps)
Monoline				
Ambac Assurance Corp	3,141	$2,824,878,591	56	Upfront+500bps
Financial Guaranty Insurance Company (FGIC)	1,828	$1,079,179,793	70	Upfront+500bps
Financial Security Assurance Inc. (FSA)	2,658	$1,718,650,976	20	Upfront+500bps
MBIA Insurance Corporation	5,243	$3,180,696,689	29	Upfront+500bps
Xl Capital Assurance Inc	3,395	$1,659,565,857	440	Spread (bps)
Berkshire Hathaway	2,579	$4,955,795,701	6	Upfront+100bps

Source: Marktit

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	L	L_{rand}	C	C_{rand}	N
WWW	3.1	3.35	0.11	0.00023	153127
Actors	3.65	2.99	0.79	0.00027	225226
Power Grid	18.7	12.4	0.080	0.005	4914
C. Elegans	2.65	2.25	0.28	0.05	282