ISSN 0378-651X
Financial Market Trends

The Subprime Crisis: Size, Deleveraging and Some Policy Options

Adrian Blundell-Wignall *

The paper revises our previous USD 300 bn estimate for mortgage related losses to a range of USD 350-420 bn. In doing this the paper explicitly rejects the previous approach based on implied defaults from ABX pricing, because these prices are affected by illiquidity and extreme volatility; they will likely lead to misleading estimates of losses. Instead it builds a proper default model approach and allows for recovery of collateral via house sales over time. The paper separates out the losses due to commercial banks in the US, and goes on to look at the implied deleveraging required to meet capital standards. It could take 6-12 months for banks to offset losses via earnings alone, depending on Fed rate cuts and the dividend policy of banks. Since even more capital than this is required if banks were to expand their balance sheets, the paper looks at possibilities for capital injections from groups like sovereign wealth funds; and it also looks at a novel plan for the use of public money with an RTC-style approach and the issue of zero coupon bonds. Finally the paper looks at the issues of moral hazard, the likely size of the impact in Europe and Asia and non-bank corporate leverage.

* The views expressed herein are those of the author and do not necessarily reflect those of the OECD or the governments of its Member countries. The author is solely responsible for any errors.

Executive summary

The main focus of this study is to review where we now stand in relation to our September 2007 calculation that the losses from subprime could amount to USD 300 bn; what the losses mean for deleveraging in the economy; and what policy options there are to deal with the negative economic consequences of deleveraging.

Section I of the paper looks at losses calculated with market price methods (the basis of the 2007 work). Liquidity problems and panic are causing major problems for price discovery, rendering this type of approach invalid. Section II therefore looks at default model-based estimates of losses. The estimates from this model, assuming a 40%-50% range for recovery on defaulting loans and an economic and house price scenario benchmarked against previous episodes, is USD 352-USD 422 bn. To get anything like recent mark-to-market losses (of virtually double our estimate) would require a 0% recovery rate – which seems extreme even for the most bearish. Section III focuses on the commercial banking share of the losses and potential transmission through deleveraging by this key sector to the economy, as well as policy options to counter this. About USD 60 bn of direct losses may be put down to US commercial banks and USD 27 bn to investment banking. Four things can happen: (*i*) commercial bank deleveraging, causing a credit crunch; (*ii*) banks can earn back the capital (with help from interest rate and dividend policy) and get back to intermediating; (*iii*) capital can be injected by investors (*e.g.* sovereign wealth funds and hedge funds); and (*iv*) public sector intervention can be used to separate problem bonds and mortgages from the intermediation process. It could take at least 6 months (with maximal interest rate and dividend cutting) and possibly up to 1 year (with more pessimistic assumptions on rates and dividends) to replace losses. This is too long for the economy, and risks early 1990s credit crunch scenarios. Capital raisings/injections from risk-taking private institutions or SWFs are a big help. But the arithmetic of getting quickly back to 'business-as-usual', which requires much more capital than simply offsetting the losses, argues for more action if possible. One such action mentioned in this context is the socialisation of losses. The paper provides a low cost example of a 'Resolution Trust Corporation-like' ('RTC-like') mechanism.

Section IV looks at US-listed prime brokers/investment banks. Direct holding losses could be around USD 27 bn (warehousing, etc). They are less capitalised and problems for the economy arise through their linkages to other sectors, particularly hedge funds.[1]

Moral hazard issues arising from actions taken to date underline that the private sector should be encouraged to do the maximum of which it is capable. These are considered in Section V. Even so, the perceptions that the trade-off between returns-to-risk is now asymmetric must be addressed in the future, and may require more fundamental financial system reforms.

Section VI of the paper draws attention to issues for Europe, but does not analyse them in as much detail as for the US. Europe is not immune from the issues raised, and has its own special set of potential problems. It also risks real economy consequences from the subprime crisis. Section VII draws attention to Asia, where direct subprime holdings are relatively less. In Asia, orderly unwinding of bubbles and avoidance of future problems turn on attitudes to exchange rate policy.

Section VIII looks at spill-over risks to corporate bonds and equities. While corporate balance sheets are in good shape on average, there is a fat tail of overleveraged companies that will default in the advent of a recession, creating pockets of turmoil in corporate bonds (non-investment grade) and equities. Avoiding such spill over from the mortgage sector is essential, and underlines why a broad approach to policy to minimise the size of the economic impact is required.

The macro policies options are summarised in section IX: liquidity support and rate cutting to enhance earnings power of banks; focus on dividend policies; capital injections and M&A from stronger financial institutions; and RTC-like socialisation of losses.

I. How big is the subprime crisis: previous FMT and now?

Was our USD 300 bn estimate in 2007 too small?

In the previous issue of Financial Market Trends (FMT), written in September 2007, USD 300 bn was considered the likely size of the subprime and Alt-A mortgage losses.[2] At the time the official views were in the USD 100-USD 150 bn range. That previous estimate was based on a 14% overall default-loss probability applied to the stock of mortgages (subprime and Alt-A, etc.) of about USD 2.3 trillion[3] (of which (USD 1.3 trillion was subprime). The 14% was based on weighting up the ABX indexes (prices of credit default swaps used to insure risk of default in the underlying subprime mortgages) across vintages and tranches at that time, September 2007.

A focus on private label RMBS

Strictly speaking the ABX applies to subprime, the worst part of the market, whereas private label Residential Mortgage-Backed Securities

(RMBS) include mortgages other than subprime – for example Alt-A, jumbo loans, etc. Collateralised Debt Obligations (CDOs) and Structured Investment Vehicles (SIVs) use RMBS and other asset-backed securities (ABS). CDO issuance (cash and hybrid) was USD 1.47 trillion at the end of 2007, and much larger if unfunded synthetic CDOs are included. The sharp acceleration from mid 2004 in underwriting of what were to become the key problem mortgages, were to a large extent securitised, and found their way mostly into private-label RMBS (including home equity); which totalled USD 2.3 trillion at the end of 2007. The leveraged demand for these was facilitated by CDOs and asset-backed commercial paper (ABCP) conduits. This study focuses primarily on the losses associated with this private label RMBS variable. Some subprime and Alt-A mortgages remain un-securitised, but the losses here are expected to be much smaller, and follow loss patterns based on past experience.[4]

The equity approach also gave a USD 300 bn number

The loss estimate in the previous FMT was cross-checked by looking at the market cap losses of all banks and major broker-dealers (most heavily affected by subprime) as compared to their average prices in June 2007. The result was a similar number of USD 308 bn.

Market liquidity & price discovery problems become extreme now

The next section sets out the results of applying the two estimation approaches used in our previous article to the current market situation. But before doing this, it needs to be stated that both of these methods are now likely to lead to a serious over-estimation of the size of losses, because they rely on market prices that have become unreliable and possibly misleading.

Liquidity and panic are affecting ABX and equity prices…

In recent months, price discovery for structured products has been problematic with bouts of panic and extreme liquidity problems. At times the only market makers in RMBS have been the central banks. The Federal Reserve at the time of writing (mid-March 2008) has increased its liquidity operations, making an unprecedented USD 200 bn available, and accepting asset-backed securities (ABS) as collateral, *i.e.* doing what private banks and capital market participants will not. In such circumstances, price discovery is hugely problematic, and mark-to-market price calculations of implied losses are unlikely to be valid. An approach to model and estimate the losses that is not dependent on these market prices is therefore required.

