Panel Discussion – Statements and Comments

Capital Requirements for Market Risks Based on Inhouse Models – Aspects of Quality Assessment

MARTIN HELLWIG and MARKUS STAUB

1. INTRODUCTION

In order to make possible an intensified exchange of views, the last two hours of the conference were devoted to a Panel Discussion. Panel participants were:

- CHARLES FREELAND, Bank for International Settlements (BIS)
- ROBERT GUMERLOCK, Swiss Bank Corporation (SBC)
- MARTIN HELLWIG (Chairman), Universities of Basle and Mannheim
- WERNER HERMANN, Swiss National Bank (SNB)
- SAMUEL THEODORE, Moody's Investors Service Ltd.
- DANIEL ZUBERBÜHLER, Swiss Federal Banking Commission (EBK)

In the following an attempt is made to summarize the discussion. We are conscious of the fact that such an attempt will never be perfect.

In the first part of the Panel, the participants presented their personal views in statements of about 10 minutes. The written versions of these opening statements are reprinted below. The second part consisted in a general discussion. This twofold structure is maintained in the following summary.

2. OPENING STATEMENTS

Martin Hellwig

1. In terms of concepts as well as procedures, the 1996 Amendment to the Capital Accord to Incorporate Market Risks represents a significant departure from previous approaches to regulating bank capital. Conceptually, the notions of risk employed are much closer to the economists' notion of risk than, e.g., the 1988 Basle Accord or the 1993 proposals; this concerns in particular the treatment of correlations between different sets of risks. Procedurally, the regulators' willingness to rely on the banks' own procedures for measuring risk is a remarkable innovation, amounting to an official recognition that methods of risk measurement are in flux and perhaps

the procedures used by financial institutions themselves are more suitable than anything drawn up by a regulatory committee.

2. Whenever a measuring rod is used to regulate behaviour and to influence economic payoffs, one must worry about the problem of manipulation. So far, inhouse models of risk have served just for the banks' internal assessment of risk exposure and risk management policies. With the Amendment to the Capital Accord, they also serve to determine the banks' capital requirements. This raises the prospect that banks may find it desirable to develop models which serve not just for risk assessment and risk management but which serve also to minimize required capital, or, since you don't usually pursue two objectives optimally with one instrument, to develop models which serve to pursue some weighted average of these two objectives. Possibly they may also develop two sets of models, one for their own risk management and one for the regulators.
   This being said, it should be clear that the incentive problems associated with inhouse models as a basis for capital regulation are not necessarily worse than the incentive problems associated with a rigid standard of exogenously set risk weights. There is, e.g., empirical evidence that the 1988 Basle Accord has affected risk in bank portfolios by providing incentives to shift from loans to mortgages where the actual riskiness of mortgages in comparison to loans was rather higher than was suggested by the 1:2 ratio of their risk weights under the Basle Accord.
3. The 1996 Amendment to the Capital Accord does not actually provide a standard for what is a «good» model. It sets out risk categories that must be considered at a minimum, but it does not specify standards for measuring these risks. It is most explicit in its description of inhouse procedures that must be in place if an inhouse model is to be accepted as a basis for calculating a bank's required capital. This corresponds to the monitoring of inputs rather than outputs of the model building process. Output monitoring is provided for at the level of «backtesting». However (i) the criteria used are not unproblematic, and (ii) in recognition of this the implications of failing to meet the criteria are vague and very much at the discretion of the regulatory authorities.
4. It is probably a good thing that the 1996 Amendment to the Capital Accord does not attempt to provide a standard for what is a «good» model. Quantitative estimation of risk is a matter for which there exist no hard and fast rules except under certain assumptions about the underlying stochastic processes, most of which are likely to be unrealistic. The Supervisory Framework for the use of «backtesting» illustrates the difficulties: The framework looks at a year with 250 trading days as a set of 250 independent experiments. In this setting the question is whether the bank's 99th percentile risk measures truly cover 99% of trading outcomes. The problem of model quality assessment is thus reduced to a standard problem in statistical decision theory, namely to trade off type I vs. type II errors in assessing whether in a 250-fold repeated binomial experiment the underlying probabilities are indeed 99% and 1%. This approach has the following problems:

- If the underlying processes are nonstationary, the meaning of this «backtest» and its implications for assessing the model's usefulness in the future are unclear.
- To reduce the problem to a binomial one, one disregards information contained in loss sizes; from the economic point of view, an assessment of risk may require not only an assessment of whether the observed percentage of outcomes covered by the risk measure is consistent with a 99% level of confidence, but also what is the nature of outcomes in the remaining 1% of instances.

5. The Basle Committee's «Framework» does not seem to recognize the fundamental conceptual difficulties of doing statistical inference in a nonstationary world. It sticks to the notions of «accurate» and «inaccurate» models – with type I and type II errors of incorrect model assessment – when the whole notion of an «accurate» model itself may be unsuitable. Recognition of the fact that there may be a problem then induces a lot of flexibility in recommended responses to «problem outcomes», including the attempt to provide «explanations» of exceptions, e.g.,
   - «Bad Luck» or markets moved in fashion unanticipated by the model:
   - Random chance
   - Markets moved by more than the model predicted was likely (i.e., volatility was significantly higher than expected)
   - Markets did not move together as expected (i.e., correlations were significantly different than what was assumed by the model).

