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## The sub-prime mortgage crisis: a synopsis

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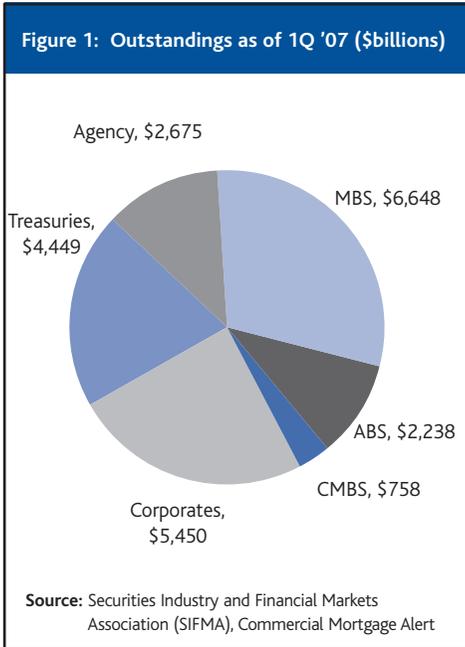
Sub-prime mortgages are just a niche within the US residential mortgage lending market, yet in 2007 they took centre stage in the global financial markets, roiling both debt and equity markets in both developed and emerging economies.

Most mortgages are securitised, creating bonds called 'mortgage-backed securities'. The nomenclature used here can vary. Generally, mortgage-backed securities are referred to as MBS, but they can also be called RMBS, for residential mortgage-backed securities, so as to distinguish them from CMBS, which are commercial mortgage-backed securities. Sometimes, market participants will use the broader term 'ABS' or asset-backed securities to refer to bonds that could be MBS or could be backed by other types of asset (eg, auto loans). Sub-prime MBS are sometimes referred to as just that, but they are also sometimes referred to as sub-prime ABS, or HEQ or HEL to denote home equity loans. Home equity is a bit of a misnomer (at least in the common lay usage of the term 'home equity loan'), since many of these loans are used to purchase homes. We will use the term sub-prime MBS throughout this chapter.

The US residential mortgage-backed securities (RMBS) market is larger than any other US fixed-income sector, as shown in Figure 1.

There are three broad categories of mortgage credit:

- prime or 'A quality' – the highest quality segment;
- Alt-A (Alternative-A) – not quite prime credit quality; and
- sub-prime – the riskiest segment.

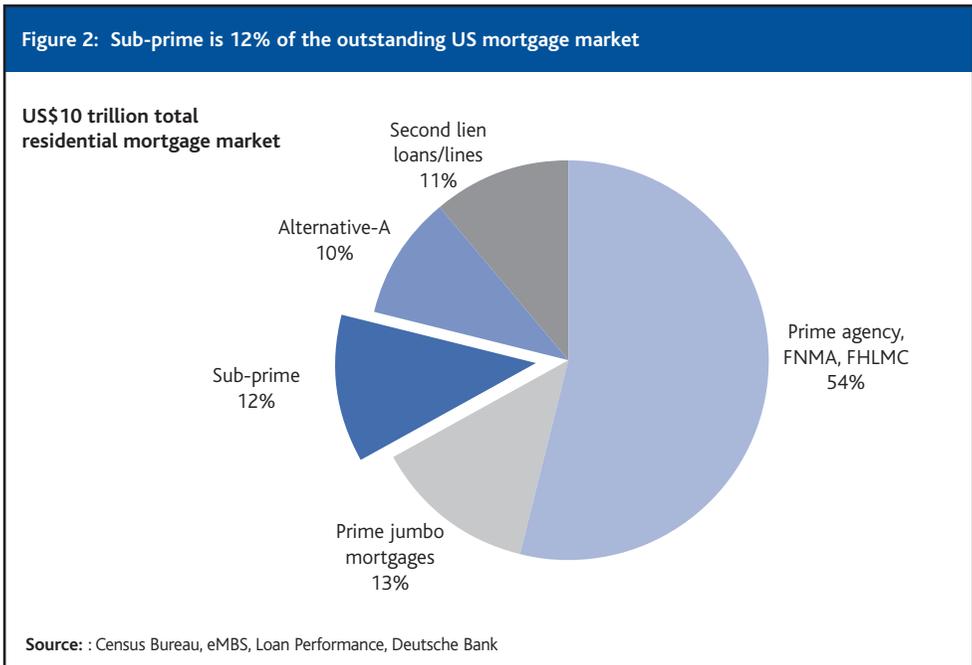


The aspects of a mortgage loan that determine credit quality include:

- the borrower – debt service burdens relative to income, past payment behaviour (as measured by a credit score, commonly FICO);
- the collateral – value of the property relative to the loan (eg, the loan-to-value ratio); and
- the loan's terms – for example:
  - fixed-rate v adjustable-rate interest;
  - amortising or interest-only; and
  - documentation (eg, the paperwork used to verify the borrower's income, assets, etc).