Potentially misleading mark-to-market approaches to loss calculations

… which means the loss calculations based on them grow larger without

The ABX estimates are shown in Table 1. The prices for each tranche/vintage are shown in the top section of the table. Thus in the first row, for ABX 06(1), the 14 March price 86 implies that 14% losses are discounted for AAA.[5] The weights by vintage and tranche (not shown) are

any change in underlying solvency!

applied and, the weighted expected loss is shown in the bottom row of the table. This number is applied to the stock of US RMBS. Using the September 7 numbers, USD 292 bn is the implied loss (the main basis of the work last year). But as can be seen, over time the implied size of the losses seems to get ever larger. On the 14th of March, a staggering USD 887 bn loss is implied.[6]

Table 1. **ABX-based subprime loss estimates**

	PRICES -- 2007		PRICES -- 2008			
	07-Sep	19-Oct	30-Nov	11-Jan	22-Feb	14-Mar
ABX 06(1)						
AAA	98	98	95	94	93	86
AA	95	93	86	85	78	64
A	84	75	61	59	50	33
BBB	65	47	34	31	25	16
BBB-	57	38	30	25	19	15
EQ	0	0	0	0	0	0
ABX 06(2)						
AAA	97	94	87	84	78	71
AA	88	77	62	60	50	37
A	63	46	40	34	22	17
BBB	47	26	21	19	15	10
BBB-	40	24	19	18	13	10
EQ	0	0	0	0	0	0
ABX 07(1)						
AAA	95	91	77	73	65	56
AA	77	65	47	40	31	22
A	50	34	28	24	14	11
BBB	36	23	20	18	12	9
BBB-	33	21	19	17	12	9
EQ	0	0	0	0	0	0
ABX 07(2)						
AAA	95	92	72	70	63	52
AA	86	70	39	40	30	22
A	61	43	32	28	22	17
BBB	42	26	21	24	17	13
BBB-	39	24	21	22	16	13
EQ	0	0	0	0	0	0
OVERALL DEFAULT-LOSS PROBABILITY IMPLIED BY THE WEIGHTED BASKET						
%	87.7	84.0	75.3	73.0	67.9	60.2
RMBS $bn	2378	2303	2303	2228	2228	2228
LOSS $bn	**292**	**368**	**568**	**602**	**715**	**887**

Source: OECD, ABX. RMBS based on OECD forecasts for 2008Q1.

A similar picture emerges from our naïve equity market-cap-loss approach in Table 2. Far from the USD 308 bn published in the last FMT, the market cap losses for levered financial institutions most affected by mortgages is now a staggering USD 702 bn, very much showing the same pattern as the ABX approach.

Both approaches are undermined by recent market panic and problems with price discovery. If it is agreed that these are features of recent experience, then it follows that these estimates of losses are way too high.

Table 2. **Major levered financial institutions with mortgage exposure**

	Mkt Cap 14th Mar $bn	Price 14 Mar $	Av Price June 2007 $	% Chg	Mkt Cap Jun-07 $bn	Decline in Mkt Cap $bn
IINVESTMENT BANKS						
Citi	102.98	19.77	51.29	-61.5	255.14	152.16
JP Morgan	124.11	36.54	48.45	-24.6	162.73	38.62
Merril Lynch	42.27	43.51	83.58	-47.9	71.50	29.23
Goldmans	62.1	156.86	216.75	-27.6	86.58	24.48
UBS	53.18	27.76	60.01	-53.7	115.79	62.61
Credit Suisse	49.8	48.79	70.96	-31.2	74.26	24.46
Deutsche Bank	51.94	108.88	144.74	-24.8	72.38	20.44
Lehmans	20.83	39.26	74.52	-47.3	39.50	18.67
Morgan Stanley	43.69	39.55	83.88	-52.8	89.02	45.33
Bear Stearns	4.08	30	140	-78.6	20.24	16.16
Total	554.98				987.15	432.17
MORTGAGE LENDERS						
Bank of America	158.54	35.69	48.89	-27.0	216.92	58.38
Wells Fargo	92.85	28.45	35.17	-19.1	116.95	24.10
US Bancorp	51.3	31.57	32.95	-4.2	56.84	5.54
Suntrust	20.65	55.83	85.74	-34.9	29.90	9.25
Washington Mut	11.59	10.59	42.64	-75.2	36.78	25.19
BB&T	17.11	31.33	40.68	-23.0	22.35	5.24
NATL City	9.63	13.15	33.32	-60.5	21.10	11.47
Countrywide	2.61	4.5	36.35	-87.6	20.95	18.34
First Horizon	2.12	16.75	39	-57.1	4.93	2.81
Indy Mac	0.42874	5.3	29.17	-81.8	2.15	1.72
Total	366.83				528.87	162.04
OTHER SIGNIFICANT						
Barclays	57.63	34.93	55.79	-37.4	91.28	33.65
Wachovia	52.61	26.54	51.25	-48.2	97.43	44.82
PNC Fin Serv	20.58	60.38	71.58	-15.6	24.13	3.55
Regions Financial	14.05	20.25	33.1	-38.8	22.99	8.94
Fifth Third	11.64	21.84	39.77	-45.1	21.18	9.54
Keycorp	8.47	21.24	34.33	-38.1	13.34	4.87
M&T Bank Cp	8.8	79.96	106.9	-25.2	11.42	2.62
Total	173.78				281.76	107.98
GRAND TOTAL	1346.98				1797.78	702.19

Source: OECD, NYSE.

II. A default-model calculation of the size of losses in RMBS

The delinquency model

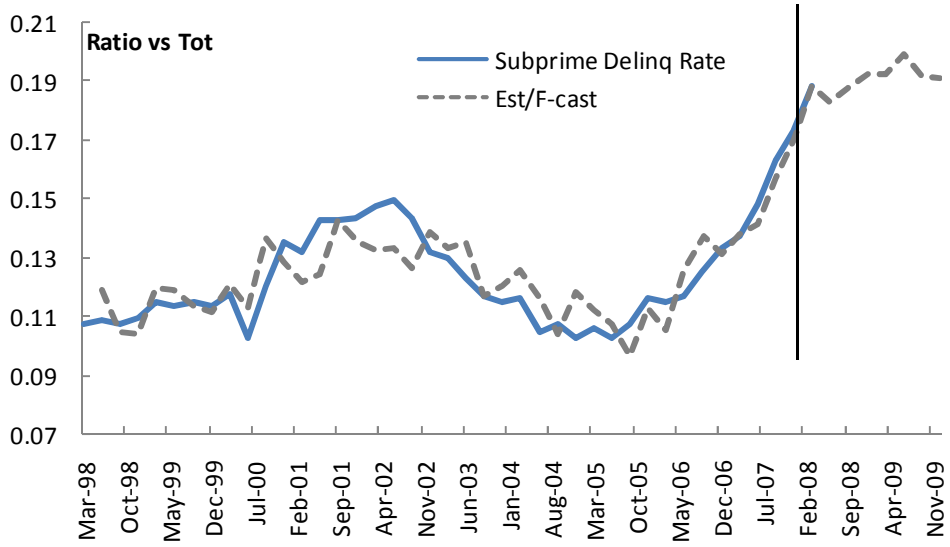
To work independently of the prices of assets (the mark-to-market approach) and focus on final default values requires modelling and assumptions.[7]

A default model calculation of losses is therefore required

The approach adopted here is to model the subprime delinquency rate, and then to make assumptions about the time path of the independent economic variables in the model, that can be benchmarked against previous crises. The delinquency rate is modelled as a simple co-integrating vector with GDP (a proxy for income to service debt), house prices (which determine the equity in mortgages), and unemployment (which drives inability to service) as components. Interest rates were also tested but did not play a significant role. This may be due to a variety of factors, such as the importance of resets, and other mechanisms to de-sensitise delinquency to rates (*e.g.* option ARMS, loan renegotiation of terms, etc.). No lagged-dependent variable is used in the model.

Figure 1. **Model of subprime delinquency rate**

Actual, estimated & forecast values



Source: Datastream, OECD.

The modeled subprime delinquency rate is shown in Figure 1. The model explains the rise in delinquency in late 2006 and 2007 as house prices stagnated at first, and then began to fall, and GDP growth slowed from 2006 as housing slumped.

Delinquency/loss scenario benchmarked against 1990s and 2001 recessions

A 'first round' scenario for losses

The approach to constructing a scenario for losses here is to benchmark the delinquency model drivers against past episodes, to arrive at ex-ante first round effects on delinquency (and hence ultimately on losses). To the extent that these drive deleveraging on the part of financial intermediaries, credit crunch mechanisms come into play that could drive bigger second round effects on the economy (and hence losses). These deleveraging issues are discussed later.