   The combination of standard statistical decision theory applied to an inappropriate model with ad-hoc assessments of problem cases does not strike me as a useful procedure exept that it allows the Basle Committee to provide a simple, one-page table to determine intervention zones for the regulatory authorities. Proper statistical procedure would have attempted (i) to eliminate nonstationarity as much as possible, (ii) to quantify estimation risks including estimation risks for variance and covariance measures as well as portfolio risks and then (iii) to apply «backtesting» on a comprehensive basis.
6. The 1996 Amendment to the Capital Accord provides a fair amount of leeway to regulators in how they assess inhouse models and how they respond to problems at the backtesting stage. This raises two serious issues:
   - What personel do they have to handle these issues? In principle, the personel would seem to need a fair amount of expertise in (i) financial-markets theory and applications, including derivative pricing and hedging techniques, (ii) sophisticated time-series estimation techniques. This expertise is scarce, and is handsomely rewarded in the market. I do not see, e.g., the Swiss Federal Banking Commission acquiring a staff that would match the expertise assembled at one of the large banks; nor do I see the New York Fed – or any other governmental US institution – trying to match the expertise assembled at Morgan Guaranty.
   - What incentives do they have to actually tackle problems that arise? The issue is well known from relations between certified public accountants and industry; there is little reason to believe that public regulatory bodies faced with a problem

and having a lot of leeway in what to do about it would be much tougher than the CPAs. Indeed the handling of the Daiwa case by the Japanese authorities suggests that regulatory capture may be just as much of a problem as the CPA's desire not to lose an account.

7. We are left with the paradoxical conclusion that on the one hand the regulatory community sees a need to regulate risk in banking but on the other hand it is entirely dependent on the risk measurements provided by the banks themselves. I share the view of many practicioners and academics that risk measurements developed by financial institutions interested in surviving are probably more useful than exogenously set risk weights; even so I see a potential conflict of interest. The rules set out by the Basle Committee for qualitative standards of inhouse models recognize this when they require, e.g., that the bank have an independent risk control unit to design and implement the bank's risk management system, that this unit be independent from business trading units and should report directly to senior management. However why should we believe in the integrity of senior management in its dealings with the risk control unit if at the same time we believe that senior management is not to be trusted to manage risks appropriately unless it is subjected to a capital adequacy requirement? Alternatively why do we need to impose capital adequacy requirements on a bank whose senior management we trust enough to have complete confidence in how they deal with their risk control unit?
8. The preceding remark is not intended as a plea to turn away from the use of quantitative models of risk exposure. For all the difficulties involved in how to assess such models, there seems to be no reasonable alternative to using them. Perhaps though one should make a case for even more of an arm's length relation between the model development unit and bank management, say along the lines of the «arm's length relation» between the CPA and its client (with all the necessary caveats). Can we think of «risk assessment» as an independent branch of economic activity? The point is to avoid (i) the setting of hard-and-fast rules for how to do things when such rules are as yet (?) inappropriate and (ii) the arbitrariness involved in having banks assess their own risks just as they please.
9. While most of the preceding discussion has concentrated on incentive problems in the relation between banks and regulators, the experience of the past two years suggests that incentive problems inside the bank, more precisely, fraudulent reporting, may be even more of a problem. The qualitative standards for banks computing capital requirements on the basis of inhouse models list integrity and accuracy of data and information systems as important elements of the overall risk management process; cases like Sumitomo, Daiwa and Barings suggest that this may be a pious wish, especially if at a critical moment senior management finds it convenient to overlook the fact that the integrity of internal reporting systems has been impaired. Given that fraud and theft inside financial institutions are as old as the financial sector itself, one may wonder how robust risk measurement and risk assessment are to such occurrences.

10. Turning from procedural aspects of the new regulations to substantive aspects, I am not convinced that the value-at-risk approach captures the essence of risk in banking. To see the issue, consider a bank which holds just cash. From the perspective of the value-at-risk approach, this bank is perfectly safe, even without capital. At the same time, the bank's returns do not cover its operating costs, so it is sure to go bankrupt eventually. Going beyond this somewhat absurd example, I note that the short-term value-at-risk approach identifies interest rate risk with the valuation risk of securities having long-term maturities. It neglects the reinvestment opportunity risk associated with securities having short-term maturities. This reinvestment opportunity risk is relevant whenever asset returns are needed to cover expenses that cannot be made contingent upon these returns, e.g., labour costs. In practice in the past twenty years, valuation risks have played a bigger role but this does not mean that reinvestment opportunity risk is irrelevant. A more comprehensive approach to risk in banking, taking account of the evolution of the bank's accounts as a whole, seems called for.
11. Continuing on the theme of comprehensiveness of the approach one takes, the combination of the 1996 Amendment with the 1988 Basle Accord seems a bit schizophrenic. While I appreciate the practical difficulties of approaching credit risk within the same conceptual framework that is now used for market risk, I do consider the separation of the two risk categories to be problematic. This is especially the case where «credit risks» and «market risks» are correlated, as they must be, e.g., in the case of interest rate derivatives where the probability that my partner cannot pay is likely to be highest in those events where he has to pay a lot, i.e., in those events against which I want the insurance from him.
12. Development of a comprehensive model for credit and market risks is likely to exacerbate the methodological problems involved in developing quantitative estimates of risks. After all default is not the realization of a continuous random variable (with a normal distribution); it is a discrete event, the realization of which tends to come about with a certain delay as one's partners may be using their assets to stave off the default as long as possible. This makes statistical inference on default risks and their correlations with other risks very difficult – even if one does have all the data that are relevant. To give a concrete example, some of the bankruptcies in Switzerland in 1994 and 1995 were due to delayed effects of the real-estate depression after the interest rate high of 1990/1991. To the extent that the banks were hit by the interest rate high in 1990/1991 in many ways, the correlation is important even if in the actual instance, the delay of the actual defaults enabled the banks to smooth the problem over. Presumably, as of 1990, conditional default probabilities on all loans were up, and hence the true economic value of these loans on the banks' books was down – just when everything else was hit by the interest rate high. How are we to estimate this effect given that actual defaults tended to occur much later?

