

Leveraged Losses: Lessons from the Mortgage Market Meltdown

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Outline:

- Characterize disruptions caused by “subprime” and compare to previous periods of financial distress
- Estimate the ultimate losses on mortgage backed securities
- Role of leverage and mark-to-market accounting in propagating the shock
- Estimate effect of contraction in B/S of financial institutions on real GDP
- Policy recommendations for C.B.

First “Post-Securitization” Credit Crisis (Come Back to this Later)

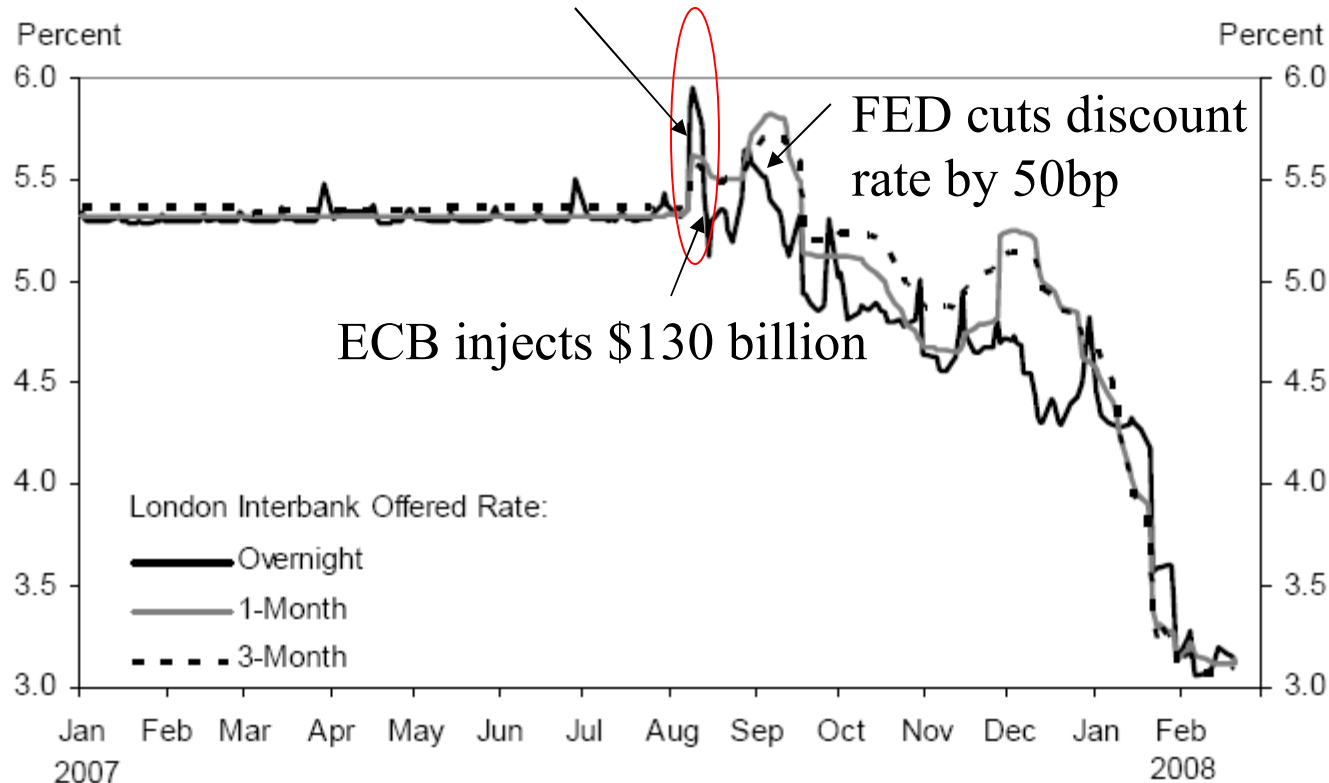
- Current credit crisis different from past because large part of credit has been securitized.
- Those securities are owned by highly leveraged investors with short-term liabilities.
- Thus they are highly sensitive to balance-sheet changes caused by price changes or changes in perceived risk.
- Amplification mechanism driven by leverage adjustments generates new features peculiar to “subprime” crisis and a spillover into real economy through decline in credit.

Credit Market since August 2007

European bank closes three investment funds because

U.S. market made it impossible to value underlying asset

Exhibit 2.1 LIBOR Rate

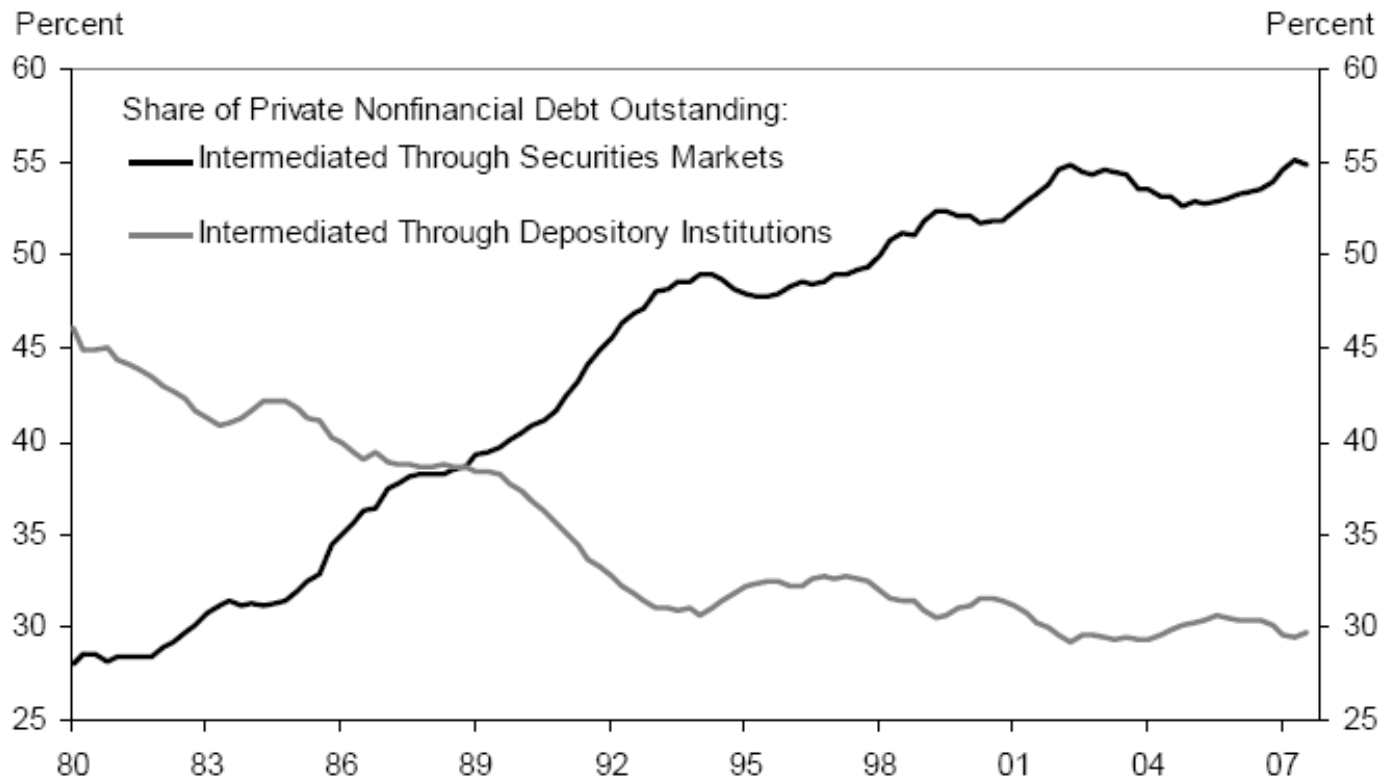


Source: Financial Times.

