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The Causes of the Financial Crisis[1]

Martin Hellwig*

Introduction

For the media in Germany, the cause of the financial crisis is obvious: Blinded by greed, bank managers thought only about their bonuses and miscalculated badly in betting on American subprime mortgages when the very name of these securities should have alerted them to their risks. If an economist suggests that the matter might be more complicated, he is denounced as a *homo exculpans,* a person who will excuse anything that managers do.[2]

If we look at the numbers, however, we see that there is something more to be explained. According to the Global Financial Stability Report of the International Monetary Fund (IMF) of October 2008, losses on non-prime mortgage-backed securities in US residential real-estate amount to some 500 billion dollars. This figure is both too small and too large.

The figure is too small in the sense that losses of 500 billion dollars by themselves cannot explain why the financial system worldwide has been so devastated by the crisis. Around 1990, losses of savings and loans institutions in the United States were said to amount to some 600 to 800 billion dollars. A decade later, losses on NASDAQ and on the New York Stock Exchange amounted to 1.6 trillion dollars in the calendar year 2000, 1.4 trillion dollars in the calendar year 2001, and again 2.7 trillion dollars in the calendar year 2002. Neither episode caused a worldwide financial crisis.

At the same time, the figure of 500 billion dollars of losses on non-prime mortgage-backed securities is too large in the sense that it cannot be explained by anticipations of losses in debt service from these securities. According to the IMF's Global Financial Stability Report, the volume of non-prime mortgages that have been securitized amounts to about 1.1 trillion dollars. Losses of 500 billion dollars would correspond to a loss rate of 45 percent on these mortgages. If the debtor's down payment amounted to 5 percent, a loss rate of 45 percent on the mortgage would correspond to a depreciation of the property by more than 50 percent. In actual fact, residential-real-estate prices in the United States on average have declined by 19 percent from their peak in the summer of 2006 to the summer of 2008; across metropolitan areas, the maximum for this period was just below 33 percent (Phoenix, Tampa, Miami). To be sure, this "back-of-the-envelope" calculation neglects correlations; it also neglects the possibility that the decline of real-estate prices is still going on. However, this calculation also neglects the fact that, in actual fact, average down payment rates were 6 percent for subprime and 12 percent for "Alt-A", or near-prime, mortgages, and that about two thirds of these mortgages had been granted before 2006, at times when real-estate prices were significantly below their subsequent peaks.

The IMF's loss estimates are not actually based on projections of debt service on subprime mortgages. They are based on market prices for mortgage-backed securities. In some cases, where markets are not functioning any more, they are based on guesses as to what market prices might be if the markets were functioning. The IMF itself points out that these prices may not be good indicators of the returns that can be expected if one is willing to hold these securities to maturity. According to the IMF, therefore, market prices at this point are not a good basis for taking for long-term, value-maximising decisions.

Under *Fair Value Accounting,* however, these market prices are used to value the securities in the banks' books. If, over the past year, banks have forever been "discovering" new losses, the reason is not that bankers are too stupid to know or too devious to reveal what their losses really are. The reason is rather that, week by week and month by month,

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[1] The following text is based on the Jelle Zijlstra Lecture which I gave in Amsterdam on May 27, 2008. The text of the lecture will be published by the Netherlands Institute for Advanced Study. A preliminary version is available at http://www.coll.mpg.de/pdf_dat/2008_43online.pdf.
The Jelle Zijlstra Lecture gives references and sources for all material in this text.
[2] *Frankfurter Allgemeine Zeitung,* October 27, 2008.

market prices have been going down and the banks' losses have become ever larger as market participants have become ever less willing to hold these securities – or less able to hold them.

The financial crisis is not just a matter of excessive lending in subprime mortgages and excessive securitization. To understand the crisis, we need to look at systemic interdependence, i.e. the mechanisms by which the subprime-mortgage crisis spilled over into the rest of the financial system.

The securitization of real-estate finance

Before I turn to the systemic issues, I briefly want to discuss the role of securitization itself. I begin with the proposition that, in principle, the securitization of real-estate loans is a good thing. It would be problematic if the crisis led us to throw the baby out with the bathwater and banned this financial innovation.

Many financial crises in the past have been associated with real-estate finance. The crisis of US savings and loans institutions in the 1980s was initially caused by the fact that, as a result of government regulation, these institutions had provided too much maturity transformation, from short-term deposits to fixed-rate mortgages, and that their assets were insufficiently diversified. Excessive real-estate finance and the subsequent downturns in real-estate markets also were a factor in the banking crises that hit the United States, Sweden, Switzerland, Japan and other countries in the late eighties or early nineties. In these years, Germany did not have a banking crisis, but German banks certainly had their adventures with excessive real-estate lending.

