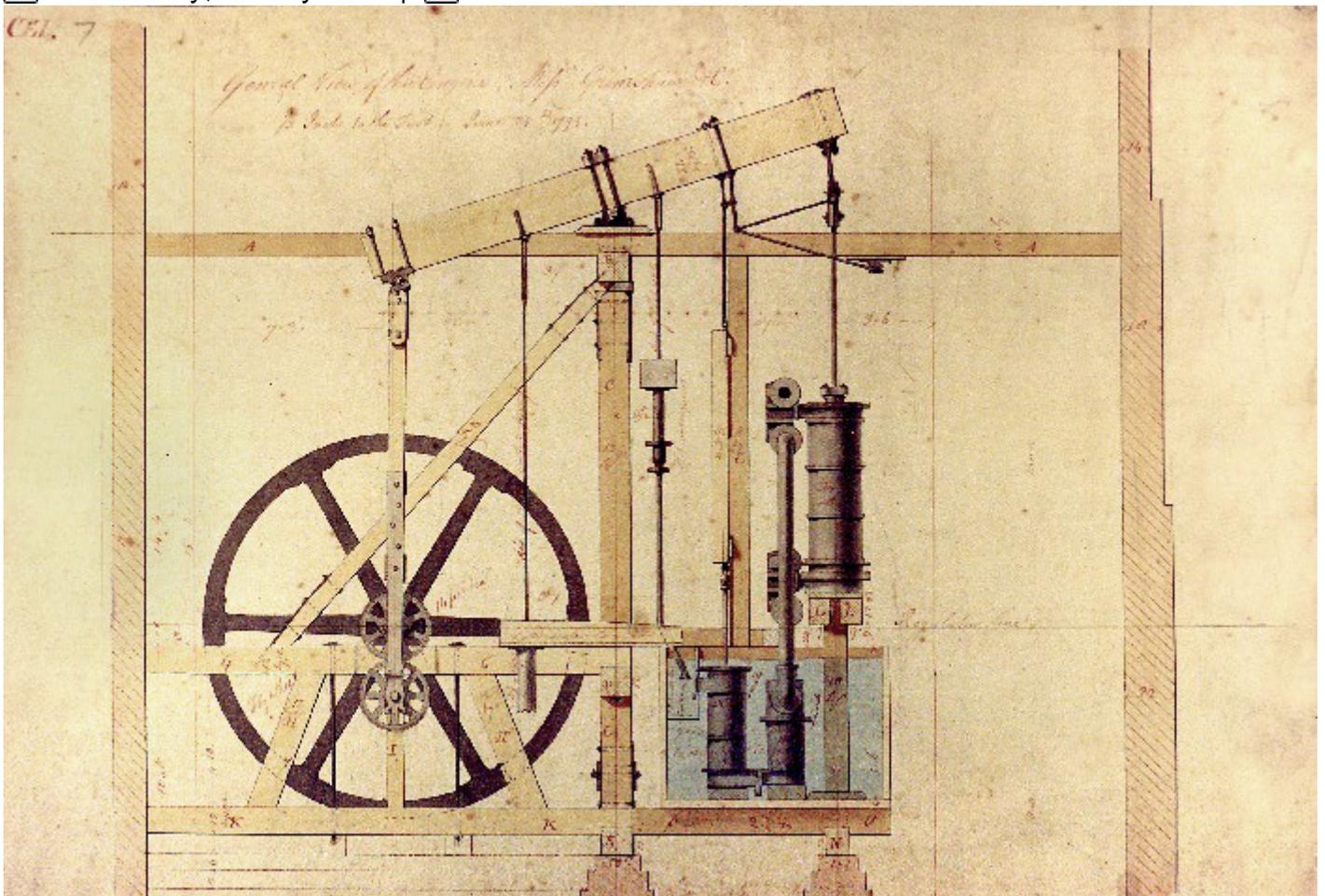


Liquidity Risk - The Sharp End Issue of the Credit Crunch in 2008

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 Wednesday, 18 July 2012 |  John A Morrison



vintage 2008 on Basel II Pillar 2; more Union Legend than asymptotix; Stress Testing & Market Risk, Holistic Risk Management but more valid today than it ever was & pointless gathering dust on an asymptotix electronic shelf!