Credit Market since August 2007

Securities market is the dominant source of financial intermediation in the U.S. today. In addition to the underlying loans financial intermediaries had exposure to jumbo mortgages, ASCP, and CDO's.

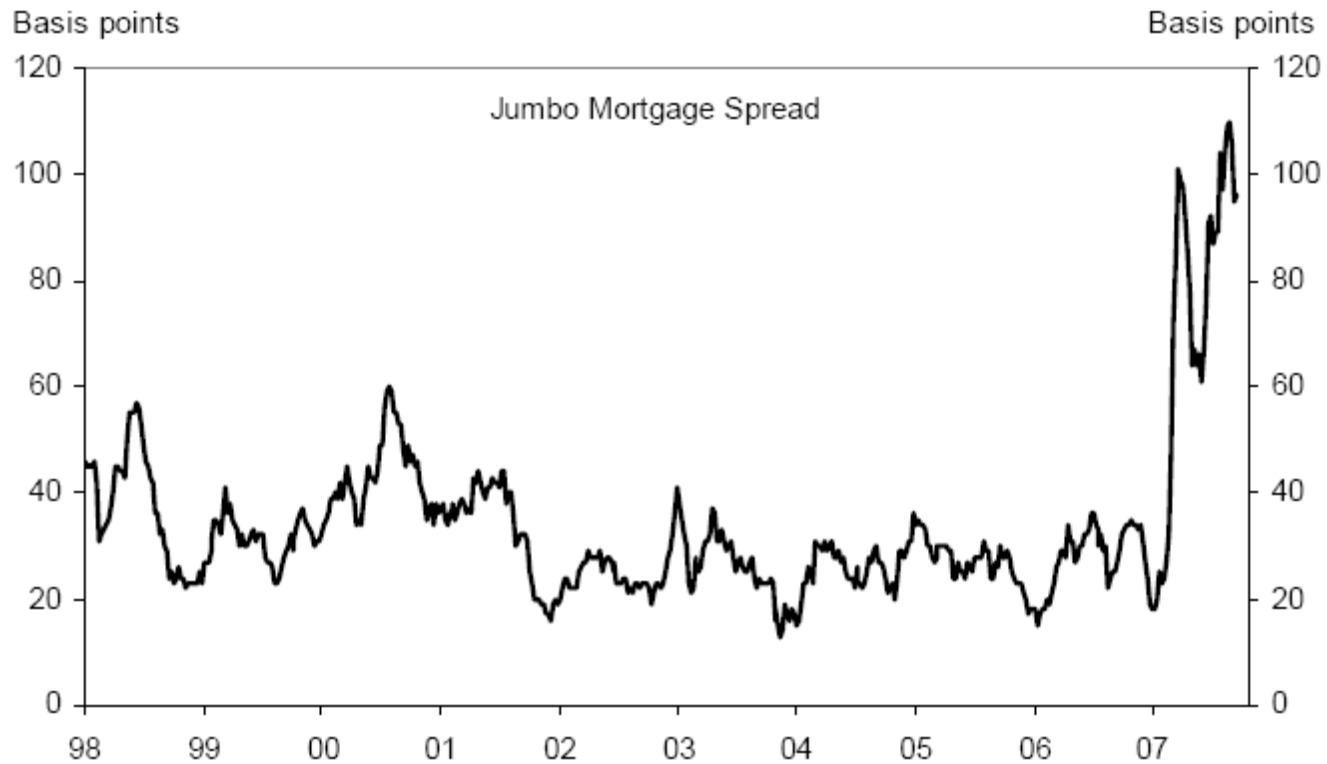
Exhibit 2.6 Share of Intermediation through Banks and Securities Markets



Source: Morgan Stanley calculations based on Federal Reserve Flow of Funds Accounts.