Charles Freeland

Much of what I have heard during the day is consistent with the strong trends within the supervisory community to move away from a quantitative and towards a more qualitative approach to banking supervision. This is accompanied by positive efforts to improve the ability of the markets to exert market discipline on their own participants – sometimes referred to as self-regulation though this is not a term the supervisors like. Whatever one calls it, the banking industry has simply become too fast and too complex to expect that regulatory norms can be wholly effective on their own. This is not to say that certain quantitative standards are not still needed. There is little dispute, even among academics, about the role of capital as a useful buffer against unexpected losses and as a positive incentive for the shareholders to protect their investment.

I have heard comments today about the complexities of the market risk proposals and the fact that some of the parameters are arbitrarily chosen. The fact is that these proposals have been developed after close consultation with the world's major trading banks and following two long consultation processes with all parties affected. Like all such processes, no-one is wholly satisfied with the outcome but the industry and the supervisors both recognise that what we now have is something that we can work with and build on. What is particularly significant, as you know, is the innovation (at least from a supervisory angle) to allow banks to use their internal models as a basis for calculating market risk capital. Although much progress has been made over the past two years, market risk measurement techniques are still at an early stage of development. Enormous efforts are being made by the industry to develop accurate predictive models – it is a dynamic and competitive process in which the practitioners are building on some brilliant academic work. The supervisors have no desire to interrupt or obstruct this process with Luddite rules.

As you know, banks using models will be subject to two sets of standards: quantitative standards governing the way in which their value-at-risk models are specified, and their link to the capital charge; and qualitative standards which are intended to ensure that only banks whose internal control and risk management systems meet the highest industry standards will be permitted to use the models approach. Essentially, the Basle Committee is saying «OK, use your models, but as a quid pro quo we insist on higher standards of control».

So far as the quantitative standards are concerned, they have not, as some commentators have implied, been arbitrarily chosen, but represent the collective judgement of the world's top regulators after extensive consultation and testing. Five types of test have been carried out. Let me briefly explain them.

Firstly, we constructed a single dummy portfolio of about 200 positions and asked a few banks to run it through their models. Only two parameters were specified, a ten-day holding period and a 99% confidence interval. The results of this test were quite disparate for a number of reasons, including:

- the portfolio itself was rather small so differences in treatment were exaggerated;
- the banks were using very different methods of measuring options risk;
- some ambiguities arose in inputting the portfolio;
- the banks were free to use whatever historical observation period they chose for the data set (some six months, others up to five years).

In subsequent tests, based on a more calibrated dummy portfolio and the parameters laid down by the Committee, far closer results were achieved.

Second, a number of banks have tried to compare the risk of their portfolios as measured by the models approach and by the «standardised» measure (similar to the CAD model). This has been difficult because few banks have the data to calculate the full «standardised» method and many do not apply the same models' parameters as the Basle Committee has specified, but such comparisons may become easier as the implementation date gets closer.

Third, many of the Basle Committee members have been monitoring over an extended period the daily value-at-risk of some of their banks' actual portfolios. This has given the Committee a «feel» for the range of numbers which banks with different levels of activity and different risk appetites can experience. Where necessary, adjustments can be made to the numbers to account for different methodological approaches.

A *fourth* type of test (commonly termed «backtesting») consists of an ex-post comparison between a model's forecast and the actual outcome. This is a difficult test to perform and to interpret with a live portfolio that is constantly changing, but it is one that banks themselves like to do in order to monitor their models' performance. One of the papers in our market risk package addresses the issues involved in conducting back-testing and we are keen to encourage the industry to develop its techniques in this respect.

Finally, in establishing the quantitative standards, the Committee did of course also conduct exhaustive studies of asset price correlations, financial market volatility, etc.

A side-effect of the supervisors' recognition of models is that the consulting and software industry has become extremely active in all this work. We would certainly encourage software houses to make databases easily available. We are more cautious about the possible sale of «off-the-shelf» models to banks that may not be sophisticated enough to use them. That is one reason why I personally regard the qualitative standards for model users as considerably more important than the quantitative standards.

How can the academics participate in this effort? I see two specific areas where special insights would be useful. One is in the process of *back-testing* referred to above. A second is in the field of *stress-testing*, a key feature of the qualitative standards. We see it as important that banks ensure that they protect themselves from unforeseen combinations of events, however unlikely. The methodology for structuring and conducting such stress tests is still in the embryonic stage.

Robert Gumerlock

Let me give you my personal opinions at the outset. Being new to the question of whether more or less capital make banks more or less safe, I found GEORGE SHELDON's paper (SHELDON, «Capital Adequacy Rules and the Risk-Seeking Behavior of Banks: A Firm-Level Analysis», 1996) to be quite compelling. My personal feeling is that the issue is not more or less capital, but whether capital is correctly determined. And therefore I am a strong adherent to the models-based approach to capital because it helps risk capital and regulatory capital to converge. I think we have a unique opportunity with the models-based approach to determining regulatory capital. If we get the models right for market risk, we can expect an extension of modelling to credit risk. In his speech of May 2nd, ALAN GREENSPAN pointed out how to apply quantitative techniques to credit risk. But we must get it right in market risk first. If we miss it here, regulatory capital will no doubt retreat to the traditional negotiation of «is more better or is less better?» and «how are firms going to react in their risk-taking behavior?», which is a terribly inconclusive deliberation.