With GDP and unemployment like the modest 2001 recession

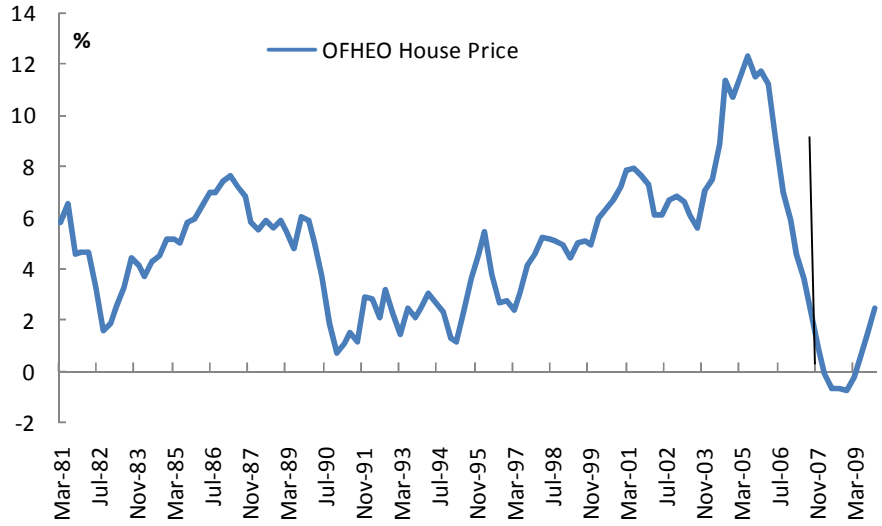
US economy is more flexible than the early 1990s and will benefit from continued growth in China and other emerging markets in 2008 and 2009 (the assumed adjustment period). The first round GDP impact of past tightening and the collapse in housing investment is therefore treated as more akin to the early 2000s recession, which was driven by the collapse of business investment after the tech bust. This was a modest recession without a credit crunch deleveraging process in play. Hence the early 2000s path of the real economy is imposed to obtain first round effects without assuming a deleveraging credit crunch – unemployment rises from 4.8% to 6.1% by end 2009; and nominal GDP annual growth slows by 2 percentage points.

But house prices worse than the early 1990s

The OFHEO house price index since March 1981 is shown in Figure 2. While various regions can do worse (California, Florida), the national 12-month % change has never gone negative, even in the early 1990s housing crisis. A future scenario worse than the 1990s episode is shown after the vertical line. The rationale for this is that subprime problems were not a feature of the previous episode, but are very much the focus of concern at present. The housing investment setback and excess inventory situation is also worse than the early 1990s.

Figure 2. **OFHEO house price index**

Total, annual percentage change



Source: OECD, Datastream.

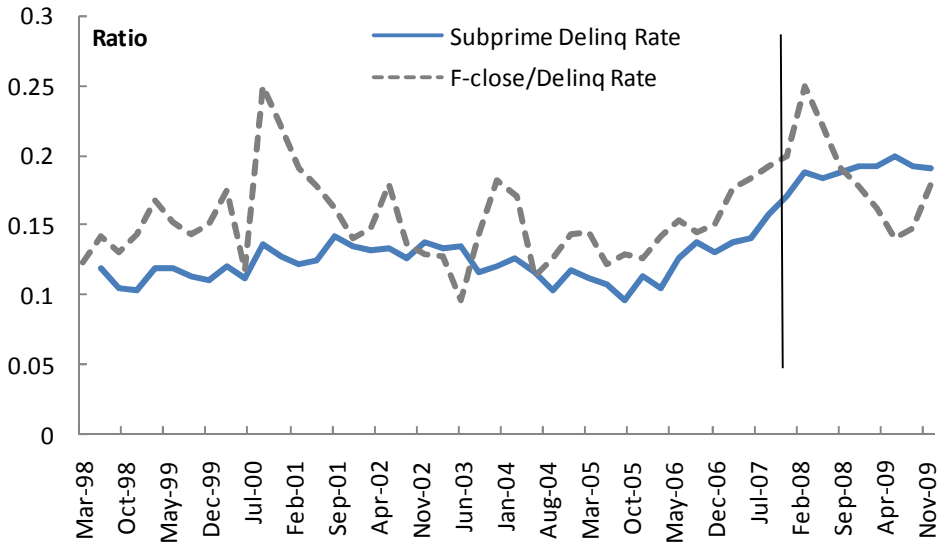
The foreclosure rate (shown as a ratio to delinquency) is shown in Figure 3. It rises quickly in a recession, as weak vintages default first, and then tends to return to the norm. This pattern is assumed to be repeated, and a rise to the worst ratio in its history (but not more than this) is imposed. The key moving part in this study remains the economic scenario driving the delinquency rate.

With a choice of collateral recovery rates

The final thing required to determine loss-given-default, is the recovery rate. That is, if a defaulted mortgagee house is foreclosed and sold, what percent of the loan is recovered? This is difficult to assess, so a range is given from 40% (pessimistic) to 60% (optimistic).

The adjustment is assumed to take place over 2008 and 2009, after which losses revert to normal and the crisis has passed. No net new RMBS is assumed to be issued in this adjustment phase.

Figure 3. **Delinquency rate *vs.* foreclosure/delinquency ratio**



Source: Datastream, OECD.

The default model loss estimates

A two-year adjustment to get RMBS back to trend

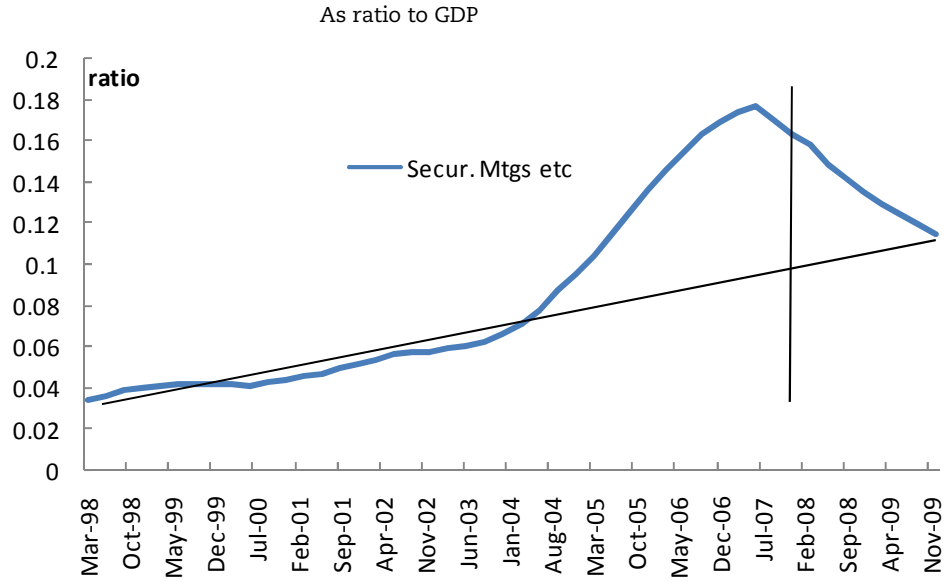
The cumulative losses quarter by quarter derived from the model and the first round economic scenario are shown in Table 3. The time path of the stock of RMBS is shown in Figure 4, as a percentage of GDP.[8] The losses implied by the model return the level of RMBS back in line with the longer-run trend that was in place before the parabolic acceleration of subprime, Alt-A and securitisation from mid 2004.

Table 3. **Securitised mortgages cumulative loss model**

	CUMUL. $bn LOSS @ RECOVERY RATE			
Quarter	0%	40%	50%	60%
Sep-07	74	45	37	30
Dec-07	153	92	77	61
Mar-08	258	155	129	103
Jun-08	344	206	172	138
Sep-08	416	250	208	167
Dec-08	483	290	242	193
Mar-09	542	325	271	217
Jun-09	593	356	297	237
Sep-09	644	386	322	258
Dec-09	703	422	352	281

Source: Datastream, OECD.

Figure 4. **Mortgage-backed securities**



Source: Datastream, OECD.

At a 40% recovery rate, the losses cumulate to USD 422 bn with this modelling approach independent of market prices. At 50%, losses drop to USD 352 bn and at 60% to USD 281 bn.[9]

The loss estimate range for a 40%-50% recovery range is USD 352 bn - USD 422 bn

A 60% recovery rate is too generous in the current environment. The (extremely pessimistic) zero recovery case is shown only as a reference point, and because it affects the stock of RMBS shown in Figure 4. If the recovery rate is in the 40-50% range, then the new estimated loss range is USD 352-USD 422 bn, (compared to the USD 200-300 bn mentioned in the previous FMT).

Spillovers to other asset classes and debts are ignored at this stage, and the issue is taken up in the latter part of the study.

The market-price based estimates quoted above are closer to the numbers shown for the default-model-based approach that assumes 0% recovery from collateral (left-hand column of the table) *i.e.* USD 700 bn. This illustrates why skepticism should be employed when interpreting any estimates based on ABX and other market prices.