Credit Market since August 2007

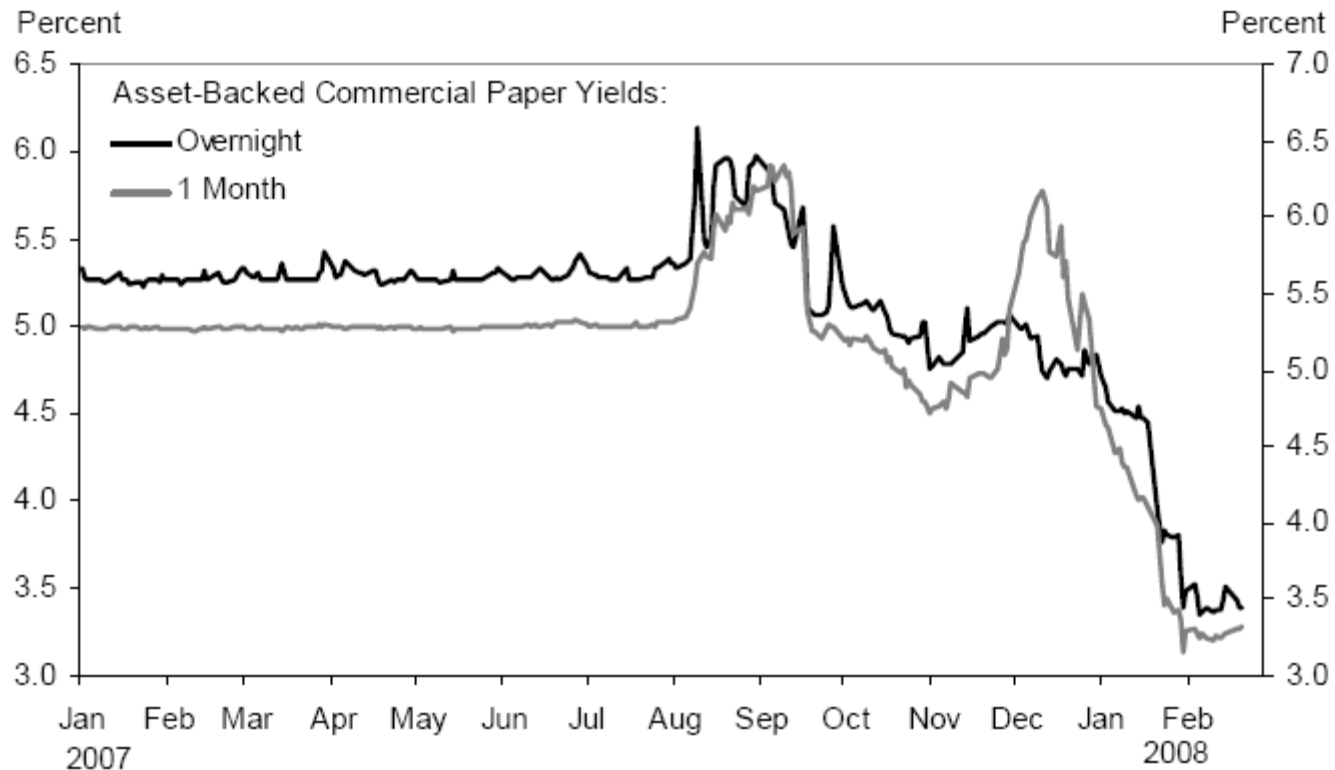
Exhibit 2.2 Jumbo Mortgage Spread



Source: BankRate.com.

Credit Market since August 2007

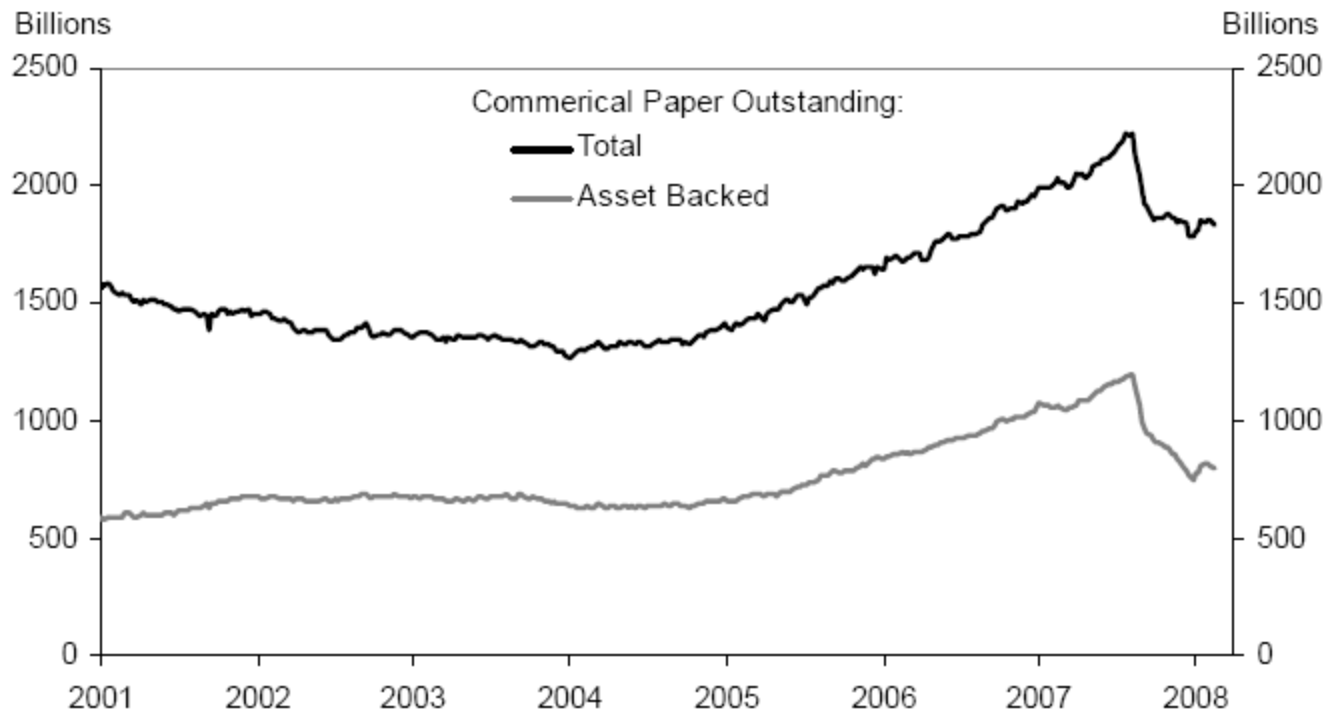
Exhibit 2.3 Asset-Backed Commercial Paper (ABCP) Yields



Source: Federal Reserve Board.

Credit Market since August 2007

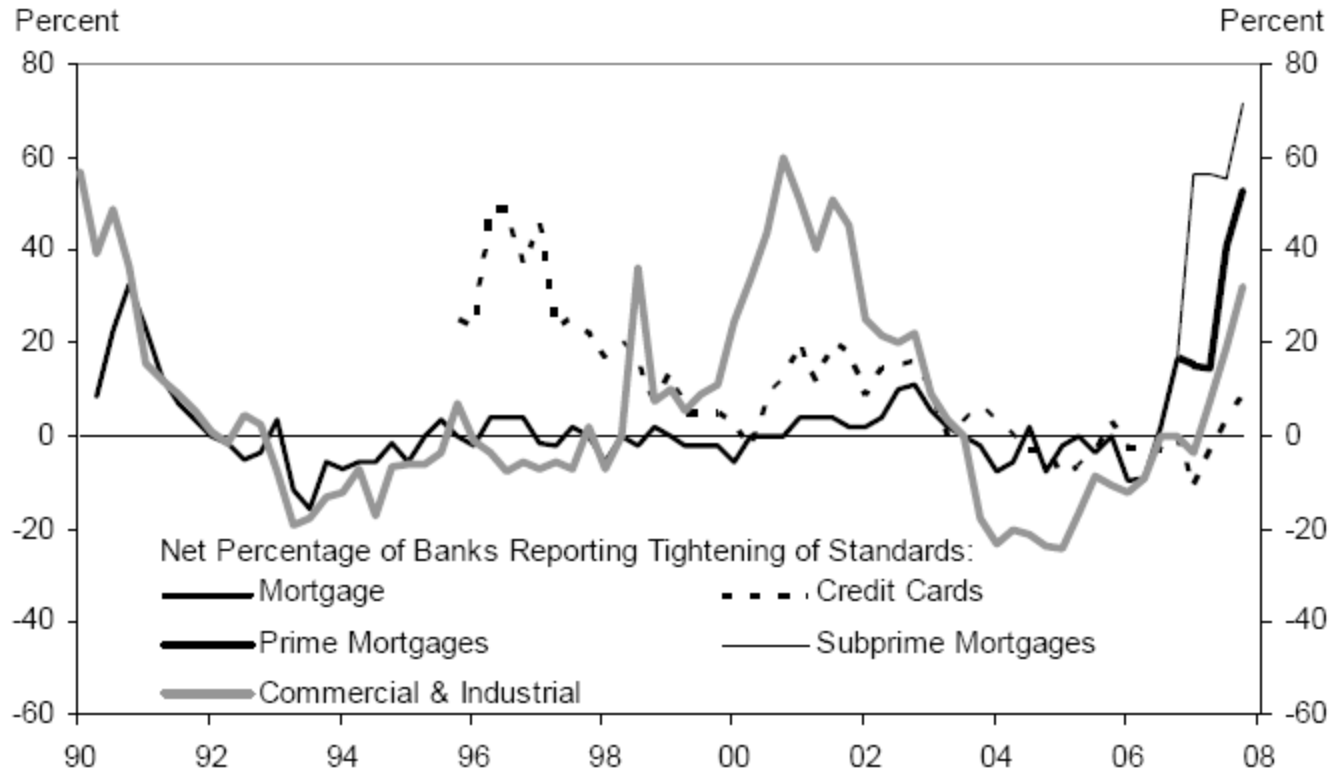
Exhibit 2.4 Commercial Paper Outstanding