Real estate is problematic because investments are lumpy, economic lifetimes are long, and, in any advanced economy, the total volume outstanding is very large. In most OECD countries, the aggregate value of residential real-estate has the same order of magnitude as the aggregate net value of financial assets; indeed, in many countries, it is higher. The economic lifetime of a house by far exceeds the investment horizon of the ordinary saver. The discrepancy between the economic lifetime of a piece of real-estate and the investment horizon of most savers is a source of risks, refinancing risks if the real-estate investment is financed by short-term borrowing, valuation risks, if the real-estate investment is financed by long-term securities, and the saver wants to liquidate these securities when he needs the money. These risks could be avoided if we chose to live in tents. If we are not willing to live in tents, we must accept the existence of these risks as a fact of life. The only question then is who should bear them.

In the past, these risks used to be borne by financial intermediaries. The US savings and loans institutions financed themselves from savings deposits with maturities of up to seven years and granted fixed-interest mortgages with maturities of up to 40 years. In 1980/81, about two thirds of these institutions were technically insolvent: market rates of interest for all maturities were significantly above 10 percent. To keep their depositors from leaving them and investing in money market funds rather than savings accounts, the savings and loans institutions had to raise their deposit rates so that their own debt service was actually less than the debt service they received from the mortgages that they had issued a long time ago. Equivalently, when discounted at prevailing interest rates, the present values of debt service on long-term mortgages that had been granted in the 1960s were significantly below the nominal values of these mortgages.

Given this experience, the 1980s saw the emergence of adjustable-rate mortgages, under which fluctuations in market rates of interest were passed on to debtors. However, when interest rates were high again, in 1989 and later, lending institutions, in other countries as well as the United States, made the experience that increases in mortgage rates under the given adjustment clauses simply induced debtor default. Moreover, at the high market rates of interest, property values were depressed. In other words, the attempt to have the risk from maturity transformation in real estate be borne by debtors did not turn out to be propitious either.

Securitization of real-estate finance is based on the assessment that neither the financial intermediaries nor the debtors are in a position to carry the risks of maturity transformation in real-estate investment and finance. Securitization provides a basis for passing these risks on to third parties. This makes economic sense if the third parties are better able to bear the risks that are involved. This is true, for example, if the third party is a life insurance company or a pension fund. These institutions usually have liabilities with very long maturities; in principle, therefore, short-term fluctuations in market valuations of assets should matter much less for them than for depository institutions.

It also makes sense for some of the risks of real-estate finance in one country to be passed on to

financial institutions worldwide. Such sharing of risks by many institutions in many countries improves the overall risk allocation by providing for greater diversification of risks for each institution. Public discussion of the losses of German banks from subprime-mortgage-backed securities in the United States often carries an undertone that a decent bank should invest its funds at home rather than abroad. To some extent, this involves the populist notion that "our" banks should lend to "our" firms; to some extent, it involves the notion that, if it invests closer to home, the bank has better information about the risks that it is incurring. The populist rhetoric about "our" banks raises questions about the semantics of the word "our" in a society in which ownership is private, and both the ownership and the control of firms are protected by the rule of law. Whether the creditworthiness of loan clients is more easily assessed closer to home is a matter of dispute; such notions may well be the result of overconfidence bred by familiarity. However, any regulation requiring "our" banks to lend to "our" firms would leave the banks seriously underdiversified. Indeed, non-diversified domestic lending, in particular real-estate lending, played a major role in the banking crises of the late 1980s and early 1990s. The most blatant example was that of savings and loans institutions in Texas where state regulation had required that these institutions limit their real-estate lending to properties in Texas. When the oil price decline of 1985 caused a downturn in the Texan economy, the prices of Texan real estate dropped dramatically, and mortgage borrowers decided that it was better to default on their loans. These events caused a crisis of savings and loans institutions in Texas – about two years *before* the general crisis of savings and loans institutions in the United States began to erupt again.

The operations of *packaging and tranching* that are associated with securitization also make good economic sense. By putting many different mortgages into one package that serves as collateral for a mortgage-backed security, one makes the mortgage-backed security somewhat independent of the risks that are specific to any one mortgage and any one property. The standardization of securities that is thereby achieved provides for their marketability. With packages rather than single mortgages serving as collateral, buyers of mortgage-backed securities have fewer reasons to be afraid of information asymmetries concerning the quality of the underlying collateral.