I am concerned that two arguments, currently en vogue, may distract us on the road to models-based capital. The first distracting argument challenges the reliability of models: They are a huge «black box», there could be fraudulent entries, there could be trades missing and so on. The Basle Committee on Banking Supervision has set the following qualitative standards, which a firm must meet before it can even consider using models for regulatory capital:

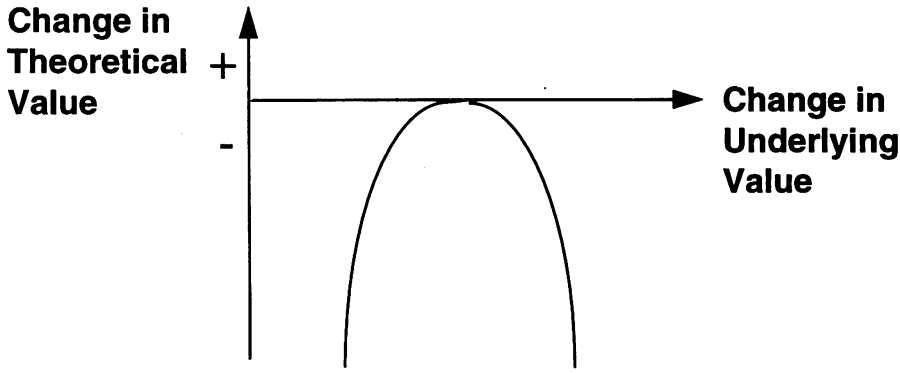
Independent risk control; Regular back testing; Actively involved senior management; Integrated risk measurement model; Model linked with trading limits; Rigorous stress testing; Documented internal controls; Internal audit reviews (Basle Committee on Banking Supervision, «Amendment to the Capital Accord to Incorporate Market Risks», January 1996).

Barings could not have passed these qualitative tests; for example, they did not have independent risk control. It would be illegal for a firm to run two sets of models because models must be linked with the trading- and the risk management system. A brief study of these qualitative standards basically says that only the most sophisticated firms will be allowed to attempt models-based capital. Swiss Bank Corporation has recently merged market- and credit risk control. And after a first glimpse at credit provisions, I can firmly state that I have never seen a differential equation as opaque as the determination of credit provisions. So I question whether market risk models are any more of a «black box» and subjective than other calculations that are routinely taken for granted by regulators, auditors, etc., such as credit provisions, calculation of own capital and operating profit. Risk Magazine published a study comparing various models from several firms. On plain vanilla instruments, models came within 10% of each other across the industry, on exotic instruments they came within 40%. What keeps a risk controller awake at night is not whether there is a quirk in the calculation of the model, but whether all trades have been input into the system.

The second distracting argument fashionable today is Pre-Commitment (cf. GUMERLOCK, R., «Lacking Committment», Risk, Vol. 9, No. 6, 1996). What is Pre-Commitment? Let us make an analogy to clearing houses; clearing houses require Initial Margin and Daily Variation Margin. Daily Variation Margin is essentially marking your position to market. (With the release of the US FASB last week, mark-to-market is now the standard among financial institutions. OTC instruments have at least caught up with exchange clearing houses in this regard). But clearing houses also require Initial Margin. This is related to the volatility of the instruments, as well as the holding period until more capital can be lodged; usually but not always daily. Pre-Commitment, rather than go down a more precise approach toward calculating that variance, basically allows each firm to guess its capital in advance of a time period. Reasoning by analogy: Who, in the middle of the copper-crisis recently, would have allowed the London Metal Exchange to stop and say, «we are not going to raise our initial margins to 15%, from now on we are going to let each firm guess what its initial margin should be. And if they lose more than that on one day, we are going to publicise it». I submit that any sane member of the clearing house at that point would resign as a clearing member. The residual risk of being a clearing member (those who suffer the losses pro rata after the collateral has been exhausted), would mean it would be foolish to be guaranteeing a situation like that. And I cannot understand why the central bankers do not have exactly the same terror of the Pre-Commitment approach, because they bear the residual risk of systemic shocks.

What are the problems with Pre-Commitment? Essentially, Pre-Commitment relies on stop loss behaviour, which inevitably exacerbates systemic risk. The second thing is, Pre-Commitment is a disguise for arguing about the holding period. The main firms behind the Pre-Commitment idea have 1 day value-at-risk models. This was said explicitly in an article by P. KUPIEC/ J. O'BRIEN published in Risk Magazine one year ago. When the Basle Committee announced 2 week holding period and 99% confidence level, rather than face the re-tooling for their models, the firms supporting the Pre-Commitment approach said that they can take their one-day models, mix it with a little stop-loss behaviour and can guarantee, over a given period, that they will not have excessive losses. Frankly, I think that results in the same level of risk that relying on «portfolio insurance» did in the 1987 crash.

The source for this is curvature. Clearly, non-linear financial products (options) make risk management much more difficult. Below is a position that in the middle basically is a flat position, i.e., has zero delta.



If you take a one day holding period, this position will not show up on your «speedometer». Using a 2 week holding period however, you get loss potential, in fact on both sides.

Thus, curvature is the reason why the 1 day value-at-risk calculations are not sufficient for measuring the systemic risk to the system and why the supervisors require a multiplication factor, because in circumstances where you have negative curvature, you are understating your risk.

In trying to ensure that curvature shows up on the speedometer, it is important to simulate large market moves. The BIS has set the following quantitative standards: Daily recalculation; 99% confidence level; 10 day holding period; 1 year historical observation (Basle Committee on Banking Supervision, «Amendment to the Capital Accord to Incorporate Market Risks,» January 1996). Pre-Commitment proponents claim, and here I quote from the April 1996 Chicago Fed. letter, that: «However, it (internal-models approach) also imposes restrictive quantitative standards on the models being used by banks» (Federal Reserve Bank of Chicago, Number 104, April 1996). Swiss Bank Corporation does not consider the Basel quantitative standards to be restrictive. The question is, who sets the parameter inputs: Firms or supervisors. And in terms of impact on models, the move from a 1 day to a 2 week holding period is essentially multiplying by the square root of 10 or a factor of 300%. This is far greater than any of the differences in models between firms.