Source: Federal Reserve Board.

Credit Market since August 2007

Exhibit 2.5 Senior Loan Officer Survey

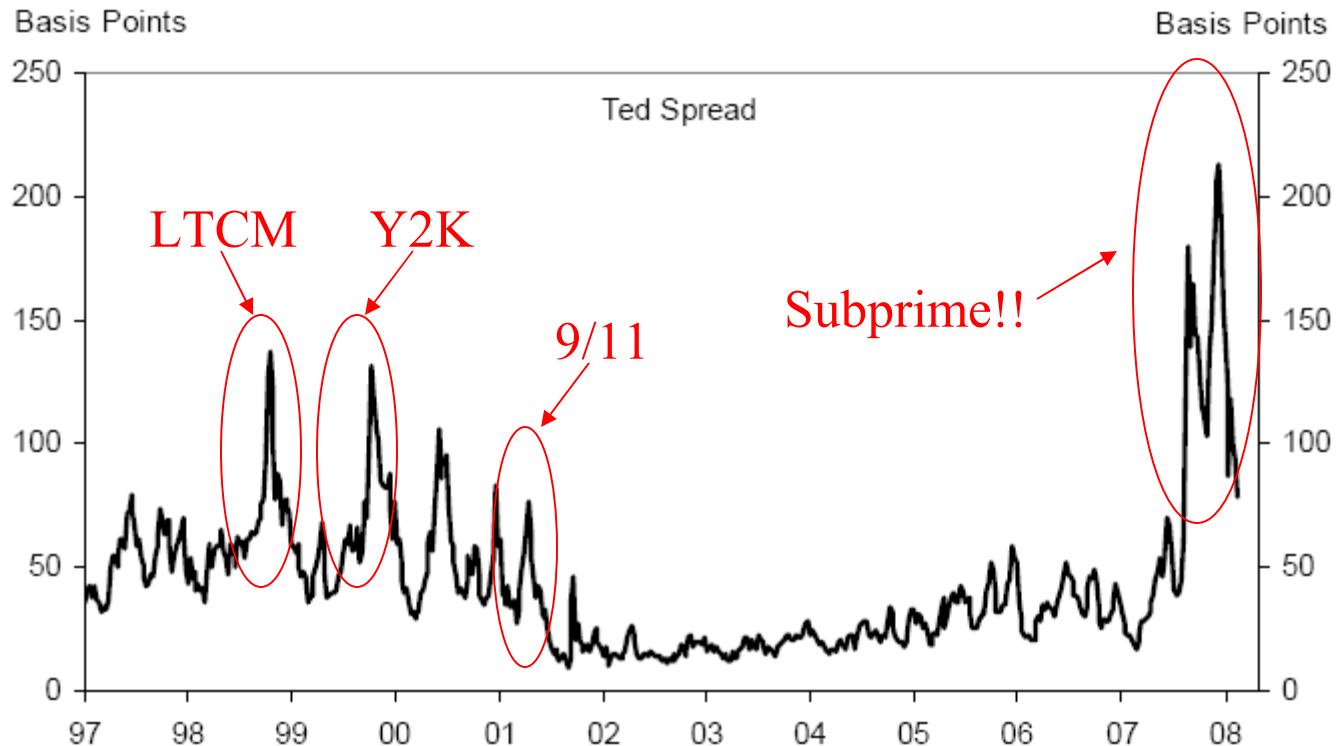


Source: Federal Reserve Board.

Residential mortgages only 25% of collateral underlying ABCP and most ABCP's were highly rated, but banks tightened credit standards on a variety of loans, because investors found it difficult to evaluate credit quality of underlying assets.

Credit Market since August 2007

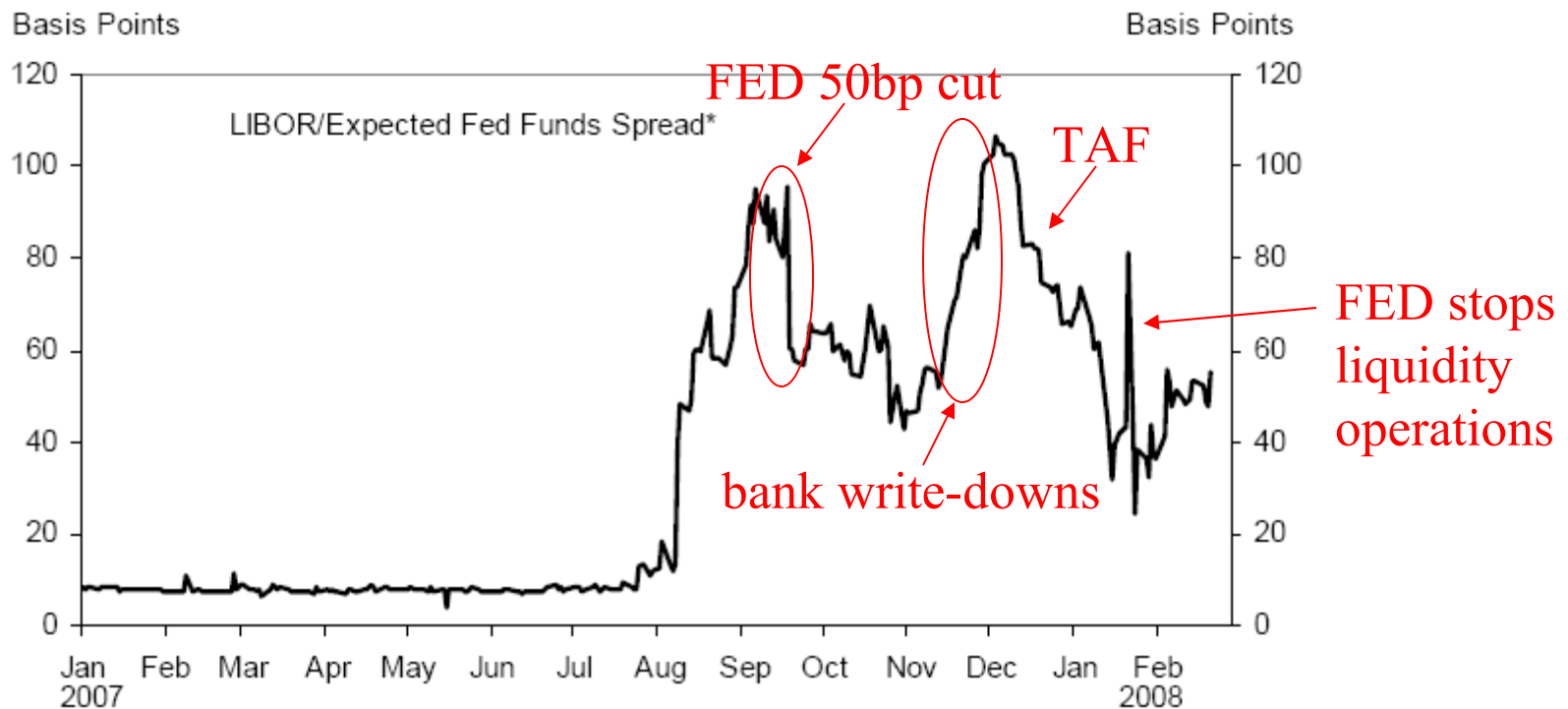
Exhibit 2.8 Treasury-Eurodollar (TED) Spread