In terms of outstandings, sub-prime mortgages are a rather small subset of the overall mortgage market, as shown in Figure 2.

The vast majority of sub-prime mortgages were pooled and securitised. The mortgage loans were then held in a trust with that trust issuing a series of ratings-agency rated tranches or bonds. Sub-prime MBS were



purchased directly by institutional investors of all types around the globe. Sub-prime MBS were also purchased by collateralised debt obligation (CDO) managers and formed the collateral backing the CDO's debt and equity. Lastly, sub-prime MBS are referenced in synthetic markets, in the form of credit default swaps (CDS) and via the set of ABX indices (each series of which is a basket of CDS).

### What were the conditions that fostered the sub-prime crisis?

Home prices in the United States have risen rapidly for several years, which made mortgage lending, even to riskier borrowers, very profitable. Based on history, many market participants did not believe that home prices would fall, but instead would only moderate, in a 'soft landing'. Against this backdrop, the sub-prime crisis was largely due to three factors:

- Originators of sub-prime mortgages originated the mortgages to sell them - no 'skin in the game'. Originators were largely unregulated as to soundness, and banks, the Federal National Mortgage Association (FNMA) and the Federal Home Loan Mortgage Corporation (FHLMC) (Fannie Mae and Freddie Mac respectively) generally were not involved in sub-prime mortgage lending.
- Buyers of sub-prime MBS (and related CDOs) over-relied on ratings - often buyers, particularly AAA buyers, did little independent credit work.
- Rating agencies were wrong, probably because:
  - they made overly optimistic assumptions on these new, untested types of mortgages;
  - they used an actuarial approach to evaluating risk, which tends to be backward-looking; and
  - they, like many, assumed a 'soft landing' for home prices.

Figure 3 illustrates the rapid growth of sub-prime mortgage lending. By 2002, with profits high, growth rapid

and the housing boom in full swing, many new entrants came to sub-prime mortgage lending. Not surprisingly, that drove down pricing, as shown in Figure 3.

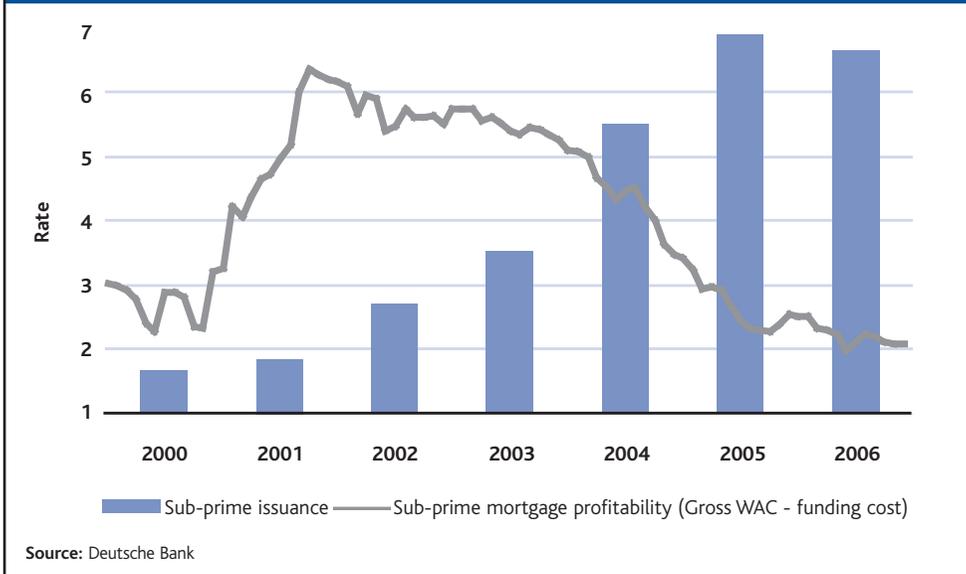
But perhaps even more noteworthy was the impact that this overcapacity in sub-prime lending had in loosening credit standards (see Figure 4). At the time, lenders heralded this looser credit as 'innovation', as they borrowed loan features from prime mortgage markets and started to offer them to sub-prime borrowers. In hindsight, it was clearly imprudent to offer these types of loan to weak borrowers, especially in a housing market that looked to be close to its peak.