Market pricing models are supposed to take into account the loss given default, (even though there is some lag between foreclosure and recovery amounts). They do not appear to be doing so – implied loss levels are virtually double the default-based calculation. Clearly, market pricing models cannot give a fair estimate in the presence of liquidity problems and panic. A default-model approach is to be preferred. The study now turns to look at the implications of the default-model measures for deleveraging and the economy – focusing first on commercial banking.

III. Commercial bank deleveraging (default-model estimates)

(i) Losses and deleveraging

Commercial banking is the key for intermediation pressures

Table 4 focuses on the US Commercial Banking sector as a whole, and uses assets minus liabilities as a proxy for equity.[10] The commercial banks are a key group in the intermediation process, and hence are critical for the impact the crisis will have on the economy – if one can solve the problems of commercial banks, there will be a return to normal intermediation and growth which will give the rest of the financial system a basis to take care of itself (after a 2-year adjustment period).

Table 4. **Deleveraging *vs.* loss recovery & equity injections**

	At start (Jun-07)	At full adjust. (Dec-09?)	%	Equity Req. ($bn) for Asset growth p.a. of: 0% p.a.	7% p.a.	& socialise losses with 7% p.a.
0% Recovery of Losses						
Assets $bn	10082.1	9169.5	-9.1			
Equity $bn	1102.9	1003.1		99.8	177.0	77.2
Lev Ratio	9.14	9.14				
Cum. Loss (14% $703bn total)		99.8				
40% Recovery of losses						
Assets	10082.1	9534.3	-5.4			
Equity	1102.9	1043.0		59.9	137.1	77.2
Lev Ratio	9.14	9.14				
Cum. Loss (14% $422bn total)		59.9				
50% Recovery of losses						
Assets	10082.1	9626.5	-4.5			
Equity	1102.9	1053.1		49.8	127.0	77.2
Lev Ratio	9.14	9.14				
Cum. Loss (14% $351bn total)		49.8				

Source: OECD, Datastream.

The leverage ratio before the start of the crisis was 9.14. If it is assumed that this is some 'desired' level, it is easy to work through illustrative loss calculations for deleveraging in US Commercial Banks. Total reported RMBS held by US Commercial Banks was USD 930 bn in June 2007. But this includes Fannie, Freddie and other GSE securities, whereas the focus is on private label RMBS in this study. This is approximated by multiplying the USD 930 bn by the proportion of Private Label in (Private Label + Federal Mortgage Pools), *i.e.* at around 38%. So the exposure to private label RMBS is about USD 345 bn, or about 14-15% of the total RMBS of USD 2.3 trillion.

Consider a USD 60 bn ultimate loss for US commercial banks

Using this figure for exposure, and applying the cumulative loss model from above, the Commercial Bank share of cumulative losses for the whole system to the end of 2009, are:

(i) USD 100 bn if zero recovery from collateral sales is assumed;

(ii) USD 60 bn if 40% recovery is assumed; and

(iii) USD 50 bn for 50% recovery.

The central case in this study is a 40% recovery rate; *i.e.* USD 60 bn.

This would cause significant deleveraging in the absence of capital injections and other policies

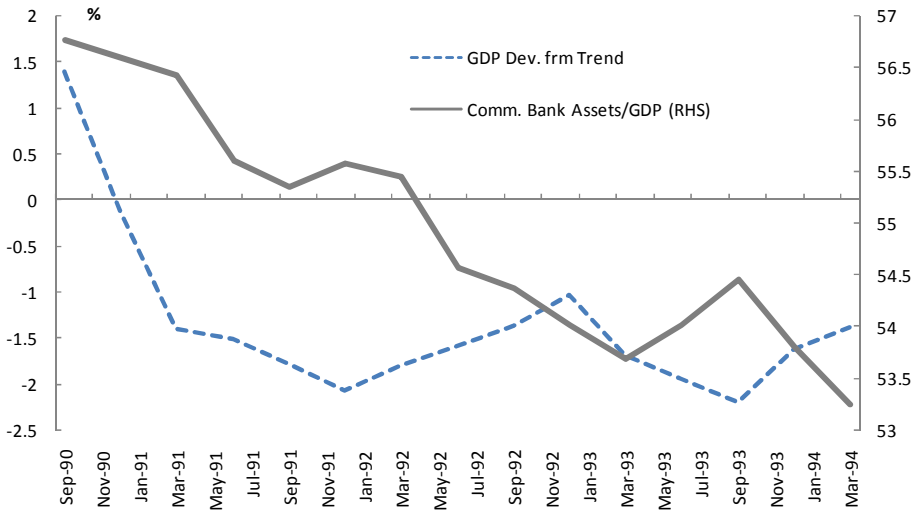
The deleveraging associated with such losses at the given leverage ratio implies falls in assets, shown in the 3rd column of Table 4. Nominal assets would fall by 5.4% over the two years in our USD 60 bn central case – assuming no new capital is injected and that there is no socialisation of the losses.

It would risk 1990s style scenarios and bigger losses

This cannot be allowed to happen! While there were large compositional shifts (*e.g.* C&I loans and government security holdings) during the serious 1990s recession, total commercial bank assets in nominal terms did not fall: assets were flat for a time, and then began to rise. Commercial bank assets did fall as a share of GDP, however, from about 56.7% of GDP in September 1990 to around 52.9% in April 1994, as shown in Figure 5. Over this same period, the cumulative fall in GDP versus its trend was around 2% – a massive loss. The kind of fall in nominal banks assets that would follow on from the deleveraging associated with the central case hypothesis for losses would imply an exceedingly heavy impact on GDP and hence cannot be allowed to happen.

Figure 5. **Commercial bank assets/GDP *vs.* GDP gap**

1990-1994



Source: OECD, Datastream.

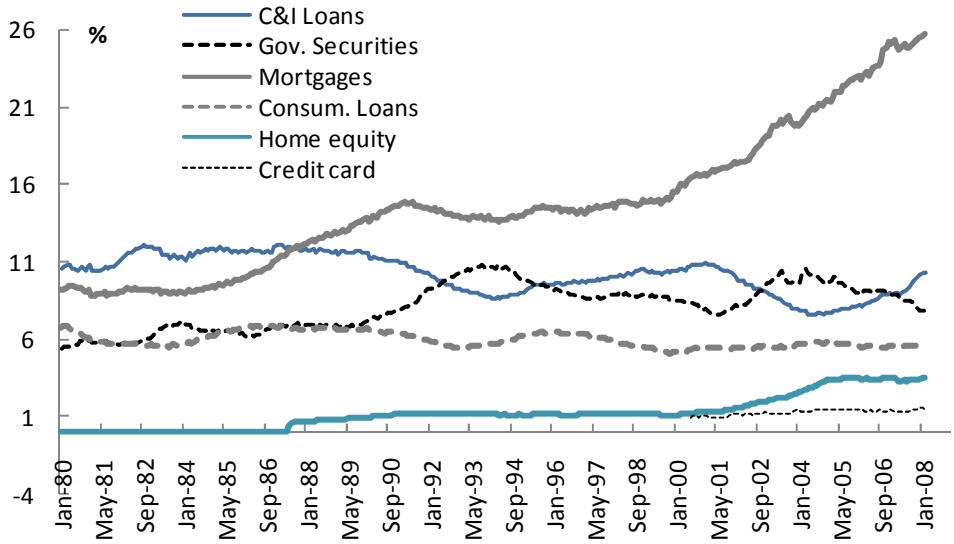
What happened in the 1990s?

During the 1990s the transmission mechanism from the financial sector to the real economy was largely through C&I loans to business, as the S&L and junk bond crisis reached its climax. C&I loans fell from 11% of GDP to 8.6% from September 1990 to April 1994, while the mortgage share fell only slightly (see Figure 6).

Encouraged by the incentives following the introduction of Basel I, banks increased their share of Government securities substantially. The same sorts of mechanisms are coming into play now, as risk aversion rises. This time, however, the cutback on mortgages could be much larger than in the 1990s. If both C&I loans and mortgages are subject to deleveraging efforts by commercial banks, the impact on the economy risks being stronger than in the 1990s.

Figure 6. **Commercial bank assets**

In per cent of GDP



Source. OECD, Datastream.