Source: Financial Times. Federal Reserve Board.

Credit Market since August 2007

Exhibit 2.10 Libor-Overnight Indexed Swap (OIS) Rate (Daily)



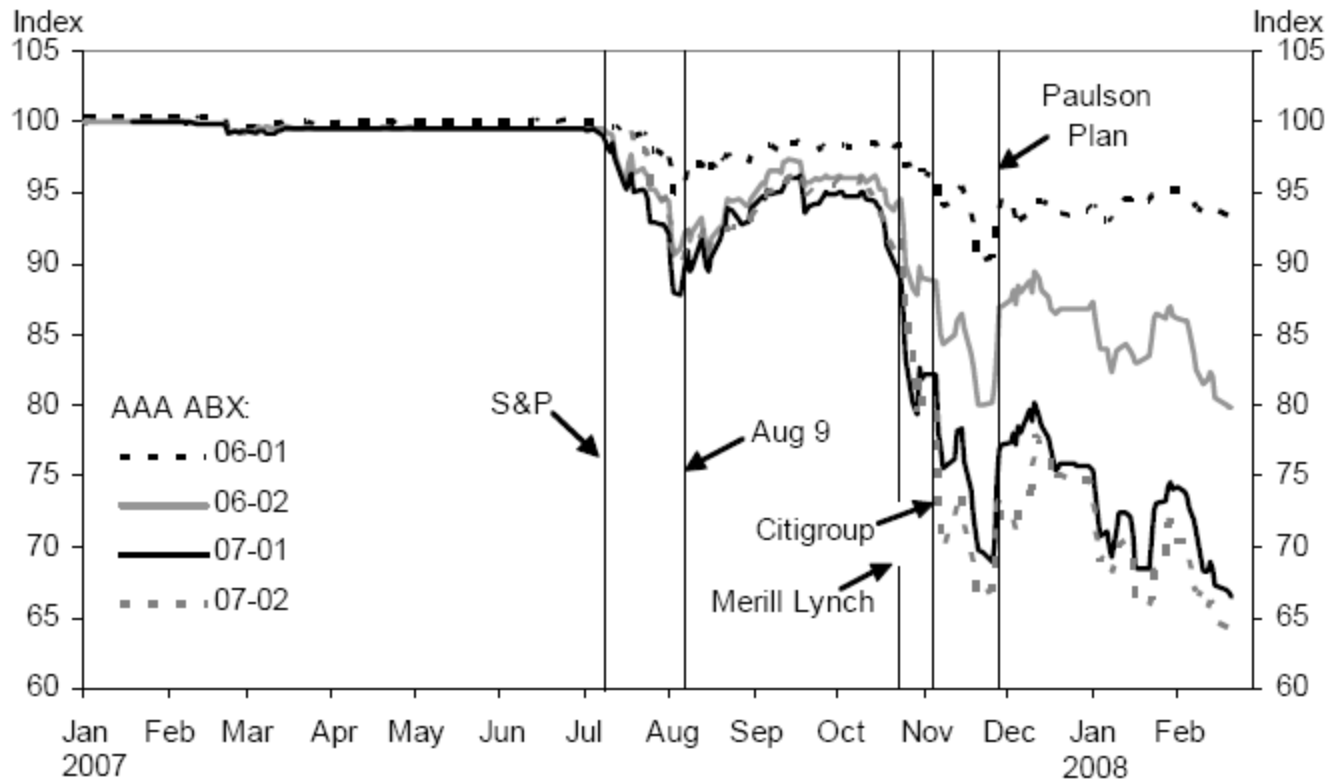
*Spread of 3-Month LIBOR over 3-Month OIS.

Source: Financial Times. Wall Street Journal.

Credit Market since August 2007

A decline in ABX Indices indicates steep increase in insurance costs for AAA bonds.

Exhibit 2.12 ABX Indices (AAA rated vintages)



Source: Goldman Sachs.

Estimating Mortgage Credit Losses

Arrive at approximate total losses of \$400 billion using three approaches:

- 1) *Adjust “mortgage vintage models”* by taking into account negative-equity dynamics since December 2006 and assuming that non-subprime mortgage losses rise to half their historic peak rate
- 2) *Market-based estimate (focus)*: multiply different pools of mortgage backed securities by their prices, map the pool into its credit rating distribution, calculate losses for the part of the pool in each rating category using ABX index.
- 3) Extrapolating foreclosure trends of housing price declines in California, Massachusetts, and Texas in 80’s and 90’s

Estimating Mortgage Credit Losses

Market-based estimate:

% of Originations by Product (except for Total Loans)									
Year	FHA/VA	Conforming	Jumbo	Sub-prime	Alt-A	HEL	ARMs	Refinances	Total Loans (\$Bn)
2001	7.9%	57.1%	20.1%	7.2%	2.5%	5.2%	16.0%	58.6%	2215
2002	6.1%	59.1%	19.8%	6.9%	2.3%	5.7%	23.5%	63.1%	2885
2003	5.6%	62.4%	16.5%	7.9%	2.2%	5.6%	26.2%	72.0%	3945
2004	4.5%	41.4%	17.5%	18.2%	6.3%	12.2%	50.1%	54.7%	2920
2005	2.9%	34.9%	18.3%	20.0%	12.2%	11.7%	47.8%	50.4%	3120
2006	2.7%	33.2%	16.1%	20.1%	13.4%	14.4%	45.0%	49.0%	2980
1Q06	2.7%	33.5%	14.6%	19.9%	14.9%	14.5%	42.1%	49.4%	705
2Q06	2.5%	34.4%	15.8%	20.6%	13.0%	13.8%	49.0%	47.8%	800
3Q06	2.9%	31.9%	17.0%	21.2%	12.1%	15.0%	44.0%	48.7%	755
4Q06	2.6%	33.1%	17.1%	18.8%	13.9%	14.6%	44.3%	50.3%	720
1Q07	2.8%	40.1%	14.7%	13.7%	14.4%	14.3%	35.3%	57.1%	680
2Q07	3.4%	44.9%	16.4%	7.7%	13.2%	14.4%	30.1%	51.6%	730
3Q07	4.6%	50.2%	14.6%	4.9%	9.5%	16.3%	29.1%	46.1%	570

Source: Inside Mortgage Finance, Morgan Stanley.