Liquidity Risk is a confused topic (from a supervisory or B2 perspective)

because it has not been clear whether this is a risk type to be treated qualitatively or

quantitatively through the development of the Basel II (B2) accords. In the initial months after the first Basel Accords were published most European regulators discussed the challenge of Liquidity Risk in qualitative terms. Latterly however the emphasis has been on the need for regulated financial institutions (FI) to stress test this aspect of Market Risk. This stress testing requirement demands that Liquidity Risk be treated quantitatively, from the perspective of a methodological approach to capturing how the FI's exposure to this risk may fluctuate under extreme conditions.

Liquidity Risk has been brought to sharp focus as a consequence of the events of the credit crunch. The developments in the requirements of the IFRS7 accounting standard and the recent publication by the Bank for International Settlements (BIS) of new more rigorous and specific standards for Liquidity Risk analysis and reporting^[1] have made it clear that the requirements in this specific area, are strictly quantitative in nature and thus will demand of the FIs an IT architecture capable of some 'heavy lifting' both in the data management and in the predictive analytic space.

A conventional analysis of liquidity risk distinguishes between funding liquidity risk and market liquidity risk.

Funding liquidity risk is the risk that the counterparties who provide the bank with short-term funding will withdraw or not roll over that funding, e.g. there will be a 'run on the banks' as depositors withdraw their funds.

Market liquidity risk is the risk of a generalised disruption in asset markets that make normally-liquid assets illiquid.

The first is more important in the context of the maturity transformation that occurs in the banking book. The second is more important in the context of tradable assets in the trading book.

If liquidity risk is defined on the narrow or funding risk definition as the risk that the bank will have insufficient funds to hand at a given time to deal with depositors' cash demands and day-to-day cash and regulatory requirements, and the source of the bank's liquidity is the issuance of debt instruments to fund an inherent funding gap, then any reduction in the liquidity of the market in that debt instrument is a threat to the bank's liquidity.

It is in this manner that market liquidity and funding liquidity are two sides of the same coin.

A market is liquid when buyers are broadly balanced by sellers. In a liquid market, the difference between buy and sell prices is small (e.g. bid-ask spreads are 'tight?'), the size of the transactions that can be absorbed without affecting prices is large (i.e. there is 'depth?'), the speed of execution is high (i.e. there is 'immediacy?') and prices quickly return to 'normal' after temporary order imbalances (i.e. there is 'resilience?').

CDS and Bond Markets ? Relative Liquidity

For example the relative liquidity of the bond and CDS markets is very different. But the difference is not systematic across maturities. Typically, the CDS market is most liquid at the

five-year maturity, followed by the three-year then 10- and one-year points. The bond market is usually liquid wherever on the yield curve the largest outstanding notional amounts lie. Not only is this likely to be at different maturities for different issuers, but it will shift over time for a given issuer as the bonds age^[2] ^[2].

Typically, the higher the liquidity in the two markets, the more bonds/CDS maturities are quoted. The indicator used is simply the number of CDS prices minus the number of bonds quoted on any given day, a rising number indicating relatively more liquidity in the CDS market. A more liquid market is usually associated with a tight bid-ask spread. This is just one dimension of liquidity, but it has the clear advantage that it is the easiest to observe. The indicator used is relative spreads (CDS minus bonds), with rising numbers indicating lower relative liquidity in the CDS market.

Econometric modelling indicates relative bond market liquidity at horizons between two and three years and in excess of five years. The CDS market is relatively more liquid below two years and around the five-year mark.