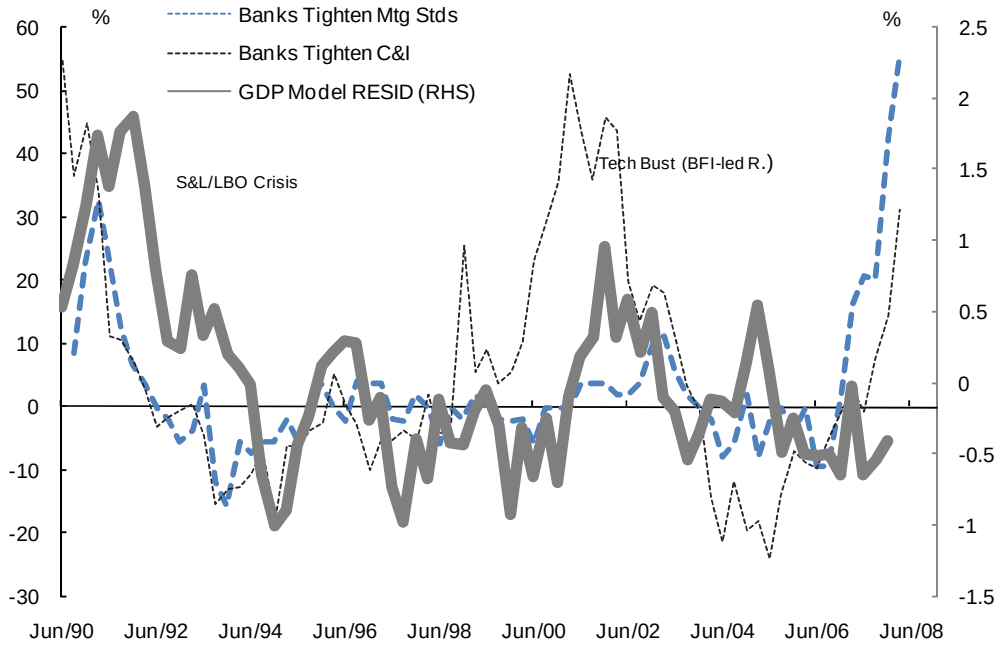
The indications are that the pressures could be larger this time than in the 1990s

The Fed's loan officer surveys of tightening lending standards are shown in Figure 7. The large and small C&I loan surveys are averaged, and the mortgage standards survey weights its components.[11] The C&I loan standards are tightening sharply, but are less significant compared to the tightening of mortgage standards. This is to be expected, given the size of the mortgage crisis. Also shown in the chart is the residual from a long-run VAR model of the US economy (based on monetary conditions price variables – Fed Funds, bonds, the exchange rate, equity prices and oil prices). If the residual moves positive, it suggests that modelled GDP is stronger or better than actual GDP; *i.e.* something abnormal related to credit crunch mechanisms from money and credit (bank balance sheets) might be at play. The correlation with the Fed lending standard surveys is instructive in this regard – in the early 1990s and the early 2000s lending standards tightened and the model residual moved up. In the early 1990s the model residual moves to 1.5-2% of GDP, (also consistent with the above trend deviation chart in Figure 5).

In the 1990s the credit crunch was worth 1.5%-2% of GDP

The risk this time is that both mortgages and C&I loans will be subject to a credit crunch, driving a significant recession tendency. Losses in RMBS could rise above the estimates set out earlier, if unemployment and house prices deteriorate by more than was assumed there.

Figure 7. **Fed survey of lending standards *vs.* GDP model residual**



Source: Datastream, OECD.

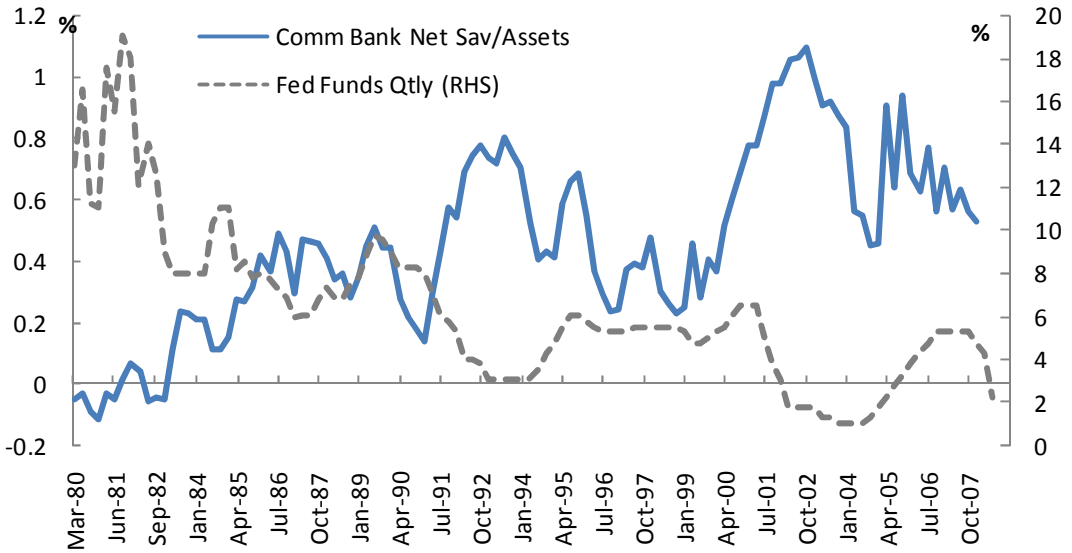
(ii) Policy options via earnings: with Fed rate cuts and the dividend payout ratio arithmetic

The simplest approach to recapitalisation is to allow banks to earn back their losses and help them along the way via rate cuts and encouraging cuts in dividends (via jawboning). The above central case of USD 60 bn commercial bank ex ante losses is considered.

Fed rate cuts help margins

The relationship between commercial bank net saving as a percent of assets (after investment and after dividends are paid) is shown alongside the Fed funds rate in Figure 8. This is one of the classic mechanisms of monetary policy in a supply-side loan crisis where capital is destroyed: see particularly what happened in 1991-92. By cutting the Fed funds rate in a crisis, the Fed improves bank margins and hence their profits net of dividends. [12] Commercial banks must decide on how much to cut dividends in order to speed recapitalisation. The basic arithmetic is shown in Table 5.

Figure 8. **Fed Funds *vs.* Commercial bank net saving % assets**



Source: Datastream, OECD.

Table 5. **Recapitalising through earnings: Fed & dividend arithmetic**

Earn. Rate p.a.	Payout Ratio 0.5			Payout ratio 0.25			Payout ratio 0		
Assets $11.4trn. %	Net Earn Rate % p.a.	Cap Build $bn p/qtr	No. qtrs recap. $60bn	Net Earn Rate % p.a.	Cap Build $bn p/qtr	No. qtrs recap. $60bn	Net Earn Rate % p.a.	Cap Build $bn p/qtr	No. qtrs recap. $60bn
1.1	0.55	$15.68	3.8	0.8	$23.51	2.6	1.1	$31.4	1.9
1.5	0.75	$21.38	2.8	1.1	$32.06	1.9	1.5	$42.8	1.4
2	1.00	$28.50	2.1	1.5	$42.75	1.4	2.0	$57.0	1.1

Source: OECD.

Without interest rate and dividend cuts it could take two years to get back on track

If the before dividend earning rate is say 1.1% and after dividend at 0.55% of assets (the current number shown in Table 5, with commercial banks implicitly paying out dividends at a ratio of 0.5, or 50%), only USD 15.7 bn per quarter is available for recapitalisation and it takes a full year before the business returns to normal (the 3.8 quarters shown in the 4th column of Table 5). Recapitalisation can happen quickly if *(a)* the Fed cuts rates and pushes the before-dividend earning rate back to its highs of 2% and the net 1% (shown in Table 5 around the early 2000s), and *(b)* commercial banks cut the payout ratio to zero. In this case about USD 57 bn per quarter is available and it takes only just over one quarter to raise the USD 60 bn. But even here, this only covers losses and does not raise new capital for actual expansion of balance sheets.

With maximal interest rate and dividend cutting this can be cut to

Taking a middle scenario (1.5% gross and 0.75% net earning rates, and a 25% payout), it would take two quarters to earn back the loss (at the USD 32 bn net earnings per quarter in column 6). If the payout ratio were not cut, then despite Fed easing it would take three quarters to earn back

about three quarters – but it is still too long

the losses (at USD 21 bn net per quarter in column 3). In both cases much more is required to actually expand balance sheets (presumably needed to avoid recession pressure). To earn back the USD 60 bn loss in the middle scenario would take two quarters, and then USD 20 bn per quarter is needed to grow balance sheets at a 7% p.a. pace (USD 80 bn p.a.), adding another quarter before the economy could get going.[13] This is too long if one wishes to avoid a full blown credit crunch and the effects on the real economy that would follow. It seems clear that rate cuts and dividend policy can only do so much – so that avoiding the 1990s-type scenario could require capital raisings independently of earnings and/or socialisation of losses.