Tranching, i.e. the issuance of different kinds of debt securities with different priority rankings and equity as the first loss absorber, can in principle reduce adverse incentive effects from securitization. The probability distribution of losses from a portfolio of stochastically independent loans tends to be highly skewed; losses above ten percent are exceedingly unlikely. Debt titles with claims of up to ninety percent of the returns on the portfolio may then be deemed as very safe. Credit risks on the underlying real-estate loans affect mainly the equity tranche. If the equity tranche goes back to the bank that initiated the mortgages, this bank has an incentive to use proper care in its creditworthiness assessments. If instead the equity tranche is retained by the securitizing bank, this institution will impose minimum standards on the mortgages it acquires from the initiating banks.[3]

When mortgage securitization was developed in the United States, the initiating banks were not made liable for the credit risks of the mortgages they issued. This omission initially did not make much of a difference. The securitization was carried out by *Fannie Mae* and *Freddie Mac,* the Federal National Mortgage Association and the Federal Home Loan Mortgage Corporation. These *government sponsored enterprises* guaranteed the debt service on the securities that they issued. At the same time, they imposed minimum standards for creditworthiness of the borrowers whose mortgage were to be taken into a mortgage portfolio for securitization; the term *prime mortgage* designates mortgages for which these minimum standards are fulfilled. For prime mortgages and prime-mortgage-backed securities, expected losses and market write-downs are still quite small: as of October 2008, the IMF assessed the loss rate on these securities at 2 percent.

Because Fannie Mae and Freddie Mac had originally been government institutions and because they still had a privileged position with the US Treasury, many investors believed that they were backed by the government even though, in fact, they had been privatized long ago, and there was no explicit government guarantee. Given this belief, the debt service guarantees that they provided made mortgage-backed securities appear to be very safe.

Following the burst of the stock market bubble in 2000 and the subsequent loss of underwriting activities in stocks, private investment banks discovered that debt securitization held great promises as a new line of business and aggressively moved forward into

[3] An example for this sort of arrangement is provided by the German *Pfandbrief*, a security that is backed by a portfolio of mortgages, where the issuing bank retains full liability for the promised debt service.

this field. Unlike Fannie and Freddie they did *not* provide any debt service guarantees for the mortgage-backed securities that were issued under their auspices, usually through special purpose vehicles that had been created for just this purpose. Moreover, they concentrated on mortgages that did *not* fulfil the quality requirements of Fannie Mae and Freddie Mac, the so-called *subprime* mortgages. In particular, they did not impose lower bounds on down payment rates or upper bounds on debt service to income ratios. Even for consumer credit scores, their standards were below those of Fannie and Freddie.

In these developments, no attention seems to have been paid to the fact that, with the displacement of Fannie and Freddie by the private investment banks and with the expansion mortgage lending and securitization from prime mortgages to subprime mortgages, there was no more check against a deterioration of borrower creditworthiness. The standards used for assessing subprime mortgages were easier to manipulate than the standards for prime mortgages, the private investment banks shunned the sort of liability that Fannie and Freddie had borne, and the initiating mortgage banks never had any liability at all. I suspect that this oversight was partly due to the fact that, by the time the private investment banks entered the field, securitization was seen as an investment banking activity and, cultural differences between investment bankers and loan officers being what they are, investment bankers do not have much of a feeling for credit risk.

The emergence of the "subprime" bubble 2003–2006/07

In 2003 to 2006 the securitization activities of private investment banks' in the area of *subprime mortgages* grew dramatically. By 2006, more than 40 percent of newly granted mortgages belonged to this category, as opposed to 9 percent in 2000; the share of subprime mortgages in the stock of outstanding mortgages had risen from 7 percent in 2000 to 14 percent in 2006. During these years, there was a steady decline in mortgage quality. To some extent, the quality decline concerned observable variables such as down-payment rates or debt service to income ratios. However, econometric studies of delinquencies suggest that the quality decline also concerned unobservable variables; conditional on all observable variables, delinquency rates twelve months after the conclusion of mortgage contracts rose steadily from 2001 to 2006. However, in 2004 and 2005, the reduction in the quality of the borrowers was concealed because increases in real-estate prices induced significant increases in borrowers' equity shares within a year of the conclusion of the mortgage contract.

After a period of stagnation in the 1990s, real-estate prices in the United States had increased by about 9 percent per year from 1999 to 2003, then by almost 14 percent from 2003 to 2004 and by almost 16 percent from 2004 to 2005. It is probably not a coincidence that the jump in the rate of real-estate appreciation in 2003 occurred at the very time when the private investment banks began to move aggressively into the mortgage securitization business.

It is probably also not a coincidence that this expansion occurred at a time when monetary policy in the United States was very loose and the yield curve was very steep. From 2002 to 2004, interest rates in US money markets were significantly below 2 percent, as opposed to 6 percent in 2000 and 4 percent in 2001. Long-term interest rates had also fallen, but much less than short-term rates: the interest for ten-year Treasuries fell from around 6 percent in 2000 to just over 4 percent in 2003–2005, the mortgage rate for fixed-rate *prime* mortgages fell from around 8 percent 2000 to just under 6 percent p.a. in 2003–2005. The excess of this mortgage rate over the interest rate in the money market thus moved from 200 basis points (2 percentage points) in 2000 to over 400 basis points (4 percentage points) in 2003–2004.