Also, OTC derivatives contracts tend to be less standardised than exchange traded contracts, which give rise to difficulties in trading the contracts, particularly in volatile conditions, creating a liquidity risk associated with these OTC derivatives.^[3] ^[3] It is for this reason (as predicted by the Doran paper) that post-CC we have witnessed a rapid flight away from the OTC nature of credit derivatives and towards listed derivative products in an effort by Financial Institutions to zero-ise counterparty risk which can be seen from the appendix to this document to be a key driving factor for Market Liquidity Risk.

Market Distress

At the heart of market distress is vanishing liquidity. Under stress, risk management practices, funding liquidity constraints and, in the most severe cases, concerns with counterparty risk become critical. The dynamics of distress are not so much the result of extraneous large unexpected untoward events (?shocks?) that hit financial markets, as it were, from outside (i.e., that are ?exogenous?). Rather, they often result from the collective behaviour of market participants, which sows the seeds of, and subsequently amplifies, the market turbulence. In this sense, risk is fundamentally ?endogenous?^[4] ^[4]

A market in distress is defined as one that experiences a sudden and substantial reduction in its liquidity.

Maturity Mismatch in the Banking Book over time

The consequences of a bank allowing a large maturity mismatch on its books to go un-hedged could conceivably have adverse consequences. Suppose a sharp rise in interest rates occurred as a result of a sudden manifestation of inflation. The bank could, by virtue of a maturity mismatch, be committed to funding loans for a period of time into the future at the earlier lower interest rate from more expensive deposits, which it must accept at the new higher interest rate. This will have an adverse effect on the bank?s profits and capital ratio and increase the likelihood of insolvency. This creates the risk that the bank in question could find itself in a position of poor liquidity causing it to default on its payment obligations.

Such a shock to an individual credit institution could propagate through the rest of the financial

system through contagion, whereby other credit institutions suffer loss resulting from their claims on customers of the defaulting credit institution, or perhaps through interbank lending with that particular credit institution. This possible sequence of events would jeopardise the financial stability of the economy.^[5] ^[5]

When evaluating what might happen to a portfolio of instruments which is maintained to ensure institutional liquidity, during the stress test the institution should consider all exposures to risk as a result of vanishing liquidity as a mathematical function of time. The actual risk as a result of lack of liquidity might be to capital prices of an instrument or to the portfolio as a consequence of derivative movements but the source of the risk is market illiquidity. The appraisal to be made during the stress test is one of taking into account the extra time and cost that would be necessary to hedge out the position, in an orderly fashion, or how much bid/offer would move over time to close out the position.

It is necessary to understand by modelling from past events and thus to define a reasonable liquidation period for each product. That period varies by firms (e.g. one firm may consider a 60-90 day period as a reasonable time period for certain types of products or trading strategies, while another may consider one week to be the norm).^[6] ^[6]

Stress Testing Maturity Mismatch (IFRS7 and Basel II) ? The Issues

A comprehensive stress **testing programme** is an essential supplement to a VAR model. Stress testing involves subjecting trading portfolios or the banking book to unexpected but possible shocks in market conditions. This enables an institution to evaluate its capacity to absorb potentially large losses and to identify steps that it can take to reduce its risk and conserve capital. The move towards more regular stress testing is in part being driven by the market risk capital requirements whereby banks using internal models will be required to submit the results of their stress testing scenarios to the Supervisor on a quarterly basis.^[7] ^[7]

IFRS7 requires Quantitative disclosures about the potential impacts of market risks of which Liquidity risk is a key aspect, the specific requirements of the standard demand a maturity analysis for financial liabilities showing the remaining contractual maturities and a description of the approach to managing the inherent liquidity risk. Then as an aspect of the Market risk rules of the standard a sensitivity analysis for each type of market risk (including liquidity risk) to which an entity is exposed at reporting date is required. This should illustrate how profit or loss and equity would have been affected by 'reasonably possible' changes in the relevant risk variable (a stress test), as well as the methods and assumptions used in preparing such an analysis.