Estimating Mortgage Credit Losses

Market-based estimate:

Exhibit 3.3 Estimates of Subprime RMBS Issuance by Rated Tranche (\$Bn)

	All Subprime	AAA	AA	A	BBB	BB/Other
Year	100%	80.8%	9.6%	5.0%	3.5%	1.1%
2005	625	505	60	31	22	7
1Q06	140	113	13	7	5	2
2Q06	165	133	16	8	6	2
3Q06	160	129	15	8	6	2
4Q06	135	109	13	7	5	1
1Q07	95	7	9	5	3	1
2Q07	56	45	5	3	2	1
3Q07	28	23	3	1	1	0
Total: 2005						
1Q07	1,402	1,133	135	70	49	15

Source: Inside Mortgage Finance. Morgan Stanley.

Estimating Mortgage Credit Losses

Market-based estimate:

Exhibit 3.4 continued

February 21, 2008

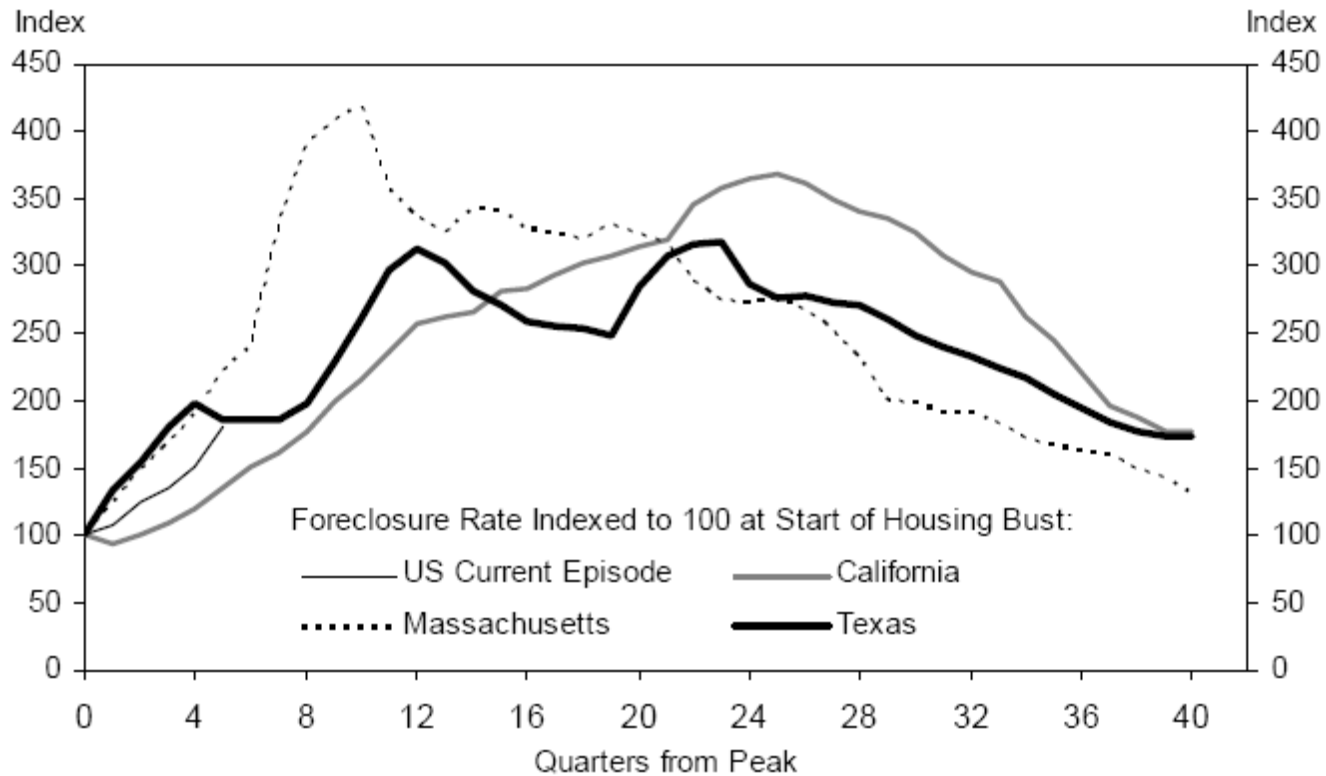
Year	ABX Prices by Vintage						MtM Loss (\$Bn) based on ABX Pricing					
	ABX Index 100%	AAA 80.8%	AA 9.6%	A 5.0%	BBB 3.5%	BB/ Other 1.1%	Sub- prime 100%	AAA 80.8%	AA 9.6%	A 5.0%	BBB 3.5%	BB/ Other 1.1%
2005	ABX 06-1	93.54	78.08	50.46	26.45	20.39	83	33	13	15	16	5
1Q06	ABX 06-2	79.81	51.22	24.44	15.24	13.53	40	23	7	5	4	1
2Q06		79.81	51.22	24.44	15.24	13.53	47	27	8	6	5	2
3Q06	ABX 07-1	66.46	32.89	15.24	12.58	12.10	67	43	10	7	5	2
4Q06		66.46	32.89	15.24	12.58	12.10	56	37	9	6	4	1
1Q07	ABX 07-2	63.53	33.17	22.75	16.97	15.97	41	27	6	4	3	1
2Q07		63.53	33.17	22.75	16.97	15.97	24	17	4	2	2	1
3Q07		63.53	33.17	22.75	16.97	15.97	12	8	2	1	1	0
							371	214	58	46	39	13

Source: Inside Mortgage Finance, Markit, and Morgan Stanley.

Estimating Mortgage Credit Losses

Estimate based on past regional experiences:

Exhibit 3.6 Foreclosures Triple in the Housing Bust



Source: Mortgage Bankers Association.

Estimating Mortgage Credit Losses

Estimate based on past regional experiences:

Average foreclosure rate triples with several years, peaking between years 2 and 6.

Cumulating the difference between projected foreclosure rate and the 0.4% rate prevailing at the start of 2006 over the entire 2006-2013 Period using \$11 trillion of 1-4 family mortgage debt get \$1.5 trillion in foreclosure starts.