(iii) Injections of capital

A 40% collateral recovery rate is our central case

On the right hand side (RHS) of Figure 8 the simple illustrative arithmetic for policy of capital injections versus socialisation of losses is shown. Taking the 40% recovery central case (the middle row), the USD 422 bn of total RMBS losses translates to USD 60 bn in losses for commercial banks. If the full amount of this loss, which has to be written off by the banks, were to be made up by capital raisings and no additional capital were raised during the adjustment period, then asset growth would have to remain at zero – shown in the 4th column – until earnings kicked in. Simply replacing capital losses would not avoid the sort of credit crunch mechanisms we saw working in the early 1990s – unless it all happened on day 1 and the market 'tone' changed as a consequence.

Offsetting losses and allowing for 7% balance sheet expansion would require USD 137 bn in the first year

A tall order now

If capital had to be raised to offset the USD 60 bn loss and also allow assets to grow at the trend rate of 7% p.a., then more than USD 60 bn would have to be raised. As before, the banks would also require about USD 20 bn per quarter (USD 77 bn p.a.) to capitalise their businesses for more normal average 7% p.a. growth (at a 9.14 leverage ratio). A total of USD 137 billion in capital raisings would be required. This is a tall order at present, after very bad initial experiences on the part of SWF investors. Nevertheless, rights issues and subordinated debt seeking new capital are essential.

A credit crunch would raise our loss estimates

If a credit crunch began to bite, so the economic scenario is worse than assumed earlier, then the losses and capital raisings required would grow too. This worse second round scenario of losses could require public money.

(iv) Socialising losses – RTC-like mechanisms

If the losses were socialised with government money – in the spirit of the Resolution Trust Corporation (RTC) or the emerging market debt bail out via the Brady Bond mechanism, then the commercial bank balance sheets could be directly cleansed of all the RMBS, and normal intermediation could begin without waiting for SWFs and earnings to kick in. This option turns the problem into an 'RTC', capital markets and mortgagee issue. If this were done quickly, the tone in the markets would

change and the banks would have some chance to go about raising capital from private sources – get back to business as usual.

An example is provided in the following box for illustrative purposes only.

An RTC-style mechanism

In a very simplistic example, this would work something like the following. The RTC would take on the USD 345 bn private label RMBS that was estimated above for the commercial banks, and take the collateral with it (claims on mortgagee's homes) with an appropriate USD 60 bn 'haircut' estimated from the default model approach. This frees the banks of these assets and liabilities – the whole purpose of the exercise. The USD 60 bn loss is subtracted from the USD 345 bn, *i.e.* USD 285 bn post the 'haircut'. The RTC issues USD 285 bn in its own notes, and these are exchanged for the RMBS held by the investors in these bonds, *e.g.* CDOs, conduits, hedge funds, pension funds etc. They also get the 17% 'haircut' to their assets and hence to their investors/note holders etc. But this is better than the sorts of haircuts in current market prices and underlines the value of the default model approach to calculating losses. To make this work without the turmoil in prices at present, a guarantee is required at the lowest possible cost; so the US Treasury, for example, could issue the RTC with USD 108 bn of zero coupon bonds with a yield of (for arguments sake) 5% and a 20 year maturity: *i.e.* the USD 108 bn will be worth the USD 285 bn at maturity. The RTC passes the interest from the mortgages through its notes to the investors and prices are stable because of the principal (but not interest) guarantee. The RTC body has assets of USD 108 bn zeros + USD 285 bn housing assets, or USD 393 bn; and liabilities of USD 285 bn to the CDOs, hedge funds etc., and equity of USD 108 bn. The government would borrow the USD 108 bn to issue the zero coupon bonds. The question of whether politics would allow this is outside the scope of this paper.

IV. The investment bank (prime broker) and hedge fund arithmetic

Counterparty credit exposures are very large

The other key focus of the crisis in leveraged institutions is the prime brokers, because of their exposure to counterparty risk. These are shown in Table 6. While prime brokers do not lend to households and businesses in the same way as commercial banks, they play a key role in the allocation of capital and the workings of the financial system. If one risks failure, as with the recent case of Bear Stearns (one entry in Table 6), financial crises may amplify due to the interconnectedness of brokers with other players like hedge funds, and the commercial banks themselves. The total counterparty exposures calculated here from loaned securities, reverse repos, derivatives and margin loans sum to just over USD 3.3 trillion for prime brokers listed in the US, grossing up to USD 4 trillion globally.

Table 6. **Prime broker published credit exposure to counterparty risk**

As of FY end 2007 *	Loaned Securites $bn	Ratio to Tier 1 Capital	Reverse Repos $bn	Ratio to Tier 1 Capital	Derivatives PRV $bn	Ratio to Tier 1 Capital	Margin Loans NYSE Total $bn	Total Credit Exposures $bn	Tier 1 Capital $bn
UBS	54.3	1.4	352.5	9.3	273.7	7.2	#N/A	#N/A	38.1
Credit Suisse	45.8	1.5	148.8	4.7	65.3	2.1	#N/A	#N/A	31.5
Deutsche Bank	15.1	0.4	203.2	5.8	89.8	2.6	#N/A	#N/A	35.1
Goldman Sachs	28.6	0.7	85.7	2.0	105.6	2.5	#N/A	#N/A	42.7
Morgan Stanley	110.4	3.4	126.9	4.0	77.0	2.4	#N/A	#N/A	32.1
JPMorgan Chase & Co	10.9	0.1	169.3	1.9	77.1	0.9	#N/A	#N/A	88.7
Lehman Brothers	53.3	2.3	162.6	7.0	44.6	1.9	#N/A	#N/A	23.1
Merrill Lynch	55.9	1.8	221.6	7.0	72.7	2.3	#N/A	#N/A	31.6
Citigroup	67.1	0.8	98.3	1.1	76.9	0.9	#N/A	#N/A	89.2
Bear Stearns	3.9	0.4	27.9	2.5	19.7	1.8	#N/A	#N/A	11.1
Total	445.5	1.1	1596.8	3.8	902.4	2.1	322.8	3267.4	423.3
Grossed Mkt Tot. (Top 10 = 80%)	556.9	1.1	1996.0	3.8	1128.0	2.1	403.5	4084.3	529.2

Source: Company accounts, OECD.

Hedge funds are big players

Given the role hedge funds play in this interconnectedness, estimates of prime broker exposure to hedge funds are shown in Figure 15. An estimated USD 1.4 trillion of these exposures is likely to be hedge-fund related.

Prime broker warehoused losses

If global prime brokers have a 6 2/3% direct exposure to our estimated losses for RMBS of USD 422 bn, this is equivalent to USD 27 bn of write-offs.[14] Adding this to the USD 60 bn for commercial banks leads to a number for US listed commercial and investment banks of something like USD 87 bn.

Table 7. **Prime broker exposure to hedge funds**

	Total Credit Exp $bn	Ratio to Tier 1 Capital	Hedge Fund $bn	HF% Total Exposure	HF Exp Ratio to Tier 1 Capital
Loaned Securities	557	1.05	223	40%	0.42
Reverse repos	1,996	3.77	499	25%	0.94
Derivatives PRV	1,128	2.13	372	33%	0.70
Margin Loans	403	0.76	266	66%	0.50
Total	4,084	7.72	1,360		2.57

Source: Company accounts, OECD.

A problem arises if hedge funds start to fail

A problem arises however, if hedge funds start to fold. If hedge funds are exposed to about 20% of RMBS[15], or USD 84 bn of our overall loss number, this rebounds to the banks. Hedge funds are more leveraged than banks. The total counterparty exposure to hedge funds calculated in Table 7 of USD 1.3 trillion is very large indeed. It is hard to estimate how much of this would be at risk in the event of RMBS hedge fund losses causing failures of funds – given the interconnectedness – and it is probably best not to find out.

This is one reason why central bank policies to flood the market with liquidity etc are very important at this stage.

V. Moral hazard and related issues

Banks too big to fail!