There are difficulties in Stress Testing for Liquidity Risk. For example, a full stress test of market risks requires detailed data on positions and contracts that are neither publicly disclosed nor subject to regulatory reporting.

But the main challenge of stress testing Liquidity Risk in particular is that makes no sense to understand Liquidity purely as function of market conditions (Market Liquidity Risk [MLR]), since Market Liquidity is a function of the aggregate demand for liquidity in the market which itself is a function of the aggregate Funding Liquidity demand of all the participants in the bank liquidity market (the interbank market). Funding Liquidity Risk [FLR] in the specific institution can only itself be modeled as a function of factors exogenous to the specific institution and

common to all institutions as market participants (macro factors). Sure, the relative impact of that common set of macro factors will differ per institution or in other words, each institution in the market will have a different 'reaction function' to the macro context which then quantifies its specific liquidity demand at time t. So each institution's FLR is given by a macroeconomic reaction function applied to that institution's specific maturity mismatch matrix at time t and indeed MLR can be defined in common for all institutions as a macroeconomic reaction function modeled for the market; both the micro and macro functions will be constructed largely by the same variable set.

Implicit in this logic above is the key salient of liquidity risk from an FLR perspective, which is that institutional demand for liquidity is not exclusively a function of the Trading Book, it cannot be, it is a function of the driving factors of the Banking book and the Trading book. The Bank for International Settlements has been encouraging institutions to consider the integration of market risk and credit risk for a number of years now (as has the Bank of England and the Bundesbank) but it is in the challenge of Liquidity Risk that the institution cannot avoid the necessity of considering these two types of risk together. The Basel Committee recognized this in its introduction to the new Incremental Risk Charge (IRC) of July 2008;

'The losses that materialized during the market turmoil have not arisen from actual defaults but rather from credit migrations combined with widening of credit spreads and the loss of liquidity.'

See also Principle 5, paragraphs 22 and 23 of the Bank for International Settlements guidelines on Liquidity Risk of June 2008^[8] ^[8]

The New Basel requirement for an Incremental Risk Charge (IRC)

The Basel Committee now requires a quantitative stress test of liquidity risk exposure implemented by 2010; this is a new requirement, the first window we have had opened for us on Basel III if you will. This requirement is specified in the new BIS requirements for computation of risk capital in the Trading Book referred above in the opening paragraphs. In the specific statement of these requirements for 'The Incremental Risk Charge' (IRC)^[9] ^[9] the BIS states;

Broadly, the incremental risk charge (IRC) set forth in this document is intended to address a number of perceived shortcomings in the current 99%/10-day VaR framework. Foremost, the current VaR framework ignores differences in the underlying liquidity of trading book positions. In addition, these VaR calculations are typically based on a 99%/one-day VaR which is scaled up to 10 days. Consequently, the VaR capital charge may not fully reflect large daily losses that occur less frequently than two to three times per year as well as the potential for large cumulative price movements over periods of several weeks or months. Moreover, the current framework's emphasis on modelling short-run P&L volatility (eg backtesting requirements) allows the use of relatively short data windows for estimating VaR parameters (as short as one year), which can produce insufficient required capital against trading positions following periods of relative calm in financial markets.

The Basel Committee introduces the IRC with an important comment related to IFRS7; *The Basel Committee also proposes improvements to the Basel II Framework concerning internal VaR models. It has further aligned the language with respect to prudent valuation for positions subject to market risk with existing accounting guidance.*