The *risk premium* for fixed-rate *subprime* mortgages had been at 300 base points in 2001 and fell to 100 base points in 2004. This decline in the risk premium for subprime mortgages is all the more remarkable because, as mentioned above, it coincided with a decline in the quality of subprime-mortgage borrowers.[4] At the same time, there was no comparable decline in the risk premia for lower-rated corporate bonds.

These observations suggest that the entire development was supply-driven rather than demand-driven. The aggressive move of private investment banks into the business of securitizing subprime mortgages contributed to the lowering of risk premia even without of any general change in risk appetites. Investors in search of high yields were happy to make more and more funds available for housing finance in the subprime segment of the market. These investors did

[4] The number of cases of fraud in connection with new mortgages grew fivefold from 1996 to 2005; in 2003 the growth rate was 77 percent, in 2004 93 percent.

not impose any "market discipline", i.e. quality standards that would have forced the securitizing investment banks and the initiating mortgage banks to address the problem of creditworthiness of the final borrowers.

Who were these investors? Three groups are of particular interest:

- Most equity tranches ended up with hedge funds and investment banks that were hungry for high yields, as the phrase went. Little thought seems to have been given to the implications of the marketing of equity tranches on the originating and/or the securitizing institutions' incentives.
- The so-called *mezzanine tranches,* subordinated-debt tranches, were being acquired by investment banks that wanted to use them as collateral in a second round of securitization, creating the so-called MBS CDOs, collateralized debt obligations that were backed by mortgage-backed securities. In this second round of securitization, debt securities with different priority rankings and equity as a first loss absorber would be issued against a portfolio of (mezzanine) mortgage-backed securities. One purpose of this operation was to obtain additional funds even for subordinated-debt tranches of mortgage-backed securities: if the credit risks in, say a portfolio of BBB-rated mezzanine securities were deemed to be sufficiently independent, the "super-senior tranche", i.e. the debt with the highest priority ranking against this portfolio, might be given a AAA rating and might thereby be eligible for inclusion in the portfolios of institutional investors, like certain insurers, that were required to invest only in AAA-rated securities. European banks, whose access to the initiating mortgage banks was worse than that of their American counterparts, were particularly active in this second round of securitization, which they saw as an opportunity to get a share of the action.
- Many of the securities that were produced by the different rounds of securitization were acquired by special entities, the so-called *conduits and structured investment vehicles* (SIVs), which banks in Europe as well as the United States were using to acquire and hold such securities without having to back them up with equity capital. These special entities had virtually no equity capital of their own. Moreover, they financed themselves by issuing asset-backed commercial paper, debt securities with maturities of one year or less.

To me as an outside observer, it is remarkable that the different participants seem to have been entirely focussed on yields, apparently without paying much attention to risks. Questions about incentives and liabilities in origination and securitization did not receive much attention. The rating agencies' assessments of the different securities were not questioned. Indeed, there seems to have been no concern that ratings of AAA on different securities must mean different things if the interest rates on these securities differed by fifty or so basis points.

The assessments of mortgage-backed securities by the rating agencies seem to have been fundamentally flawed. The agencies seem to have assumed that problems of borrower creditworthiness would be defused by continued increases in real-estate prices – partly because such increases would raise the borrowers' stakes in their properties and partly because they would improve the protection that the properties serving as collateral were providing to lenders. In assuming that real-estate prices would continue to rise, they failed to see that some of the reasons for the increases that had occurred, in particular the lowering of interest rates from 2000 to 2003 and the inflow of funds into these markets that was due to the development of subprime-mortgage securitization, were one-time changes that would not be repeated, and that, therefore, an extrapolation from past and current real-estate price increases into the future was unjustified.

The agencies also seem to have neglected the *correlations* of credit risks that were caused by the dependence of all mortgage contracts on common factors such as changes in market rate of interest and changes in real-estate prices. Neglect of correlations is the only reason I can see for why, in the assessment of MBS CDOs, they would have given an AAA rating to the super-senior tranche on a package of BBB-rated mezzanine securities. However, correlations came into play when interest rates again began to rise and real-estate prices began to fall.

Systemic risks in the crisis

Beginning in 2005, US monetary policy became more restrictive, with some caution at first and then very strongly, so that interest rates in US money markets moved back to around 5 percent in 2006 and 2007. Real-estate prices continued to rise from 2005 to 2006, albeit at a slower rate of 7.5 percent; in the summer of 2006, they began to fall, first slowly, at 3.6 percent from 2006 to 2007 and then at 15.3 percent from the summer of 2007 to the summer of 2008.