The unconventional methods the Fed has adopted in smoothing the crisis raises a multitude of issues concerning moral hazard: these most recently include the guarantee to JP Morgan on Bear Stearns securities in order to encourage the former to take over the latter. Should taxpayers' money be used in this way? How was JP Morgan selected versus other financial institutions? Can the effectiveness of markets as an efficient allocator of capital amongst competing ends be relied upon in the future, when the trade off between risk and return is now asymmetric and banks know they are too big to be allowed to fail?

Taxpayers helping out the banks?

Should taxpayers pay the price of rapid moves up the risk curve to gain short-run bonuses and returns, often involving financial innovation that is too difficult for regulators to monitor, understand and control. This is particularly pointed now, as signs emerge of banks beginning to take strategic advantage of the situation. Examples of such strategic behaviour include:

(i) A hedge fund may have a portfolio of strong assets (*e.g.* securitised complying mortgage loans such as Fannie and Freddie) but be dependent on prime brokers for various forms of leverage. If the leverage is withdrawn, for example increased margin calls are made, the entity with little capital may fail. The bank would take the attractive assets at their current high spreads and be in a strong position later on when asset prices firm.

(ii) A prime broker subject to defaults of hedge funds may be at risk in a liquidity sense, but still have an attractive business. A stronger institution may acquire it for a bargain price with huge upside to its stock price and earnings after the crisis, particularly if guarantees on unknown risks in the portfolio are given by authorities.

Obviously RTC-like proposals would further imbed the risk of moral hazard. Undertaking these sorts of actions could well require a complete reconsideration of the regulation and structure of the financial system, in order to ensure that even bigger problems associated with asymmetric risk and moral hazard do not arise in the future. Secretary Paulson of the US Treasury has opened this debate. How far it should be taken is a critical issue, going beyond the scope of this paper.[16]

VI. The spill-over issues: Europe

Europe is not immune

Europe is not immune from these issues. One third of RMBS related CDOs etc. is thought to have moved offshore, and to Europe in particular. One third of the USD 422 bn default loss amount is USD 138 bn. Insurance companies are likely to have a large part of the RMBS held in Europe. Fortunately, from a financial intermediation perspective, they do not mark to market. Nevertheless, levered financial institutions are also exposed to

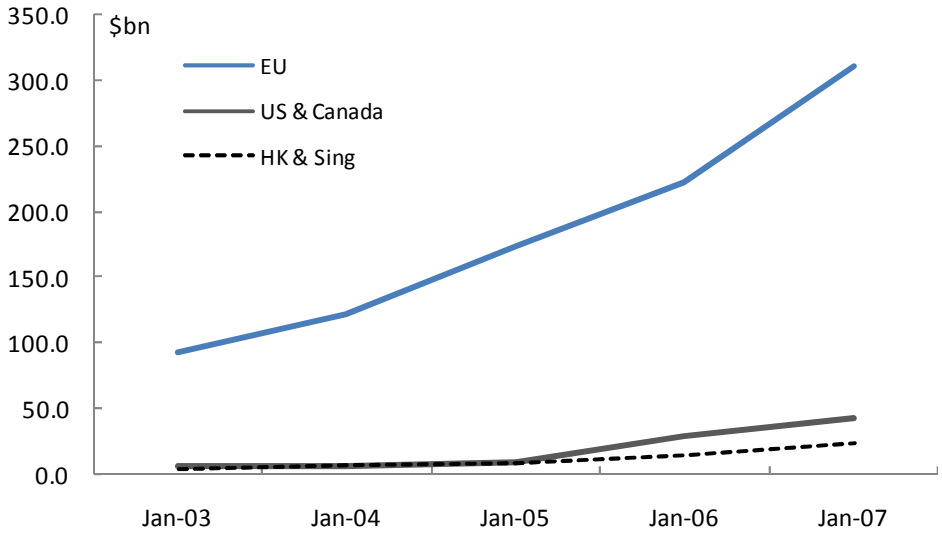
RBMS-backed products, so all of the issues concerning losses and deleveraging above apply in Europe too.

Equity derivative problems could follow

A related concern is structured products that do not include any RMBS. Once again this involves prime brokers at the core. For example, a small bank or building society offers to its clients capital guaranteed products with exposure to risk assets such as equities. Constant Proportion Portfolio Insurance (CPPI) products are a popular form of this that use complex options replication programs and are passive; *i.e.* in the sense that they are not managed in a discretionary way by a fund manager. Of course the small bank or building society is only distributing the products. The real guarantee is coming from the prime broker that issues and manages it.

The parallels are clear. If a major market break occurs and counterparties fail, the guarantee is going to fall on prime broker capital. The current crisis, if not handled well, could spill into these products. Interestingly, Europe is in the forefront of issuing these products. By the start of this year no less than USD 1 trillion of these products had been issued since 2003, and all to retail investors. Europe's pre-eminence in this respect is shown in Figure 9.[17]

Figure 9. **Retail equity structured product issuance: EU *vs.* others**



Source: Structured Retail Products.

Eastern European exposures

Finally, a European banking system concern is the exposure to banks in Eastern Europe. These countries fix their exchange rates and borrow in foreign currency. Inflation is accelerating in some of these countries as capital inflows and managed exchange rates prove incompatible. This situation is reminiscent of the Asia crisis of the late 1990s.

VII. The spill-over issues: Asia

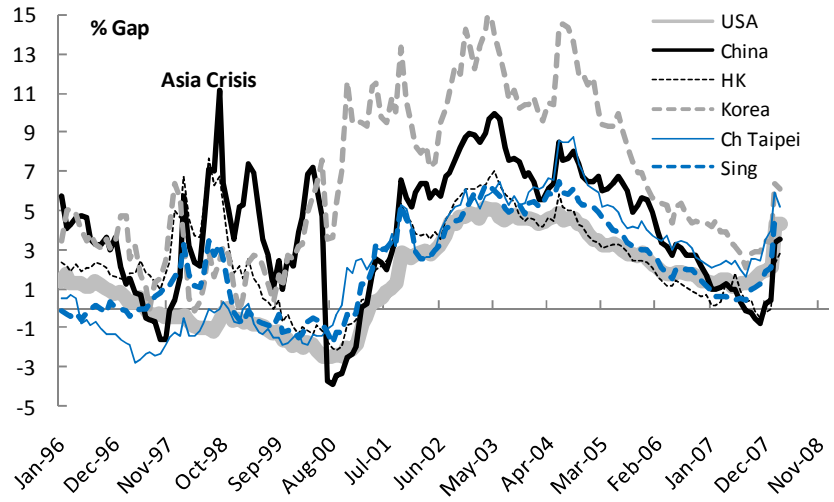
Asia is less directly exposed to subprime. But as the US dollar falls, they face a different type of risk – asset inflation through excess liquidity. This is because many countries in the region peg to the US dollar, and may try to resist exchange rate appreciation. Avoiding the rolling bubbles associated with excess liquidity, which are at the very origin of the crisis in the US, argues for more flexibility in their exchange policies. If credit crises are to be avoided in Asia, it is essential that asset bubbles should be avoided and unwound where they have been in place.

Flexible exchange rates help avoid inflation and bubbles

The greater the flexibility of Asian country exchange rates versus the US dollar, the more independent monetary policy can be. This is shown in Figure 10, which shows equity yields of China, Hong Kong, Singapore, Korea and Chinese Taipei alongside the USA, all versus Libor. At the peak of the recent bubble, the risk premium went negative in the case of China and Hong Kong – clear signs of bubble trouble. Countries which showed more flexibility in exchange rates during the 2000s experienced less equity price inflation.

Figure 10. **US *vs.* Asian equities**

Equity yield *vs.* Libor



Source: Datastream, OECD.