Challenges of Integrating Market and Credit Risk

The first steps by the Basel Committee for Banking Supervision (BCBS) to respond to the CC and strengthen systemic resilience were announced in April 2008^[10]_[10], in relation to Liquidity Risk; the committee identified weaknesses and shortcomings it perceives through the CC in the management of Liquidity Risk, these are;

stress testing practices, contingency funding plans, and management of on- and off-balance sheet activity as well as contingent commitments. The Committee will coordinate rigorous follow up by supervisors to ensure banks adhere to these fundamental principles. The BCBS indicate their preferred locus of response to strengthen risk management practices generally; *Pillar 2 (the supervisory review process) provides supervisors with additional tools to assess banks' risk management and internal capital management processes. The Committee will issue Pillar 2 guidance in a number of areas to help strengthen risk management and supervisory practices.*

Pillar 2 and Economic Capital require being the subject of a whole new paper, post credit crunch, suffice it to say here in relation Liquidity Risk that it is advisable that an institution deploy solution architecture to support BOTH the regulatory and supervisory aspects of capital calculation and not consider them separately. If the reader requires a detailed discussion of economic capital quantification and Basel II, the author of this paper developed a White Paper (WP) for the software 'mega vendor' SAP on the subject of the second pillar of the Basel II accords (B2P2)^[11]_[11]. The most recent important discussion of economic capital is that published by the Bank for International Settlements in August 2008^[12]_[12]

In the view of this author, when planning a solution to a challenge like risk capital quantification, start with the most difficult aspect first (eCap) and its downhill thereafter, do the

simplest thing first and you are forever climbing a hill of which you can never see the top!

The Bank for International Settlements and the Deutsche Bundesbank hosted a conference in December 2007 about the integration of market and credit risk[13]^[13]. This proposition is by no means new. In fact it has been championed principally by Mathias Drehmann[14]^[14] of the Bank of England who has developed his ideas with co-authors in a number of papers over recent years of a modeling approach to this challenge. In considering this it is worth pointing out two aspects of this challenge; a) one is by definition leaving the realms of regulatory capital and entering exclusively an economic capital domain (the detailed argument is presented below) and as with all aspects of economic capital (b) one is entering a mathematical domain since it is sometimes difficult to express concepts of economic capital without considering the modeling technique to quantify that capital. That technique being in a manner ?derived from? but certainly appropriate to the specific real world situation in which we are trying to price or quantify risk.

Failure to jointly consider the Banking and Trading Book underestimates Risk

A keynote paper[15]^[15] at the Bank for International Settlements and Deutsche Bundesbank conference on the integration of market and credit risk (referred above) asks the question does the logic of Basel II in separating market and credit risk adequately provide a basis to compute capital. The authors? logic proceeds as follows in summary;

?Regulators have traditionally thought of credit risk as mainly relevant for the banking book and market risk as mainly relevant for the trading book. In this way the regulatory categorization mimics the traditional organization of banks into a credit department and a market investment department. Pillar 1 of Basel II requires separate regulatory capital for credit and market risk. The total risk capital is then calculated as the sum of these numbers. Credit risk is seen as mainly relevant for the banking book, market risk is mainly seen relevant for the trading book. Underestimation of risk is possible if the portfolio is not separable into a market and a credit sub-portfolio.

In many situations a split into credit and market portfolios is not possible because positions in the portfolio will simultaneously depend on market and credit risk factors. If in such a situation a sub-portfolio construction along the traditional lines is enforced this will necessarily lead to wrong portfolio valuation and as a consequence to wrong assessment of the true portfolio risk.?

As described by the BIS, nowhere does this issue come more into focus than when quantifying Liquidity Risk, since Banking Book driving factors causally drive Funding Liquidity demand and Trading Book driving factors drive Market Liquidity conditions as argued above.

Integrated Market and Credit Risk; Difficult but Do-Able.