When real-estate prices began to fall, delinquency rates increased dramatically. The impending difficulties in subprime mortgages and mortgage-backed securities were quickly recognized, but, prior to August 2007, hardly anybody appreciated the implications for the overall financial system. In April 2007, the Global Financial Stability Report of the International Monetary Fund provided a detailed description of the crisis in subprime-mortgages and subprime-mortgage-backed securities, but ended with an assessment that the crisis was unlikely to spread to other parts of the financial system. In June 2007, the Annual Report of the Bank for International Settlements provided a similar assessment.

In August 2007, however, the crisis of subprime mortgages and subprime mortgage-backed securities did turn into an international financial crisis. The triggering event was the downgrading of a large set of mortgage-backed securities by the rating agencies, some of them by three grades at once, something that was almost unheard of for corporate bonds. This downgrading had an immediate impact on the market prices of these securities. Even more importantly, it made market participants wake up to the fact that these securities were much less safe than had been thought to be, not just in terms of the underlying credit risk but also in terms of market risk associated with the downgrading and the system's reaction to this downgrading.

This first surprise was almost immediately followed by a second surprise. Lagging debt service on certain mortgage-backed securities and declines in these securities' prices after the downgrades caused losses at institutions holding them. For some of these institutions, these losses caused problems for solvency and for refinancing. Hardest hit were a few hedge funds and various special entities, the *conduits* and *structured investment vehicles* (SIVs), which European and American banks had used as instruments for investing in mortgage-backed securities without increasing the amount of capital that they had to hold in order to meet regulatory requirements. These entities had practically no equity capital; they invested in asset-backed securities and refinanced themselves by issuing commercial paper. Given the lack of equity capital, the initial declines in the prices of mortgage-backed securities wiped out their solvency and took away their access to the commercial paper market. Pledges of liquidity provision in case of need that they had previously been given by the sponsoring banks were then called in. However, not all of these pledges were honoured, some of them were insufficient to entirely refinance the conduit or SIV in question, and, given the losses that had already occurred, some of these pledges exceeded the sponsoring banks' own capacities to absorb losses. For Industriekreditbank and Sächsische Landesbank, for instance, liquidity commitments to conduits amounted to more than four times and ten times the bank's equity!

Whereas the existence and use of conduits and SIVs had always been known, hardly anybody appreciated the scope of their activities. *Ex post,* their holdings of asset-backed securities have been estimated at 1 trillion dollars as of July 2007, almost equal to the total outstanding volume of securitized subprime mortgages (1.1 trillion dollars), over 17 percent of the volume of all securitized residential mortgages in the United States. The information that such a large part of the outstanding volume of mortgage-backed securities had been financed by issuing short-term commercial paper and that this refinancing mode was no longer available came as a second surprise. This second surprise very much magnified the impact of the first surprise, the drastic downgrading of mortgage-backed securities by the rating agencies. Either surprise on its own would have required a significant adjustment of market prices. Coming together, their consequences were all the more dramatic.

The surprises that had just been experienced contributed to an atmosphere of mutual mistrust. The solvency problems of conduits and SIVs and of the banks that had sponsored these institutions raised the question of who else might be involved. As a result of such mistrust, interbank lending was much reduced; indeed, since August 2007, there have been recurrent instances when interbank markets stopped operating altogether, and central banks were the only institutions providing liquidity.

Given this mistrust of investors, institutions like investment banks and money market funds that had been used to refinancing themselves by short-term securities now had to make provisions for the event that their financiers might cease funding them. Money market funds did so by moving out of commercial paper and into government securities, from cash to short-term Treasuries; investment banks also tried to shift from less liquid to more liquid assets. This left little room for buying mortgage-backed securities, even though the prices of these securities might have dropped much more than the discounted present values of expected debt service on the underlying mortgages.

Given this atmosphere of apprehensiveness and mistrust, in response to the twin surprises of August

2007,[5] the international financial system has inexorably moved in a downward spiral. At times, the spiral has been slowed down by central banks providing liquidity to the system. However, as long as the issue of solvency of participating institutions was not addressed – and the downward spiral itself went on exacerbating this issue, there was no prospect of the spiral ending. The subsidies and guarantees that governments in the United States and Europe have provided after the fiasco created by the insolvency of Lehman Brothers may provide such a prospect – *if* these guarantees are indeed sufficient to eliminate doubts about financial institutions.