Most of the sub-prime mortgages underwritten in recent years were in a product called a hybrid adjustable-rate mortgage (ARM, also known as a '2/28' or '3/27'). A 2/28 hybrid ARM carries a fixed rate for two years; after that, the loan 'resets' and becomes an adjustable-rate mortgage (for 28 years).

In the wake of Federal Reserve rate cuts that began in late 2007, the payment shock associated with resetting sub-prime hybrid ARM loans has been greatly diminished. Payment shock occurs when the initial 'teaser' fixed interest rate resets after the first two years of the loan. At that initial reset date, the interest rate resets to the lesser of the fully-indexed rate (which is a specified margin over six-month London Interbank Offered Rate (LIBOR)), and a capped rate (which is a specified margin over the teaser rate). As six-month LIBOR has declined, that fully indexed rate has come down. However, rates will not stay this low in perpetuity - a significant amount of loans will still reach their first reset date over the course of the next two years, as well as loans that have passed their initial reset date but still face subsequent resets over the course of the loan. When rates eventually rise again, the reset rate issue will resurface.

Even at these below-market, 'teased' rates, these loans are heavy burdens for their borrowers. Many borrowers found themselves unable to make payments even before hitting their first reset date, particularly in the current climate of rising job losses and continued declines in home prices. The sub-prime crisis has largely

Figure 3: During the boom, sub-prime profits attracted capital; overcapacity led to irrational competition (in this case, on price)



dried up these borrowers' refinancing ability and the decline in home prices has also made it difficult to satisfy the mortgage simply by selling the property. As home prices (and equity in homes) continue to fall, we expect delinquencies and foreclosures to continue to rise, with or without significant payment shocks relating to reset.

**Impact on home prices will continue to be broad**

As we have said, sub-prime mortgages make up only a small fraction of the US mortgage market. For that reason, many observers felt that this crisis would not broadly impact on home prices to any significant extent. However, the important point is that sub-prime borrowers were the marginal buyers

Figure 4: Product features offered to sub-prime mortgage borrowers

Mortgage product	% of US sub-prime originations, at peak
Interest only	37%
No money down	38%
No proof of income	43%
Low, "teaser" interest rate, "exploding" after two years	~80%
"Layered risk"; combines all of the above*	26%

\* Plus a high debt-to-income ratio and low credit score (600-620), with the exception of LTV, which would have been 90-95 per cent rather than 100 per cent

Source: Deutsche Bank

Figure 5: A slow-moving crisis

Indicator	Comment
↓ Volume of home sales	Nationwide, existing one-family home sales is down 32 per cent
↑ Inventory	California, January '08 inventory of homes at 16.8 months more than doubled since January '07
↓ Home prices	Three indices, all show deterioration ... NAR, OFHEO, CS*
↓ Serious delinquencies on subprime mortgages	In many cases, deterioration at an accelerating rate
↓ Mortgage defaults/foreclosures	This can take a long time ... six to 18 months in good times
↓ Mortgage losses	Loan level loss severity clearly on upswing from 40 per cent levels (eg, 60 per cent recovery rate)
↓ Downgrades of MBS/CDOs	Downgrade methodology somewhat mysterious

\* "NAR," "OFHEO" and "CS" are abbreviations for National Association of Realtors, Office of Federal Housing Enterprise Oversight, and S&P/Case-Shiller, respectively

Source: Deutsche Bank

of housing and as such very much drove market prices. Together with Alt-A borrowers, they made up almost 40 per cent of home buyers in 2006. We believe that in the current environment, the sub-prime borrower will become the marginal seller of housing. Moreover he (or his lender, upon foreclosure) will be a distressed seller.

#### How long will this crisis last?

The market has already priced a great deal of this stress into security values. But this crisis will play out over years. The indicators to watch and our current observations are below.