Why the multiplicaton factor of three? I agree with the Basel Committee that you have Non-normal distributions, Non-stationary volatilities and correlations, Intra-day risks, Exceptional market events, Linear approximation of curvature, particularly in options. However, I submit that those firms who do full revaluation of curvature instead of linear approximation should in fact have a smaller multiplication factor. This would give good incentives to those firms who have yet to accomplish full revaluation.

Let me conclude by quoting from CHARLES GOODHART's paper; he refers to it as an *alternative* approach, but to me it is the approach that the regulators *are* adopting: «An alternative approach might be for the external regulators to decide what were the limits in market movements beyond which they would be prepared to come to the assistance of their own financial institutions, e.g., over a specified period of time a fall in equity, or of property, prices more than x%, or a rise of interest rates more than y% could be regarded as the extreme limit for self-help. Then these values could be fed into stress tests, and the institutions required to hold sufficient capital to meet shocks up to such pre-designated limits. This is somewhat similar to the Lamfalussy requirement...» (GOODHART, «An Incentive Structure for Financial Regulation», 1996).

Anything beyond that would be borne by the lender of last resort, i.e., the central bank. This is why the central bank, and ultimately the Ministry of Finance, who must fund the losses, are partners in this process.

I submit that in fact that is not an alternative; that is what the models based approach already does.

Werner Hermann

Most people involved in banking supervision are concerned about the increasing complexity of the regulatory framework. In order to show that already understanding how to apply the rules could become a burden I do not need to make a forecast about the number of pages banking law, ordinance, circular letters etc. we will have in Switzerland ten years from now. In the late seventies the rules in the banking ordinance outlining capital requirements were less than two pages long; the current rules fill about fourteen pages and soon it will be more. Capital requirements based on in-house models are one way to reduce the complexity of regulation and at the same time align regulation more with the risks of banking.

The topic of this panel is quality assessment of models, which is an interesting statistical problem; but it is more than that. I would like to point out five aspects:

1. Definition of model

What do we mean by in-house model? There are several possible notions. A model could mean a stable set of equations that generates a result called value at risk (VAR) or it could mean a mathematical model that is constantly revised due to new insights or even a part of a bank called risk control, in which case there is much room for judgement. Furthermore, the relevant variable needs to be defined. One possible and frequently used definition is the VAR of the bank's portfolio at a certain point in time. However, since the composition of a portfolio can be changed before the end of the holding period, another candidate is the VAR taking into account the trading in response to price changes.

If it were possible to judge the quality of a model solely based on its past performance, the definition of a model could be flexible enough to include a broad range of risk control systems used by banks. This would create the smallest incentive to develop separate, most likely less appropriate models for supervisory purposes. Unfortunately, in practice past performance is a rather low yielding source of information.

2. Backtesting

Assessing the quality of a model by past performance is called backtesting. The straightforward way to backtest a model is the sign test. One only needs to draw a sample, count how many times the loss of the portfolio was larger than the VAR predicted by the model and compare the evidence with the binomial distribution. The sign test has some nice properties: it is easy to carry out and does not require other assumptions than the independence of the observations. The catch is its poor power. While dismissing an inappropriate model is a relatively safe decision, a very large sample is required to recognise an appropriate model. Assume you want to reject the null hypothesis that a certain model underestimates VAR in more than two percent of the cases. Then you need at least one hundred observations to make a decision that has a mere 90% chance of being the correct one. Power could be improved by adjusting the desired confidence level of the model, measuring the accuracy of a model across all percentiles of the probability function (not just on the basis of a tail event) or resorting to a parametric test.

An idea which deserves further thought is stochastic verification. Statistical tests are based on random sampling. Therefore, it is not obvious that supervisors should inform the banks about the observations they plan to include in the sample.

3. Precommitment

Because of the problems involved in backtesting, it was suggested that each bank should decide and disclose the amount of capital devoted to market risk. In case the amount turns out to be insufficient, supervisors would impose sanctions on the institution. This suggestion would avoid all the problems of model quality assessment. Many banks favour the precommitment approach, but most regulators remain sceptical. The crucial question is: what kind of sanction makes economic sense. The possible sanctions need to be judged against their effect on bank capital because at the moment the sanction has to be decided, a reduction in capital will have occurred. A fine would make things even worse. Limiting the possibility to take on risk would be a sanction with severe macro-economic drawbacks: In the aggregate, a flight out of risky assets due to a significant market move could trigger a capital market crash. A sanction without these drawbacks would be a credible commitment by shareholders of a bank or any other third party to provide more capital after an unexpected loss.

Supervisors might be more prudent than bankers, but they cannot claim to know the optimal amount of capital to back speculation. Precommitment means betting on it,

approving a model means agreeing on it. There are many similarities between the two procedures. For instance, the certainty of judgement of risk can be expected to develop with experience. In practice, the transition to internal models will contain elements of the precommitment approach.

4. Other Tests

Because backtesting does, at least in the early stage, not reveal enough information, approval of models has to tap other sources as well. These include the modelling process, the proficiency of risk managers, the check if all relevant transactions are reported, the possibilities to manipulate the data, the specification of the model and in sample as well as out of sample ex-post forecasts.

5. Expertise of supervisors

Expertise of supervisors is important, but its importance is sometimes overemphasised. It is not true that supervising banks requires the same type of expertise as the banking business itself. Making money, after all, is not a task of supervisors. Bank and regulator are not in a simple contest. In soccer, nobody is worried that the referee might not be a very good player and that some players make much more money than the referee.

Samuel Theodore

In the broad scope of bank risks, it seems to us from looking at banks around the world that the risk of having inadequate models for market risk is not an essential risk for banks.