The downward dynamics have been driven by the interplay of following factors:

Market Malfunctioning: The prices of many asset-backed securities have gone down much more than expectations of future debt service or foreclosure proceeds would seem to warrant. This explains the discrepancy, mentioned in the introduction, between the estimated losses of 500 billion dollars on these securities and the losses that would be anticipated on the basis of actual developments in real-estate markets. There are few buyers for these securities; some markets have become inactive altogether. Even where markets have remained active, following the twin surprises of August 2007, maturity premia and risk premia have risen and prices have declined dramatically. The lack of buyers is due partly to investors feeling too weak to take on new commitments, partly to their expecting the price declines to continue, and partly to their being afraid of adverse selection. Akerlof's "lemons" problem, whereby, in the presence of asymmetric information about quality, the average quality that is put up for sale is worse than the average quality outstanding, is relevant for used securities as well as used cars.

Accounting Rules: Many financial institutions have treated asset-backed securities as market risks, rather than credit risks, because this allows them to determine capital requirements on the basis of their own internal models. For these risks, they must follow the principle of *mark-to-market* or *fair value accounting.* Under this principle, declines in market values must immediately enter the banks' financial statements. In cases where markets have ceased to function, the financial statements are based on estimates of what the market prices would be if the markets did function. This accounting regime is very different from traditional accounting for assets in the banks' credit books. If the bank declared that it was going to hold these assets until maturity, it could disregard fluctuations in market values. Write-downs would be determined by doubts about future debt service rather than market prices. To the extent that market prices are deemed to provide measures of value that are more "objective", less at the discretion of the banker, this difference may be seen as an advantage of fair value accounting over traditional accounting for credit risks.[6] However, if market prices are driven by panic and fears of a liquidity shortage, fair value accounting may be providing the bank with the wrong signals on which to base its strategy.

Insufficiency of "free" equity capital: In their quest for high rates of return on equity, many banking institutions had greatly expanded their operations relative to their equity base. They had little or no equity in excess of regulatory requirements. Fair value accounting and regulatory requirements being what they are, losses from declines in the market prices of assets required the banks to react immediately, either by recapitalizing or by "deleveraging", i.e. by selling assets. By deleveraging, they put additional pressure on asset markets and on other institutions that were faced with further price declines.

Insufficiency of regulatory capital: Banks were also economizing on regulatory capital. Using the model-based approach to determine regulatory capital for market risks, some of the most sophisticated institutions had managed to reduce their equity to a small fraction of the balance sheet, in the case of UBS somewhere between 2 and 3 percent. At such low levels, it doesn't take much of an asset price decline to raise doubts about solvency. Even if solvency is not of an issue, deleveraging needs are likely to by quite drastic.

It is important to appreciate the role of capital adequacy requirements in the downward spiral. Whereas past studies had discussed pro-cyclical effects of capital regulation in terms of macroeco-

[5] I am treating the breakdown of maturity transformation by conduits and SIVs as an "independent" surprise. While this breakdown was triggered by the downgrades of subprime-mortgage-backed securities, financing structures of these institutions were so unhealthy that some other shock, e.g. a general increase in interest rates, would have had the same effect.

[6] Thus, for a long time in the nineties, Japanese banks did not write down their loan portfolios even when it was clear that many of the loans in these portfolios were bad; this failure to acknowledge losses delayed the cleanup of the crisis and thus contributed to the prolonged recession in Japan. In the early eighties, US savings and loans institutions kept long-term, fixed-interest mortgages at face value in their books, even though, at the double-digit market rates of interest, the discounted present values of debt service on these mortgages were much lower. Thereby they concealed the fact that they were technically insolvent and gave themselves the opportunity to "gamble for resurrection", with the consequence that the cleanup after 1990 was much costlier than a cleanup in 1981 would have been.

nomic *flows* of aggregate demand, corporate revenues, corporate borrowers' debt service, bank profits, new loans and aggregate corporate investment, in this crisis, we have seen pro-cyclical effects of capital regulation on *stocks* of assets and liabilities in the bank balance sheets. Asset prices declines that induce write-downs automatically eat into the banks' capital. Under a mechanical regime of capital adequacy regulation, the bank is forced to sell asset, possibly even to realize book losses that are not matched by losses in the present values of future returns on the securities in question. The bank's asset sales induce further declines in asset prices and put additional pressure on other banks.

Financial developments since August 2007 have been driven by the interplay of price declines in malfunctioning markets, fair-value accounting, capital requirements, and deleveraging. At times, the downward movement has accelerated, sometimes because individual banks ran into trouble, sometimes because, once again, interbank markets broke down. On these occasions, liquidity assistance from central banks, to individual institutions or to the market as a whole, has brought some relief, but was unable to stop the downward movement as such. Whenever market participants and the media proclaimed that the worst of the crisis was over, the next problem would appear on the horizon.

At last, the insolvency of Lehman Brothers had such repercussions for other institutions (AIG) and for asset markets worldwide that governments in the United States and Europe and, ultimately, the taxpayers have become involved. We can only hope that this government involvement will suffice to stop the downward spiral and to help rebuild confidence among the actors in the financial system. This is by no means certain, however.