Assuming repossession average 55%-60% and average loss severity of 50%, the implied foreclosure starts will translate into \$400 billion in mortgage credit losses.

Estimating Mortgage Credit Losses

Exhibit 3.8 Subprime Mortgage Exposures, Bottom-Up

	Total reported sub- prime exposure	Percent of reported exposure
US Investment Banks	75	5%
US Commercial Banks	250	18%
US GSEs	112	8%
US Hedge Funds	233	17%
Foreign Banks	167	12%
Foreign Hedge Funds	58	4%
Insurance Companies	319	23%
Finance Companies	95	7%
Mutual and Pension Funds	57	4%
US Leveraged Sector	671	49%
Other	697	51%
Total	1,368	100%

Note: The total for U.S. commercial banks includes \$95 billion of mortgage exposures by Household Finance, the U.S. subprime subsidiary of HSBC. Moreover, the calculation assumes that U.S. hedge funds account for four-fifths of all hedge fund exposures to subprime mortgages.

Source: Goldman Sachs. Authors' calculations.

First “Post-Securitization” Credit Crisis

Two distinguishing features of current crisis:

- 1) Divergence between those markets that suffered acute distress (interbank market, jumbo mortgages, ABCP and CDOs markets), and other markets such as stock market that came out largely unscathed.
- 2) Absence of contraction in balance sheets (decline in leverage) in response to falling asset prices.

First “Post-Securitization” Credit Crisis

Exhibit 2.9 Correlations between measures of credit risk and asset returns
Correlations: August 1987 through May 2007

	TED	Baa-Aaa	S&P500	EMBI	Jumbo
TED	1				
Baa - Aaa	0.22	1			
S&P500	-0.07	-0.07	1		
EMBI	0.04	0.07	0.38	1	
Jumbo	0.41	-0.19	0.05	0.03	1

Correlations: June 2007 through January 2008

	TED	Baa-Aaa	S&P500	EMBI	Jumbo
TED	1				
Baa - Aaa	0.33	1			
S&P500	0.00	-0.37	1		
EMBI	0.38	-0.03	0.34	1	
Jumbo	0.76	0.47	-0.25	0.58	1

Series descriptions:

TED = Treasury/Eurodollar spread

Baa-Aaa = Spread between Baa and AAA seasoned bonds

S&P500 = 1 month return on S&P500

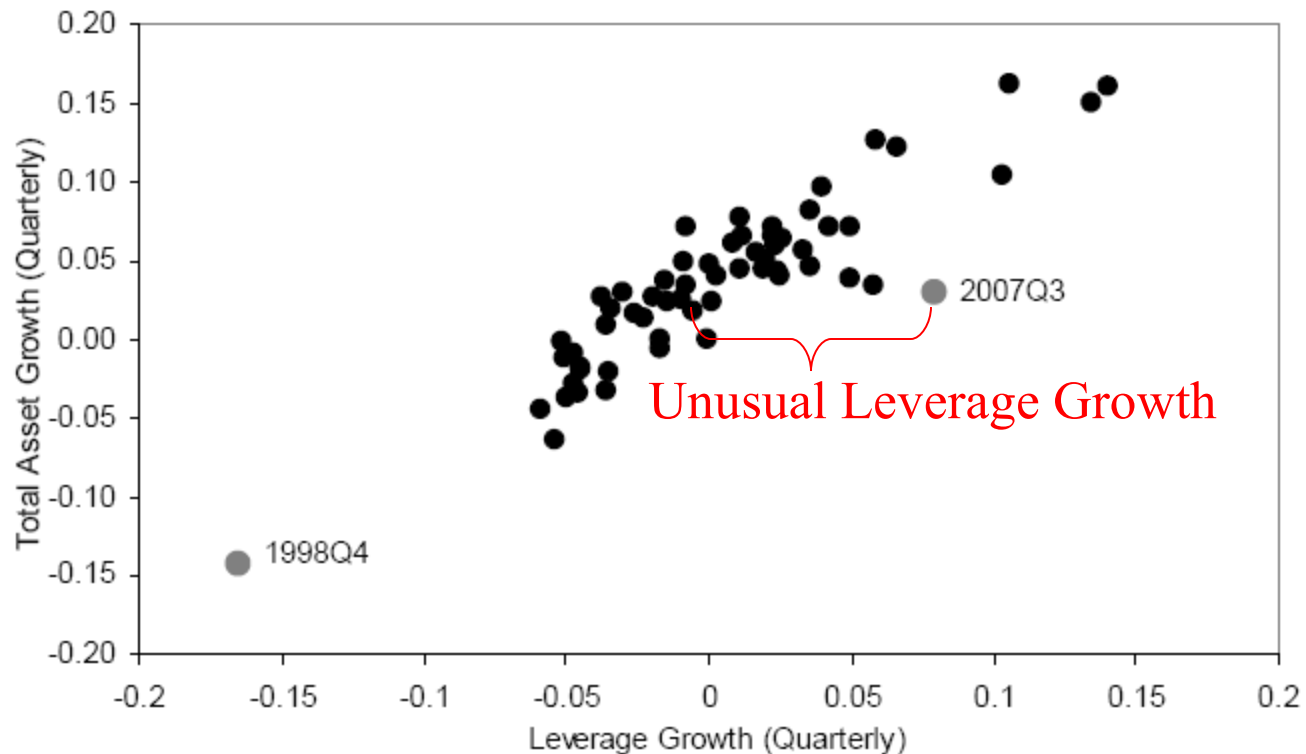
EMBI = 1 month return on the Emerging Market Bond Index

Jumbo = Spread between rates on Jumbo 30 year mortgages and conventional 30 year mortgages

Note: All data are weekly and start in August 1987, except EMBI which starts in January 1994 and Jumbo which starts in June 1998.

First “Post-Securitization” Credit Crisis

Exhibit 4.1: Quarterly Changes in Assets and Leverage of U.S. investment banks



Note: Growth rates are assets-weighted.

Role of Leverage and Mark-To-Market Accounting

U.S. leveraged institutions hold 51% of all outstanding mortgage debt. Their balance sheets consist of very short-term claims, and as such are actively managed in response to changes in anticipated risk and asset prices (Mark-to-Market Accounting).

They usually adjust their balance sheets so that leverage is high during booms and low during busts. However, through 2007 Q4 neither investment banks nor even commercial banks have shown signs of deleveraging.

Role of Leverage and Mark-To-Market Accounting

Leverage targeting implies that adjustment of leverage and of price changes will reinforce each other in an amplification of the financial cycle.

When prices go up, the leverage become too low relative to target and financial intermediaries look for ways to employ surplus capital by taking on short-term debt on liabilities side and by accumulating new borrowers on the asset side.

This implies that when balance sheets are expanding fast enough, even borrowers who do not have the means to repay are granted credit – so intense is the urge to employ surplus capital. → SUBPRIME MORTGAGE MARKET

Role of Leverage and Mark-To-Market Accounting

- 1) So why were markets for stocks, sovereign debt, and high grade corporate bonds little affected?