#### The role of securitisation in the sub-prime mortgage crisis

Securitisation has been in use for over 20 years. As a tool, it allows issuers to diversify their funding base and reach a broader array of investors. Securitisation also played a role in the sub-prime crisis. In many cases it facilitated a misalignment of interests. Moreover, securitisation enabled the development of a synthetic market in sub-prime MBS, which had the effect of multiplying the impact of defaults.

Below we look at the various steps in a representative securitisation. In the first step, the mortgages are originated by a third-party independent mortgage broker, which sold the mortgage to the specialty finance company (banks were generally not heavily involved in the sub-prime mortgage origination business). While the specialty finance company did monitor the performance of brokers' loans, in large measure the mortgage broker had no further exposure to the performance of the loan. Hence, at the very start of the process is a broker which is incentivised to generate as much volume as possible, largely without regard to the credit risk of the loans.

The specialty finance company purchasing the loans had a franchise to protect and therefore had a greater interest in the quality of the mortgage loans being originated. However, with strong demand for the mortgages they created, these originators were able to originate mortgages and sell them for a profit almost immediately. In most cases in recent years, we believe they even sold the equity tranche in most securitisations. Clearly, this made the originators less

**Figure 6: Example of pool losses**

If this many borrowers defaulted on their loan...	and the lender resold the property for...	the loss severity is...	Total "pool" losses would be ...
10%	60 cents	40%	10% x 40% = 4%

**Source:** Deutsche Bank

concerned about the ultimate performance of the loans, all else being equal. Moreover, the mortgage origination business has high operating leverage, so the originators needed to keep volumes high. And with many of them being monolines, they arguably had little choice but to originate whatever loans the market would bear.

The originator pools the mortgage loans together and sells them into a trust, and that trust issues sub-prime MBS. The cash flows that the trust is expected to generate are carved into tranches (slices), each of which has different credit risk (and/or different tenors). The ratings agencies examine the credit quality of the pool of loans and establish the sizing of the tranches required to earn a given rating. The rating is based on a combination of:

- the expected performance of the pool;
- the size of the tranche;
- the size of the credit enhancement backing the tranche; and
- structural features such as performance triggers.

The credit enhancement for a given tranche is designed to absorb any pool level losses. An example of pool losses is shown in Figure 6.

The most important form of credit enhancement is subordination (ie, the existence of tranches 'below', or junior to, a particular bond). Excess spread is also a form of credit enhancement. Excess spread is equal to all of the interest income generated by the pool of mortgages, less the servicing fee on the loans less the total coupon payments due the various bond tranches.

In normal circumstances, excess spread is expected to more than cover all of the pool losses. Therefore, if a given bond had 6 per cent subordination behind it, any

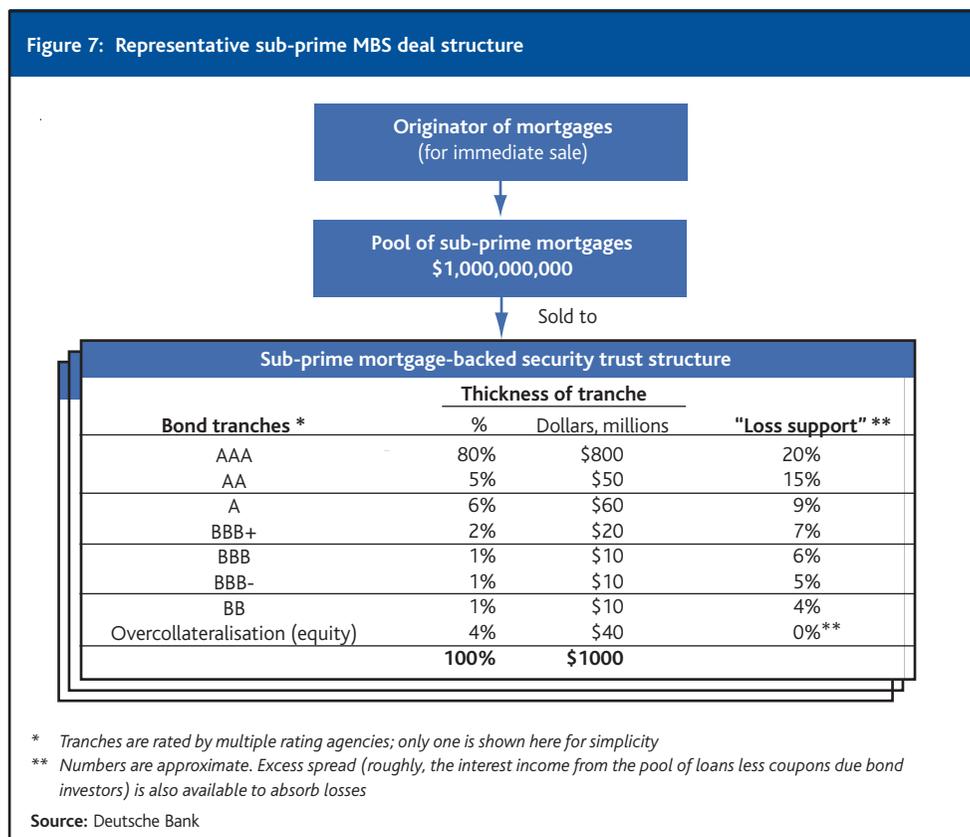
pool losses would need to be so great as to extinguish excess spread and the 6 per cent enhancement before the bond would lose any principal (see Figure 7).