In the introduction, I asked why the losses from subprime-mortgage lending have disrupted the entire financial system worldwide. The answer to this question lies in the interconnectedness of the system and in the interplay of the factors that I have described. Because of these systemic interactions, the twin surprises of August 2007 induced a gradual implosion of markets, prices and institutions that even the central banks' interventions could not bring to a stop.

Whose fault was it?

In assessing these developments, it is important to distinguish between individual misbehaviour and faulty system design. *Individual misbehaviour* involves choices that end up harming the individual or institution that have taken them. By this, I do not mean choices that turned out badly *ex post* because of bad luck, but choices whose flaws should have been obvious *ex ante*. *Faulty system design* involves institutional arrangements and regulatory rules that lead to undesirable results, for the institutions that are involved or even the financial system as a whole, when individuals pursuing their own interests are subjected to these arrangements and rules. The question of who was responsible arises for flaws in system design as for individual misbehaviour, but it arises at another level, the level of regulatory design rather than any specific actions.

By this logic, the insufficiency of creditworthiness assessments by originating banks in subprime lending would be deemed to be a matter of faulty system design rather than individual misbehaviour. Because the originate-and-distribute system of mortgage securitization had been designed so that the originating banks had no liability, these banks had no reason to spend more than a minimum of resources on creditworthiness assessments. The fact that they had no liability, however, was an instance of faulty system design.

As the genesis and the evolution of the crisis have been described above, the following instances of *misbehaviour* seem to have played a role:

- Investment bankers focussing on growth and market shares in securitization ignored risks. To be sure, once they sold the securities they would no longer be liable. However, in the crisis, the losses just from "warehousing" securities in the process of securitization turned out to be enormous.
- All sorts of investors, individuals, private universities, foundations, German public banks, American and Swiss investment banks were so much concerned about yields that they neglected the associated risks and failed to ask why a mortgage-backed security with a rating of AAA was paying more interest than a corporate bond with the same rating.
- These investors also failed to think through the implications of liability rules for incentives in origination and securitization.
- Risk control and risk management in the large investment banks that were involved in securitization and/or holding mortgage-backed securities failed to provide comprehensive analyses of their institutions' risk exposures from these securities,

taking into account the joint dependence of securitization as a business and of the returns on securities held on the movements of residential real-estate prices in the United States and on the factors that were driving these movements.

- To the extent that credit risks were hedged, risk control and risk management did not pay attention to the possibility that, because these risks were highly correlated, their counterparties, monoline insurers or institutions like AIG, might go under at the very time when they would be called upon to substitute for the defaulting borrowers.
- The *rating agencies* also failed to develop an adequate, comprehensive and timely understanding of the relevant risks and the correlations between these risks taking into account their joint dependence on movements in underlying factors.
- *Conduits* and *SIVs* were engaging in excessive maturity transformation. Not having any equity worth mentioning, investing in long-term assets, and refinancing through the money market would be a sure recipe for disaster even if the long-term assets were not subject to credit risk but "only" to interest rate risk. The risks of such maturity transformation should have been known to any professional banker.
- By the same token, the risks that the pledges of liquidity assistance to *conduits* and *SIVs* imposed on the sponsoring banks should have been obvious to any professional banker. As an outsider, I suspect that these pledges were not compatible with large-exposure regulation limiting lending to any one client. Perhaps, the public prosecutors should take a closer look at this.
- Finally, mention must be made of the looseness of monetary policy in the years 2002 to 2004. The low money market rates and steep yield curves that the United States had in these years made borrowing short to lend long appear to be very attractive and contributed to the push of US investment banks into the business of securitizing subprime mortgages. The Federal Reserve Bank should have known that this constellation was bound to make the financial system vulnerable, so that a reversal of monetary policy would be difficult to achieve without endangering financial institutions. After all, this is what happened when the liquidity flush of 1988 was followed by the restrictiveness of 1989 and when the expansionary policy of the years after 1990 was ended in 1994.