Very few banks around the world actually did choose to adopt to present internal models and not to adopt the standard approach when doing their market risk capital calculation. Even some among the very large banks in the European Union chose so far to go by the standard approach; they are claiming that building up an internal model is too expensive and that ultimately the result would be the same.

One question we are very often faced with is to what extent we have a correlation between our own bank ratings and the level of capital. I guess we do not really look at the absolute level of regulatory capital; it is a very interesting number for comparisons, but I think it is rather less relevant in terms of showing bank risk. What is really more important is the capacity of the bank to generate internally an appropriate level of core funds. A second element is that we do not look so much at regulatory capital as we look at economic capital in general.

Another observation is that many banks talk to us about the way they internally allocate capital for both credit and market risk. We find that very often this process of allocating capital internally is not any more than complying with regulatory rules and trying to efficiently allocate regulatory capital.

Coming back to internal models: what we really look for is the fundamental analysis. Who is the bank? To what extent do the trading activities, the financial markets activities justify having or not sophisticated internal models? We also make judgements about the capacity of regulators to understand these models; as a general comment, on average we find Swiss regulators among the most sophisticated in Europe.

Concerning the 99% confidence interval, the 1% of potential loss really concerns us. The importance of stress testing is essential. We want to understand to what extent the bank having these good models in place also has a good system for stress testing.

A key here is the element of liquidity and the fact that current models do not really incorporate these liquidity risks which truly exist for more sophisticated products. Most banks adopt an intuitive approach to liquidity risk, not a quantitative approach. Another major questionmark consists in agency risk. Here again we look at the fundamental analysis of the bank.

Daniel Zuberbühler

1. Preliminary Remarks on the Market Risk Amendment to the Basle Capital Accord

Before entering into the problems associated with the supervisory recognition and qualitative assessment of banks' internal VAR-models for capital adequacy purposes, I wish to place the 1996 Market Risk Amendment to the 1988 Basle Capital Accord into a wider perspective of capital adequacy regulation.

- The complexity and density of the regulation on market risks is in a blatant contrast to the primitive framework of the 1988 Accord on *credit risk* although credit risk is still the predominant factor in almost every bank, especially Swiss universal banks. We do not seem to have got the balance right and dedicate too much time and effort on the wrong subject. I am tempted to speak of over–regulation for market risks or under–regulation of credit risk. In a big Swiss bank, market risk will account for only about 1/10 of the total capital requirement, for smaller regional banks the percentage is almost negligible. Banks are still dying in this country and the main causes are plain-vanilla credit risks or the underlying risk of the real estate market, which unfortunately is not captured by the 1996 Amendment.
- *Interest rate risk*, as one form of market risk, according to the 1996 Amendment is subject to capital requirements exclusively for debt securities in the trading book, but not covered at all in the general banking book, where again it is clearly predominant in a universal or commercial bank. From a conceptual point of view, this is inconsistent. It can only be explained by the negative reaction of the banking community to the 1993 proposal and the subsequent failure to reach an agreement on the right measurement framework in the Basle Committee. If banks are capable to design the most sophisticated models for other market risks, they should also be in a position to

model their customers behaviour for assets and liabilities with uncertain maturities, deviations from legal withdrawal limits etc.
- Compared with the present Swiss capital adequacy ratios for market risks, however primitive and incomplete they may be, the implementation of the Basle standard approach, let alone the models approach, would bring about a *further erosion* of the once tough capital requirements. Every adaptation to the international minimum standards since 1989 has decreased the amount of required capital in Switzerland. The amendment of the Banking Ordinance of December 12th, 1994 resulted in a reduction from 81 to 72 billion for the entire Swiss banking system between 1994 and 1995 (Swiss National Bank, The Swiss Banking System in the Year of 1995 (Nr. 80), p. 45 and Tables 44.0 and 44.a.). Nobody can claim that the risks were reduced accordingly within one year. Our patience as regulators is running out, if the ongoing implementation exercise is moving into in the same direction.

I am therefore more concerned with the overall effect of the market risk package than with details of the implementation of internal models for regulatory purposes.

2. Conceptual Problems of the Models Approach

In my contribution to the 1995 Conference (Swiss Journal of Economics and Statistics 1995, Vol. 131 [4/2], 811-816), I had summarized some of the implications of the supervisory recognition of internal models as outlined in a paper of IOSCO Working Party 3 (Prof. HELLWIG has also raised some of these points in his introductory comments):

- The rationale for using models changes from an adequate control of risks to minimising regulatory capital.
- VAR-models address what is likely to happen under normal circumstances, whereas supervisors are most concerned with what happens in face of unusual events or when the unexpected happens.
- Supervisors have a tendency to impose their parameters on the internal model and thereby change it into a supervisory model.
- There are a lot of judgemental issues involved with the assessment of the quality of a model, hence a danger of arbitrariness.
- The direct involvement of the supervisor in internal risk control issues of a bank can blur the boundaries between mere external oversight and intrusion into business policy and management decisions.
- For bank supervisors, reliance on internal models is acceptable for market risks in a bank, because this is usually not its core business and because there is no long tradition of regulation in this field. Securities regulators are much more reluctant to make this step, because market risks are the predominant factor in a securities firm and the related traditional hair-cuts make up for a large part of the capital requirements. As

bank supervisors, we would be equally sceptical if we had to accept internal models for credit risks.