An important aspect of the sub-prime MBS market was the strong demand for subordinated (or 'mezzanine') sub-prime MBS (ie, more junior tranches, in particular BBB and BBB- tranches) from CDO managers. CDO managers bought the majority of these bonds in recent years and traditional cash buyers were largely absent. The reason the bonds were so attractive is that the rating agencies assumed that a portfolio of subordinate mezzanine bonds from various securitisations would not be highly correlated (much as they assume that a portfolio of corporate bonds from various industries are not highly correlated). Because of this assumption of low correlation, pooling sub-prime mezzanine bonds into a CDO structure enabled the CDO manager to create, in essence, new AAA-rated CDO bonds, using only BBB sub-prime MBS. The assumed diversification benefit drove the capital structure of the CDO. It was very attractive for the CDO manager and led to heavy demand for sub-prime mezzanines (see Figure 8).

#### **Why did so many participants acquiesce to such aggressive lending practices?**

First, the entities with the closest contact with the borrower, and presumably the best knowledge of the borrower and the property, had little to no 'skin in the game'. They were driven by volume and in most cases had no ongoing exposure to the performance of the loans. The same could be said of CDO managers, which were able to buy assets, issue CDO liabilities and sell the CDO equity; in return, they increased assets under management and were paid a fee. Of course, all parties

Figure 7: Representative sub-prime MBS deal structure



had reputational risk, but in a challenging and competitive environment, that type of risk carries less weight than risking one's own capital.

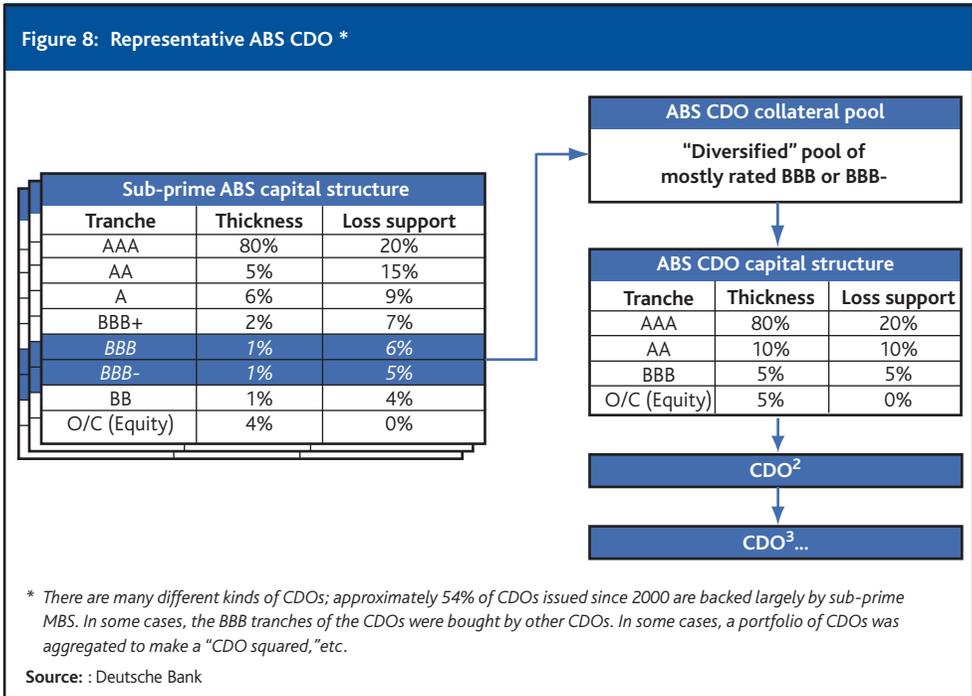
Keep in mind, too, that the vast majority of sub-prime mortgages (approximately 82 cents on the dollar) ended up being rated AAA by at least two and sometimes three ratings agencies. A rough estimate, assuming that the sub-prime MBS was 80 per cent of the total, and that 80 per cent of the BBB tranches were rated as AAA CDOs. Investors that bought triple-A often may not have fully understood the credit risk in the underlying loans or many have felt that, by virtue of their position in the capital structure (and the ratings), they were sufficiently insulated from the mortgages' credit quality. Given the track record of the rating