The main argument against integrated credit and market risk e.cap modeling is that it is simply difficult. The argument runs such that given that it is already hard to estimate precisely market

and credit risk independently. To estimate them jointly you need to take a stand on some structural model. The compound effects of model risk and estimation error may make your estimates quite unreliable. A case in point was the announcement by Goldman Sachs last summer (2007) that they were hit by a 25 standard deviation shock twice in a row. Clearly this does not make sense[16]^[16]. Difficult or not it does appear from a recent survey of risk management practice by the BIS[17]^[17] that this is the direction in which the larger banking groups are moving. The survey notes that

?risk concentrations at most financial conglomerates are still chiefly identified, measured and managed within separate risk categories and within business lines. This is characterized as ?silo management?. However, it becomes increasingly clear (from the CC, recent experience) that risk concentrations may arise from interrelated exposures across risk categories, given this; it is clear that it is especially important for those firms with a significant presence in the risk transfer markets to have an integrated risk concentration management approach across risk categories (credit risk, market risk, insurance risk and liquidity risk).?

Stress Testing Liquidity Risk ? The Practical Guide

The recent paper by the BCBS (Basel Committee for Banking Supervision) referred above ?Principles for Sound Liquidity Risk Management and Supervision?, goes into some detail on how to stress test liquidity exposure in the specification of Principle 10; paragraphs 92 through 107. Again the necessity to consider the Banking Book and the Trading Book jointly is emphasized; ?A bank should specifically take into account the link between reductions in market liquidity and constraints on funding liquidity.? This section of the paper lists in detail factors to consider when constructing the Liquidity Risk stress test and gives some detailed supervisory guidance as to the role of the board of directors and senior management in relation to the stress test output.

This is very useful indeed but what we need to know for the purposes of a practical addressing of both the IFRS7 requirement and the Supervisory (Basel II Pillar 2) requirement for a stress test of Liquidity is first what does the statistical methodology for a stress test of Liquidity Risk need to look like and second thus what would the data management and predictive analytic solution architecture have to look like to support such a stress test. It is important to note, that it is not simply the advice of this author that the client institution should implement a single Liquidity risk stress test platform to support both IFRS7 and Basel II process requirements, it has become the stated policy of at least the Basel Committee that the supervisory requirements and accounting requirements are aligned.

The BCBS recommends that ?a bank should employ a range of customized measurement tools, or metrics, as there is no single metric that can comprehensively quantify liquidity risk. A bank should have metrics that assess the structure of the balance sheet (i.e. static ratios), as well as metrics that provide a more forward-looking view of liquidity risk exposures. These metrics should span vulnerabilities across business-as-usual and stressed conditions over various time horizons. Under business-as-usual conditions, prospective measures should identify needs that may arise from projected outflows relative to routine sources of funding. Under stress conditions, prospective measures should be able to identify

funding gaps at various horizons, and in turn serve as a basis for liquidity risk limits and early warning indicators.?

This general recommendation of basic principles requires to be fleshed out in detail if we are to consider what a Solution Architecture might look like which would integrate the necessary Analytics with a Data Management platform necessary to support them. The Committee of European Banking Supervisors (CEBS) in its recent publication on Liquidity Risk Management (LRM)^[18] selects 'Methodology' as the most accurate term to define the range of tools actually used by institutions to measure and monitor Liquidity Risk. CEBS continues to comment that 'In contrast with market risk and credit risk, there is not really any best-practice model', in the sense of an integrated measurement tool that is capable of covering all of the dimensions of liquidity risk, and that is used in similar form by a majority of institutions.?

^[1]^[19] "Computing Capital for Incremental Risk in the Trading Book" and "Revisions to the Basel II market risk framework" - consultative documents issued by the Basel Committee on Banking Supervision

22 July 2008. <http://www.bis.org/press/p080722.htm> ^[20]

^[2]^[21] What central banks can learn about default risk from credit markets, Ian W Marsh, Bank of England

BIS Papers No 12

^[3]^[22] Interest Rate Related Derivatives Growth at Credit Institutions in Ireland, by David Doran
Financial Stability Report 2004, Central Bank of Ireland