3. Challenges of a qualitative assessment by the supervisor

- It is obvious, that every supervisory authority has serious problems to recruit *qualified staff* to assess and approve complex internal models. Any external examiner is always in a disadvantaged position vis-à-vis those who have designed the model and work with it every day. To narrow the gap, one would have to hire someone who knows all the tricks from the inside. Experienced risk managers are expensive and would hardly be satisfied with government salaries. The only attraction we could offer them is an independent position and a unique insight into the systems of a wide range of the top players. But after having gained such an experience, they would either be hired by a bank or become independent consultants. In the case of the Swiss Federal Banking Commission (FBC) we have to overcome an additional bureaucratic obstacle: the personnel ceilings and budget constraints of the Federal Government. But this administrative dependence from the central government is not God-given. It could be changed with the support from the banking community, because internationally active banks have an interest to demonstrate that they are supervised adequately by a properly equipped home supervisor, especially if they wish to obtain a formal recognition for their models by foreign supervisors in the host countries of branches and subsidiaries.
- In the two-tiered *Swiss supervisory system*, in which all on-site inspections are – at least up to now – performed by private, FBC-recognised *external bank audit firms*, one could ask the question whether it is necessary to treat the recognition and assessment of internal models differently. After all, we also rely on the external auditors for the equally challenging assessment of the loan portfolio, provisioning, adequacy of internal controls, implementation of selfregulatory standards such as the Swiss Bankers Association's Risk Management Guidelines for Trading and the Use of Derivatives. As I explained last year, we believe that it would be unwise to leave the approval and examination of internal models including setting the multiplication factor for capital adequacy purposes exclusively to the external audit firm of each bank. The audit firm might have less problems to hire qualified risk-control experts than the Banking Commission and it can draw on its international network of partner firms. But it would probably not have a large enough oversight in Switzerland to assure an equal treatment of all banks which want to use the models approach. Above all, its inherent conflict of interest as a servant of two masters – the FBC and the public interest on one hand and the bank who hires and pays it on the other hand – would be pushed to an extreme, if it had to decide on the recognition and the multiplication factor with far reaching financial consequences. In addition, the model would lack credibility with foreign supervisors, if it was only approved by a private audit firm.

- In the mixed Swiss working party on capital adequacy we have recently discussed different *alternatives*. It was agreed that the assessment of internal models should be done in tandem by the external audit firm and a small team of FBC-experts, whose main function would be to assure equal treatment and implementation of sufficiently rigorous standards. A subgroup will study in more detail what the assessment issues are, which procedures should be followed and how the roles (and corresponding liability) would be attributed. The bankers rejected the idea that the FBC could mandate other external independent experts (e.g., specialized consultants, university institutes) to assist our people in their task. They pointed out that such outside consultants could abuse their position for their own business objectives or would be mere theorists with no practical experience. There was however no objection against a reinforcement of the FBC-team by specialists of the Swiss National Bank. Through the ongoing tests of the Basle Committee's models task force, in which all three Swiss big banks participate, valuable experience can be gained until the final implementation.
- One of the implications of the models approach in Switzerland is a partial shift to on-site inspections by the FBC. If we move further in this direction, we might end up with a mixed supervisory system, where the FBC will still mainly rely on external bank audit firms, but complements their work with selected on-site inspections of its own staff in various fields. On the opposite side, authorities which nowadays almost exclusively perform their function with their own field examiners may make an increased use of private audit firms as an additional source of information. Hence, further *convergence* of the systems lies ahead.
- The *risk of fraud* inside financial institutions and fraudulous reporting will always exist and this risk is more relevant than the risk of an inaccurate model (model risk). Prof. HELLWIG rightly asks if this is not the more relevant issue. It is essentially a matter for internal controls (or in a wider sense, corporate governance) and qualitative external oversight. For external auditors and supervisory examiners, it is at best possible to uncover organisational flaws and gaps, but detecting fraudulous transactions or reports would be a mere stroke of luck. For such unmeasurable risks we should have an additional capital cushion.
- In my view, the main positive effect of the models discussion between banks and supervisors is not a strengthening of capital standards, but a better understanding for *risk management issues*. Without the link with capital adequacy regulation, we might not have seen a need to enter into such an intensive dialogue. It remains to be seen, whether this positive indirect effect of the models approach is worth the price of giving up simple and easily applicable capital rules.

3. GENERAL DISCUSSION

HELLWIG draws the following main points from the initial discussion:

1. The order of magnitude of the problem seems to be considered as being small in relation to other problems.
2. In both GUMERLOCK's and THEODORE's statements there was a distinction between the notion of economic and the notion of regulatory capital, where it was clear that economic capital was the right concept to use. This would seem to imply that the notion of regulatory capital and the need to work with this notion is just a nuisance.
3. The models themselves are not so much of a problem given that they are best industry practice, but the real problem seems to be fraud, missing data, misreporting and so on. This raises the issue of how robust the risk management is to such instances, both at the level of the individual institution and the systemic level.
4. As indicated by ZUBERBÜHLER's statement, there may be a problem if supervisors get too closely involved in actual bank management. If ongoing model assessment becomes part of the process of banking supervision, this may change the «culture» of relations between banks and their supervisors.

He opens the floor to overall discussion and suggests to come back to the above issues in final statements.

FREELAND agrees with ZUBERBÜHLER that interest rate risk is important, but the Basle Committee is not convinced that a capital charge is the right way of dealing with it. This will reassure those who have asked for a «standstill». Responding to ZUBERBÜHLER and HELLWIG who question the need for capital charges on market risk, the two main reasons the Basle Committee has introduced them are the fact that the 1988 Capital Accord for credit risk has led to some bias in shifting business into trading books, and the effects of intense competition in the industry which has led banks to increase the scale of their own account trading. The Committee believes that capital charges are essential to create the right incentives in today's hyper-active trading environment. Simply put, those who deliberately take open positions need more capital.

ZUBERBÜHLER comments that he never said that market risk should not be covered by capital, but that he meant that the rules should not be so complex for something which is maybe a minor fraction of the whole business activity. He also emphasizes the point that minimum standards tend to become the standard. The existing Swiss market risk capital requirements are much tougher than the Basle standard.