VIII. Spill-over issues: corporate bonds and equities

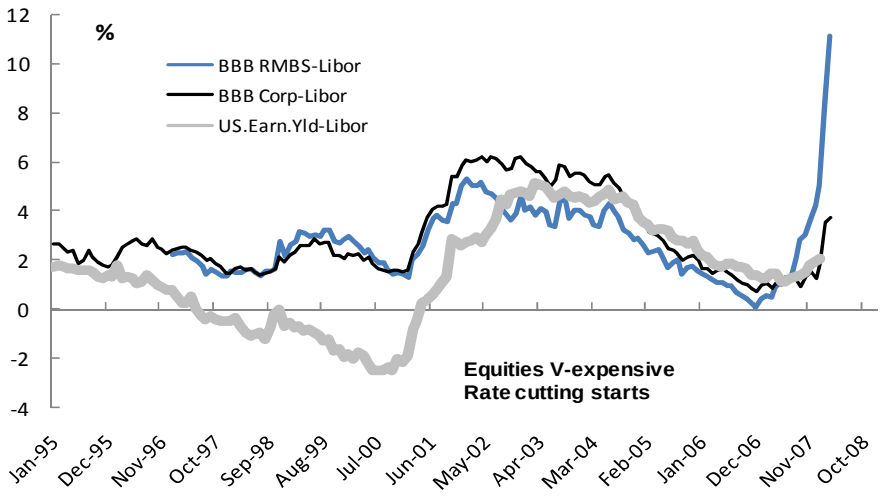
Bubbles in other assets, were not present to the same extent as in the mortgages market, as is shown in Figure 11, which shows spreads for BBB assets and the equity yield versus Libor. For RMBS, the rally to early 2007 (incredibly) pushed the RMBS BBB yield into line with what essentially is cash. The BBB corporate bond spread is also shown. It rallied, but not nearly as much as RMBS. Here it needs to be recalled that corporate

balance sheets on 'Main Street' are in good shape on average. So a rally from the tech-bust sell off was justified by fundamentals (much more so than the low end of the housing market).

A 'fat tail' of overleveraged companies

There is however a fat tail of companies that are overleveraged following the LBO boom of the past few years. A large number of companies have issued a lot of less-than-investment grade debt. S&P believe that 90 or so companies are at risk of defaulting on over USD 50 bn in debt, 75 possibly in the next year. A recession in the next year will bring this factor into play, with the size of losses depending on the extent and duration of the recession.

Figure 11. **The RMBS bubble & reversal *vs.* corporate bonds & US equities**



Source: Datatream, OECD.

Similar points can be made about equities. While balance sheets are in good shape on average, and the earnings yield remained positive (certainly did not move into very expensive territory as occurred with the negative risk premium implied in the chart for the late 1990s and early 2000s), the fat tail of indebted non-financial companies will remain a concern. This could lead to equity volatility and a spill-over to equity derivatives products mentioned above.

This underlines why authorities need to move quickly using the full arsenal of macro tools at their disposal.

IX. Some policy issues raised

The bears are getting carried away in the markets, as mark-to-market losses move well above default-model based estimates. The estimate of losses on a default-model basis here is USD 352-USD 422 bn, assuming 40% to 50% recovery on defaulting loans and a harsh house price index scenario. To obtain a result anything like recent mark-to-market losses

would require a 0% recovery rate – which may be a little extreme even for the most bearish. About USD 60 bn of the losses may be put down to commercial banks listed in the US and a further USD 28 bn to prime brokers. These are key intermediaries and are therefore a major focus of the study.

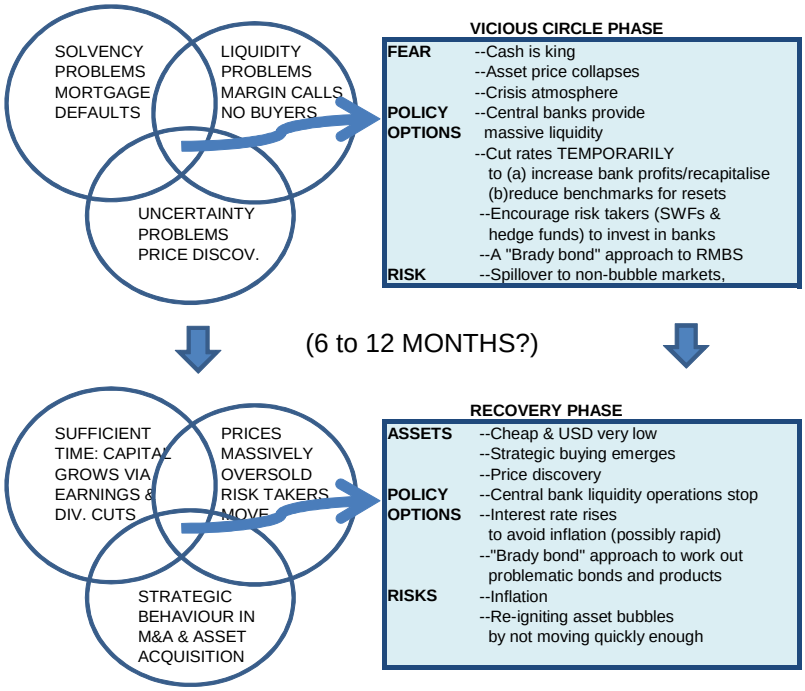
Under certain assumptions concerning the Fed Funds rate and dividend pay-out rates, it could take US commercial banks six months to earn back the capital write-offs that will be required. But further recapitalisation is necessary if banks are actually to re-start lending and expand their balance sheets. A six-month-plus period to rebuild would risk credit crunch scenarios such as happened in the 1990s.

Capital raisings/injections from risk-taking private institutions or SWFs are a big help. But the arithmetic of getting quickly back to 'business-as-usual', which requires much more capital than simply offsetting the losses alone, argues for more action if possible. One such action mentioned in this context was the socialisation of losses through government action like the RTC.

A combination of approaches has a better chance of success.

The issues discussed here are summarised in Figure 12.

Figure 12. **The requirements of recovery**



Source: OECD.

While avoiding credit crunch mechanisms resulting from past policy failure is a prime short-term concern, the longer-run issue of moral hazard and asymmetries in the trade off between returns to risk is a critical issue. Fundamental reform of the financial system and its regulation has to be a key focus of policy debate going forward. It will no longer be possible to assert the Panglossian view that we have the best of all possible financial systems.

Notes

1. Citi is a prime broker and investment bank. But this is buried in the bank holding company structure of Citi. It has a consumer bank. These should be separated for analytical discussion. The question of whether they should be separated for regulatory purposes is not considered in this study.
2. A. Blundell-Wignall, "Structured Products: Implications for Financial Markets", *Financial Market Trends*, Volume 2007/2, No. 93.
3. Or about 20% of subprime, if Alt-A and jumbos were ignored. But ignoring them seemed unreasonable. If 14% of subprime defaulted and 11% of Alt-A and the rest, a number of USD 300 bn results. See A. Blundell-Wignall, "Structured Products: Implications for Financial Markets", *Financial Market Trends*, Volume 2007/2, No. 93.
4. Citigroup commentary.
5. These prices in principle are supposed to take all major factors into account in theoretical models: default probability, loss-given default, and default correlations. The issue of recovery via collateral to determine loss given default is important and taken up below.
6. If this is applied to subprime mortgages alone, as opposed to RMBS private label, the number is USD 557 bn. But this is too small as it ignores Alt-A, jumbo loans etc. as previously discussed. If the estimate is updated to the 14th of March, following a minor rally in prices, USD 100 bn drops off the number, illustrating extreme volatility.
7. Efforts in this regard simply make assumptions about defaults and losses by mechanical extrapolations, as in David Greenlaw, Jan Hatzius, Anil K. Kashyap, and Hyun Song Shin, *Leveraged Losses: Lessons from the Mortgage Meltdown*, paper presented at the U.S. Monetary Policy Forum, New York, NY, February 29, 2008.
8. It is calculated without the recovery rate. This is paid to bond holders later as compensation for defaulted securities.
9. These estimates would be too high if Alt-A performs better than subprime in delinquency. This is very much a house price profile issue. Compensating this, the results would be too low on account of ignoring subprime and Alt-A that was not securitised. The results are therefore a fair estimate.
10. While this is not strictly speaking regulatory capital, it is close enough for the approximate nature of the calculations here.

11. This weights the prime and subprime surveys for the last couple of quarters, due to new procedures now separating these in the survey. This is necessary to keep the continuity of the series.
12. The funds rate is shown quarterly, but it can move a number of times in a quarter; the latest daily value in the chart for the Fed funds rate would already be at 2.25%.
13. If assets are around USD 11 trillion, a leverage ratio of 9.14 requires USD 1.2 trillion in capital. If this has to grow at 7% p.a. then about USD 80 bn a year is needed.
14. Goldmans estimate that US investment banks have 5% exposure. If US investment banks are 75% of the total, this is around 6 3/4%.
15. Goldman estimates that hedge funds have exposure to about 21% of subprime.
16. The basic issue is that regulators, the private sector and monetary policy have combined to lead to an outcome with unintended consequences: the potential for a serious recession and spill-over to countries and markets where excesses were less marked. While short-run policies are needed to avoid this, the long-run cost may be severe if the system is not fundamentally reformed.
17. Norway has already taken action against these products.