^[4]^[23] Market distress and vanishing liquidity anatomy and policy options, BIS Working Papers No 158

by Claudio Borio, July 2004

^[5]^[24] Interest Rate Related Derivatives Growth at Credit Institutions in Ireland, by David Doran
Financial Stability Report 2004, Central Bank of Ireland

[6] ^[25] Trading Book Survey A Summary of Responses, April 2005, Bank for International Settlements

[7] ^[26] Calculated Risk: How banks make sure they stay off the Barings path, By Neil Hereford Senior Analyst, Market Risk, Reserve Bank of Australia

[8] ^[27] Principles for Sound Liquidity Risk Management and Supervision, June 2008 ? DRAFT FOR CONSULTATION, <http://www.bis.org/publ/bcbs138.pdf?noframes=1> ^[28]

[9] ^[29] Guidelines for Computing Capital for Incremental Risk in the Trading Book, July 2008, <http://www.bis.org/publ/bcbs141.htm> ^[30]

[10] ^[31] Basel Committee on Banking Supervision announces steps to strengthen the resilience of the banking system, 16 April 2008, <http://www.bis.org/press/p080416.htm> ^[32]

[11] ^[33] <http://www.sap.com/uk/images/baselii/whitepaper.pdf> ^[34]

[12] ^[35] Range of practices and issues in economic capital modeling Issued for comment by 28 November 2008 in August 2008 <http://www.bis.org/publ/bcbs143.pdf?noframes=1> ^[36]

[13] ^[37] http://www.bundesbank.de/vfz/vfz_konferenzen_2007.en.php#interaction ^[38],

[14] ^[39] The integrated impact of credit and interest rate risk on banks: an economic value and capital adequacy perspective, <http://www.bankofengland.co.uk/publications/workingpapers/wp339.pdf> ^[40]

[15] ^[41] Regulatory Capital for Market and Credit Risk Interaction: Is Current Regulation Always Conservative? Thomas Breuer (Fachhochschule Vorarlberg), Martin Jandaka (Fachhochschule Vorarlberg), Klaus Rheinberger (Fachhochschule Vorarlberg), Martin Summer (Oesterreichische Nationalbank)

[16] ^[42] Simone Manganelli, Principal Economist, Financial Research Division, DG-Research, European Central Bank

[17] ^[43] Basel Committee on Banking Supervision, The Joint Forum Cross-sectoral review of group-wide identification and management of risk concentrations, April 2008

[18] ^[44] SECOND PART OF CEBS'S TECHNICAL ADVICE TO THE EUROPEAN COMMISSION ON LIQUIDITY RISK MANAGEMENT - Analysis of specific issues listed by the Commission and challenges not currently addressed in the EEA - CEBS 2008 147 18 September 2008

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- [18] http://www.asymptotix.eu/news/liquidity-risk-sharp-end-issue-credit-crunch-2008#_ftn18
- [19] http://www.asymptotix.eu/news/liquidity-risk-sharp-end-issue-credit-crunch-2008#_ftnref1
- [20] <http://www.bis.org/press/p080722.htm>
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- [22] http://www.asymptotix.eu/news/liquidity-risk-sharp-end-issue-credit-crunch-2008#_ftnref3
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- [27] http://www.asymptotix.eu/news/liquidity-risk-sharp-end-issue-credit-crunch-2008#_ftnref8
- [28] <http://www.bis.org/publ/bcbs138.pdf?noframes=1>
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- [30] <http://www.bis.org/publ/bcbs141.htm>
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- [32] <http://www.bis.org/press/p080416.htm>
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- [34] <http://www.sap.com/uk/images/baselii/whitepaper.pdf>
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- [38] http://www.bundesbank.de/vfz/vfz_konferenzen_2007.en.php#interaction
- [39] http://www.asymptotix.eu/news/liquidity-risk-sharp-end-issue-credit-crunch-2008#_ftnref14
- [40] <http://www.bankofengland.co.uk/publications/workingpapers/wp339.pdf>
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