Most stocks and high grade bonds are held by non-leveraged investors such as households and long-only/hold-to-maturity investors who are insensitive to changes in balance sheet size. (households, mutual funds, insurance companies)

In contrast, most mortgages, speculative grade bonds, and mortgage-backed securities are held by leveraged institutions.

(broker-dealers themselves, hedge funds, SIV's)

Role of Leverage and Mark-To-Market Accounting

- 2) So why didn't banks' balance sheets contract (⇔ deleverage), even though VaR had doubled by Nov. 2007 relative to May 2006?

Distressed entities, such as SIV's, having difficulties rolling over their ABCP liabilities, began tapping into their *back-up liquidity lines* from commercial banks, leading to involuntary expansion of credit.

Economic Impact of Deleveraging

- Under imperfect capital markets and if some borrowers depend on financial intermediaries for financing, then balance sheet adjustments by leveraged intermediaries will have effects on real economy.
- To calculate the real effect of a decline in credit on GDP growth, must first determine *leveraged sector's total claims against non-leveraged sectors* (households, corporations, etc.).

Economic Impact of Deleveraging

$$\frac{A^*}{E^*} \equiv \mu \times \frac{A}{E}$$

$$\frac{A^*}{A} = \mu \times \frac{E^*}{E} = \mu \times \left(1 - \frac{L(1-k)}{E} \right)$$

A – initial aggregate assets of leveraged sector

E – initial equity of leveraged sector

μ – ratio of new leverage to the old leverage

L – total credit losses suffered by leveraged sector

k – proportion of credit losses made up by raising new capital

Economic Impact of Deleveraging

Exhibit 4.5 Leverage of Various Financial Institutions

	Assets (\$bn)	Liabilities (\$bn)	Capital (\$bn)	Leverage
Commercial banks	10793	9693	1100	9.8
Savings Inst	1914	1687	227	8.4
Credit Unions	748	659	89	8.4
Brokers/hedge funds	5397	5226	171	31.6
GSEs	1633	1567	66	24.7
Leveraged Sector	20485	18804	1681	12.2

Source: Authors' calculations based on Flow of Funds, FDIC Statistics on Banking, Adrian and Shin (2007), and balance sheet data for Fannie Mae, Freddie Mac, and broker-dealers under Goldman Sachs equity analysts' coverage.

$A = \$20.5$ trillion

$E = \$2.05$ trillion (satisfies A and L)

$L = \$200$ billion (50% of \$400 billion in total credit losses)

$\mu = 95\%$ (benchmark reflecting a 50% increase in VaR)

$k = 50\%$ benchmark

Economic Impact of Deleveraging

Exhibit 4.7 Total Asset Contraction (\$Trillion) Associated with Deleveraging

		Decline in Leverage		
		0%	5%	10%
<i>k</i>	100%	0.00	1.03	2.05
	75%	0.50	1.50	2.50
	50%	1.00	1.98	2.95
	25%	1.50	2.45	3.40
	0%	2.00	2.93	3.85

Note: Estimates of total asset contraction not very sensitive to the choice of *k*

Economic Impact of Deleveraging

$$S = \sum_i s_i \text{ and } Y = \sum_i y_i \text{ etc.}$$

$$A = S + Y = D + H + E$$

$$S = D$$

$$Y = H + E$$

$$z = \frac{H}{A}$$

$\lambda = A/E$ denote aggregate leverage.

$$\frac{H}{E} = \frac{H}{A} \times \frac{A}{E} = z\lambda$$

$$Y = E + H$$

$$= E \left(1 + \frac{H}{E} \right)$$

$$= E(1 + z\lambda)$$

$$\frac{Y}{A} = \frac{Y/E}{A/E} = \frac{1 + z\lambda}{\lambda}$$

$$Y = \frac{1 + z\lambda}{\lambda} A = 0.46 \times A$$

Assets	Liabilities
s	d
y	h
	e

s claims to other leveraged parties

y loans to non-leveraged end-users

d obligations to leveraged parties

h obligations to non-leveraged users

e equity

$H = \$7,567$ trillion (Flow of Funds Data)

$A = \$20.5$ trillion

then $z = 0.36$

$\lambda = 10$ (A/E , aggregate leverage)

Economic Impact of Deleveraging

Exhibit 4.9 Decline in Credit (\$Trillion) to Non-Levered Entities

		Decline in Leverage		
		0%	5%	10%
<i>k</i>	100%	0.00	0.47	0.94
	75%	0.23	0.69	1.15
	50%	0.46	0.91	1.36
	25%	0.69	1.13	1.56
	0%	0.92	1.35	1.77

Economic Impact of Deleveraging

Exhibit 5.1 OLS Regression of GDP Growth on DNFD

Dependent Variable Quarterly GDP Growth (at an annual rate)

Independent Variable	Coefficient	Standard Error	T-Statistic
Constant	1.470	0.475	3.080
GDP Growth _{t-1}	0.290	0.112	2.590
GDP Growth _{t-2}	0.284	0.102	2.800
GDP Growth _{t-3}	-0.224	0.107	-2.100
4 quarter DNFD Growth _{t-1}	0.140	0.072	1.950

Proxy for domestic credit using domestic non-financial debt (DNFD)

Exhibit 5.2 Instrumental Variable Estimates of GDP Growth and DNFD

Dependent Variable Quarterly GDP Growth (at an annual rate)

Independent Variable	Coefficient	Standard Error	T-Statistic
Constant	0.904	0.590	1.530
GDP Growth _{t-1}	0.247	0.118	2.100
GDP Growth _{t-2}	0.242	0.111	2.190
GDP Growth _{t-3}	-0.264	0.110	-2.410
4 quarter DNFD Growth _{t-1}	0.338	0.176	1.920

Instrument for DNFD using TED spread and bank willingness to makes installment loans (Senior Loan Officer's survey) p.41

Economic Impact of Deleveraging

Summary:

\$910 billion contraction in end-user credit (3.0 percentage drop in DNFD growth) will reduce real GDP growth by 1.3 percentage points over the following year

Policy Recommendations

Monetary Policy: must help banks raise new equity capital

1. ~~X~~ *Liquidity injections* will only increase leverage, because induces financial intermediaries to *expand* their balance sheets by borrowing from C.B.
2. *Lower short-term rates* will improve yield spread on which banks operate, thus allowing them to rebuild equity capital
3. *Lower short-term rates* stimulate demand, improving borrowers' positions thus helping financial intermediaries.
4. *Lower short-term rates* are prices at which collateralized borrowing and lending is rolled over, thus lower the marginal price of quantity adjustments.

Policy Recommendations

Other Policy Options to help banks raise new equity capital:

1. Encourage banks to retain cash flow by *cutting dividends* (government has a role in helping financial sector overcome the stigma of doing so)
2. Reinstate monthly survey that tracks commitment lending vs. voluntary lending