SPREMANN points to the character of models as a benchmark; he mentions that discussions of deviations are possible on a better and more differentiated basis if we have a standard, i.e., a model. He emphasizes that regulation is important even if it is imperfect as long as it puts standards and benchmarks on the table. He then concludes that standards should be simple and should be the same for different places in the world.

ENDERLI asks whether ZUBERBÜHLER was talking about actual capital or capital requirement.

ZUBERBÜHLER responds that he meant capital requirements.

ENDERLI replies that Swiss banks have become much more sensitive to and knowledgeable about capital as well as more risk-averse, which explains the decreased need for capital.

FISCHER comes back to bank book risks and warns that modelling customer behaviour is difficult in Switzerland due to the lack of statistical history.

GUMERLOCK agrees with this comment on modelling difficulty. To try to attemper interest rate risk would be problematic at this point. Furthermore, he believes that there are certain central banks and treasuries around the world who still want to use the investment book as a tool of fiscal policy. He stresses that he is not certain that governments would want to give up this latitude at this point of time.

HERMANN stresses that maturity transformation, a traditional activity of the banking industry, requires an assessment of interest rate risk.

HELLWIG refers to certain governments using the yield curve to recapitalize their banks and asks whether this is actually something that is very desirable. Looking at the spring 1994 experience, he mentions his suspicion that some of the risks involved in that policy actually came home and it would have been preferable had they been taken into account before.

GUMERLOCK states that Swiss Bank Corporation moves all of its fixed-rate and fixed-dated interest rate risk from its loan book to its trading book.

He comes back to the distinction between risk (economic) and regulatory capital and emphasizes the need for regulatory capital to stay off systemic risk. If you do not have convergence of risk and regulatory capital, two things will happen: You need two monitoring systems, one for regulatory capital, the other for risk capital and you have sometimes adverse incentives created by the structure of the regulatory capital. He admits that it is a dream to have convergence of risk and regulatory capital, but he advises to keep trying.

ZUBERBÜHLER reponds that one distinction between regulatory and economic capital is that subordinated debt could not be counted as economic capital, whereas some hidden reserves are economically capital, but not regulatory capital.

THEODORE mentions that some German banks have significant hidden reserves in the form of equity participations in industrial companies. If you add those, economic capital increases significantly; on the other hand, if they were to sell those participations, they would pay 70% capital gain tax, so obviously they are not going to do that.

Concerning the distinction between regulatory and risk capital, SHELDON asks whether the point of regulatory capital is not to lower the probability of a bank failure. Since the purpose is to control the probability of bank failures, he wonders whether one could not simply use market data. People are saying that volatility is changing; it may be changing, but there is certainly stationarity in the sense that there is not unboundedness. This sort of analysis does not require highly qualified people.

ZUBERBÜHLER replies that the most problematic banks have no equity capital traded on a securities exchange and therefore no reliable market data is available. As far as the big banks are concerned, you could say that they are too big to be controlled anyway.

GOODHART would like to hear the views of the other Panelists about precommitment and to hear the Panel interdiscussing the issue.

HELLWIG refers this question to the panelists' final statements and adds the question of how vulnerable the different systems are to fraud as well as to potential dangers of chain reactions between financial institutions.

Beginning a round of brief final statements, GUMERLOCK first observes that for *fraud* to succeed, two things have to happen: It has to go undiscovered and the market has to go in the direction of the position taken by the trader. The incentive for fraud activity is an order of magnitude less than what we encounter in situations where you have immediate individual benefit.

Second, regarding *precommitment*, he clarifies his position: if you get rid of stop-loss-behaviour and insist on two-week 99% confidence, you are back at models.

As an answer to SHELDON's suggestion, HERMANN refers to the problem of implicit insurance which might distort equity prices.

THEODORE expresses his view that agency risks remain an ongoing risk indifferent of the sophistication of their internal systems since neither rating agencies nor regulators nor banks can assess these risks.

ZUBERBÜHLER does not like the precommitment approach. According to him, it is a «sunshine» approach which cannot be implemented in bad weather.

FREELAND sees three types of fraud. The most difficult for the authorities to detect is when a bank's own management connives in the fraud. The best people to detect this are external auditors through cross-checking counterparty balances. Second, fraud by individuals on a bank or its customers is becoming increasingly dangerous because of technological vulnerability. Vigorous computer securities controls are necessary to keep ahead of the fraudsters, internal or external. The third type of fraud, highlighted by recent events, is the «rogue trader», who gets drawn into fraud through his own failure to trade successfully. It is unreasonable to expect a supervisor or auditor, who is in the bank rarely, to detect such frauds if the management, who are constantly present, cannot do so. Rather, it is essential for each bank to have sound internal audit and management control procedures. There is a problem with «distant places», of which bank controllers are uncomfortably aware. The Basle Committee has tried to address this issue by its qualitative standards for models.

Turning to GOODHART's question, the pre-commitment approach has received enormous publicity given that it is a concept (not a proposal) floated by one of several US regulators (albeit an important one) and not supported by any other. It is no surprise that the industry likes it. The penalties, which are a crucial element, have not been spelt out. FREELAND agrees with GUMERLOCK that the approach poses a systemic threat – in collapsing markets all will run for the exits. The Fed has suggested that in extreme market conditions the penalties can be waived, but the market will not know in the heat of a crisis whether the authorities will waive the penalties or not.

Closing the Panel with thanks to all participants, HELLWIG guesses that ten years later there may well be another panel, this one devoted to problems of quality assessment for

inhouse models of *credit risk* and that a key question is what will happen to banks and banking systems in the ten intervening years.