agencies (which had been very good) and the low spreads being offered, it may have been difficult for securitisation investors to justify the staffing needed for a thorough, independent analysis.

Even equity investors had reason to be less concerned about loan quality. In many instances, the equity exposure to sub-prime MBS is structured so that the cash flows are front-end loaded. Some equity investors believed that their primary exposure was to the timing of losses, not the magnitude, and further believed that for a variety of practical and logistical reasons, it was unlikely that losses would be realised early in the life of the sub-prime loan pools.

In summary, many participants in the sub-prime mortgage, sub-prime MBS and related CDO businesses

Figure 8: Representative ABS CDO \*



\* There are many different kinds of CDOs; approximately 54% of CDOs issued since 2000 are backed largely by sub-prime MBS. In some cases, the BBB tranches of the CDOs were bought by other CDOs. In some cases, a portfolio of CDOs was aggregated to make a "CDO squared," etc.

Source: Deutsche Bank

did not necessarily need to have strong convictions about underlying loan quality. For some participants, it was largely an arbitrage. For many others, they felt the AAA provided sufficient protection. This set of circumstances played a key role in facilitating the origination of sub-prime mortgages that were inappropriately risky.

**How will sub-prime mortgages behave as home prices fall?**

Relatively little applicable history exists on sub-prime mortgage performance because the products offered are relatively new. With the last significant (regional) housing downturn dating back to the early 1990s, we have virtually no experience of sub-prime mortgages in a downturn.

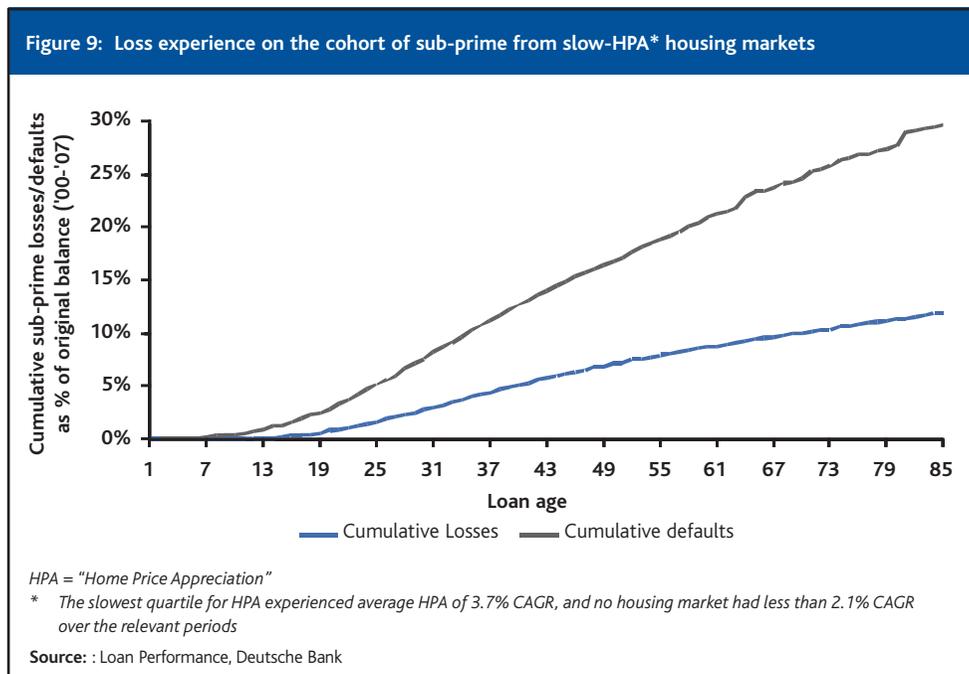
However, we can extrapolate by looking at the performance of sub-prime loans from the weakest housing markets. Specifically, we looked at the defaults and losses on sub-prime mortgages that were originated in those metropolitan statistical areas (MSAs) with the lowest home price appreciation during the 2000-2007