The following *flaws in system design* were also important:

- The decline in the quality of subprime mortgages was at least partly caused by a lack of incentives for originating mortgage banks to spend resources on creditworthiness assessments. Incentives were missing because (i) the originating banks did not carry any liability and (ii) the securitizing private investment banks – unlike Fannie Mae and Freddie Mac – did not impose strong quality standards of their own.
- The failure of the securitizing private investment banks to impose strong quality standards of their own was due to their not being liable either – unlike Fannie Mae and Freddie Mac. Their failure to provide guarantees was possible because hedge funds were willing to buy up equity tranches – presumably satisfying the demands of final investors hungry for yields.
- The failure of the securitizing investment banks to impose strong quality standards was also supported by the willingness of other investment banks to buy up mezzanine securities for a second round of securitization (MBS CDOs). Apparently, these other investment banks cared more about market shares in the securitization business than about the credit risks in mezzanine securities. Incentives for investment banks in the second round of securitization to impose quality standards were just as deficient as for investment banks in the first round of securitization. For the economist, it is not evident that the second and higher rounds of securitization served any useful purpose – except of course, to get additional AAA ratings so as to attract additional investors that were required by regulation to invest only in AAA-rated securities.
- The absence of any regulation or supervision for *conduits* and *SIVs* and for their relations with the sponsoring banks implied that the extent of maturity transformation by these institutions was by and large unknown. When this became known in August 2007, it contributed greatly to the shock, perhaps even more than the unexpectedly large downgrading of the subprime-mortgage-backed securities as such.
- Private-sector banks had significant governance problems. Internally, they were unable to subject their investment bankers to effective risk control. Externally, in relations with shareholders, analysts, and the media, the mechanisms that support "market discipline" in order to enhance "shareholder value" were biased towards yields with little concern for risk. When Deutsche Bank was claiming that a 25 percent rate of return on equity was the *benchmark* for modern banking institutions, it raised protests among labour unions

militating against layoffs, but *not*, it seems, by financial analysts suggesting that this benchmark might be an indication of undercapitalization and demanding that the bank provide information about the risks associated with this benchmark. Moreover, the mechanisms that support "market discipline" in order to enhance "shareholder value" do not pay much attention to risks that will be borne by others than shareholders, i.e. to risks that affect the banks' creditors or the taxpayer when he is called upon to save the bank.

– German public banks had even greater governance problems. Whereas private investors and banks may have been suffering from yield mania, these public banks were caught up in a yield *panic*. When interest rates and intermediation margins are low, and you do not have much of an established business model, when the implicit public subsidies that you used to get in the past have just been outlawed by the European Commission, where do you get the returns you need in order to cover your operating costs and to satisfy the demands of the politicians? For these banks, mortgage-backed securities looked like a God-sent remedy, especially when refinanced at 1 percent in the American money market. For the politicians sitting in these banks' supervisory committees.
– The portfolio managers and risk managers of institutional investors cannot be blamed for not having taken into consideration the system risk exposure that was created by maturity transformation in *conduits* and *SIVs*. After all, they did not and could not know the extent of this maturity transformation. They can be blamed, however, for not having paid enough attention to the possibility that there might be a major risk that their risk models had not captured. I see this as a problem of system design rather than any specific misbehaviour. Common experience suggests that there are always matters outside one's horizon of analysis; any system of risk management must address such eventualities and consider how to make provisions for them.
– The preceding point concerns the system of banking regulation as well as the system of risk management at the level of the individual bank. When they allowed the banks to determine their regulatory capital for market risks exclusively on the basis of their own quantitative risk models, the regulators – like the bank managers – neglected the possibility that important risks might not have been captured by the models.
– The very mechanical approach to capital regulation that we have under the Basel Accord has greatly contributed to the interplay between malfunctioning markets, fair value accounting, capital requirements, and deleveraging that has driven the implosion of the system since August 2007. If overall capital requirements had been higher, the multipliers would have been smaller. If the application of the regulation would have left more scope for discretion with respect to the speed of deleveraging, the systemic impact of the regulation would have been cushioned even more.
– Banking regulation and supervision must be criticized for their lack of systemic thinking. They tend to think about the solvency of the individual institution and the protection of its investors in isolation. Yet, the survival of the institution also depends on its systemic environment. The fact that hedge funds, *conduits* etc. were not subject to any reporting requirements makes sense if we think about these institutions in isolation and consider their investors to be sophisticated enough and important enough to fend for themselves. It does not make sense if we think in systemic terms about the roles of these institutions as counterparties in the securitization business or about the impact of their failure on asset prices and all the institutions that are thereby affected. Deleveraging, i.e. the sale of assets after a loss, can make sense as a way of adapting the bank's risk exposure to its reduced equity,[7] but it is counterproductive if the induced decline in asset prices requires other banks to deleverage as well, with additional price effects that hit right back at the first bank.

At this point, most politicians seem to be agreed that financial supervision must be expanded and strengthened. However, there are few signs indicating that the politicians appreciate the extent to which not just the lack of supervision over hedge funds, conduits and SIVs, but also the very mechanics of the system that is imposed on banks has contributed to the financial crisis. If we are to prevent a recurrence of such a systemic implosion, we need to address this problem as well. For this purpose, the conceptual foundations of banking regulation and supervision must be altogether reconsidered.

[7] Even here, there is a possibility that the realization of losses through a fire sale in a malfunctioning market may destroy the viability of the bank in the medium run.