timeframe. We chose those MSAs in the bottom quartile of home price appreciation (HPA) as the best data to examine performance in a weaker housing market. Now, with a credit crunch and falling home prices, 12 per cent losses should clearly be viewed as a 'floor'.

**The contagion**

The crisis, though severe, is limited in the sense that the entire sub-prime mortgage market is only approximately \$1.2 trillion outstanding. If we assume that losses were, for example, 12 per cent (as in Figure 9 above), that is less than \$150 billion. While figures on the size of the synthetic sub-prime MBS/CDO market are not published, we think losses there could be comparable in size to those in the cash market (there will be gains there, too, of course, but the losses are nonetheless a strain). In sum, this is by no means a minor crisis, but one that, on the face of it, does not seem to explain the turmoil we have seen in global markets this year.

Figure 9: Loss experience on the cohort of sub-prime from slow-HPA\* housing markets



The first type of contagion is what we think of as 'fundamental' – that is, contagion caused by concerns over solvency. When investors uncovered the lack of discipline in the sub-prime mortgage niche, they became concerned that there may be other asset types where lending discipline broke down. As a result, risk premiums widened and underwriting standards tightened across many asset classes, in response to the sub-prime crisis. Furthermore, when the market came to accept that the sub-prime crisis would trigger a downturn in US home prices, the concern turned to the consumer and the likelihood of recession. Would the US consumer pull back, causing US recession and thus leading to global recession?

The question as to whether a decline of at least 20 per cent in home prices (peak to trough, nominal), which is what many now forecast, could cause recession probably rests on the consumer confidence impact. Historical data on consumers' marginal propensity to consume out of housing wealth would suggest that the

pullback in spending will not be so severe as to cause recession. However, we really have no experience with significant, nominal, US nationwide home price declines, and thus there is a fair amount of uncertainty around how consumers will react.

Technical contagion, or contagion that affects supply and demand, has also been at work. First, when managers are facing redemptions, withdrawals or margin calls, they often will be forced to 'sell what they can'. In this way, pricing pressure is transmitted from 'bad assets' (eg, sub-prime MBS, which caused the crisis) to 'good assets', since these good assets may be more saleable to meet cash needs.

The other technical contagions in this crisis have been confidence related. Investors have had difficulty determining where all of the sub-prime credit risks actually lie, since they can take many forms and be financed and or hedged in different ways. Without sufficiently detailed disclosure (and some subject expertise as well), it became very difficult to assess who

might be harmed. As a result, markets assumed that the risk was in just about every possible arena. The collective impact of such assumptions meant that the assumed losses were a multiple of reality. Lastly, a crisis of confidence in securitisation ratings further roiled other markets, such as the asset-backed commercial paper market.

### Conclusion

A series of forces coalesced to create an environment in which billions of dollars of overly aggressive sub-prime mortgage loans were originated and securitised and distributed around the globe. These mortgages could perform only in an environment of continued easy credit and rising home prices. That environment no longer exists and millions of those loans will now likely

default. We expect cash losses in sub-prime MBS to be approximately \$226 billion, with a like amount of losses in the synthetic market. The losses are likely to occur over several years. But the impact will likely be broader than sub-prime, as the added supply and withdrawn demand for housing will lead to a widespread decline in housing values, creating a drag on US growth. All consumer credit portfolios will likely see an increase in losses, as the benefits of borrowers' growing wealth had kept their losses near-record lows. But none are likely to see deterioration of the magnitude of sub-prime MBS, where the wrong product was given to the wrong borrower at just the wrong time.

*This chapter is taken from previously published Deutsche Bank research.*