

### 3 STRESS TESTING AND CONTINGENCY FUNDING PLANS: ANALYSIS OF CURRENT PRACTICES IN THE LUXEMBOURG BANKING SECTOR

Par  
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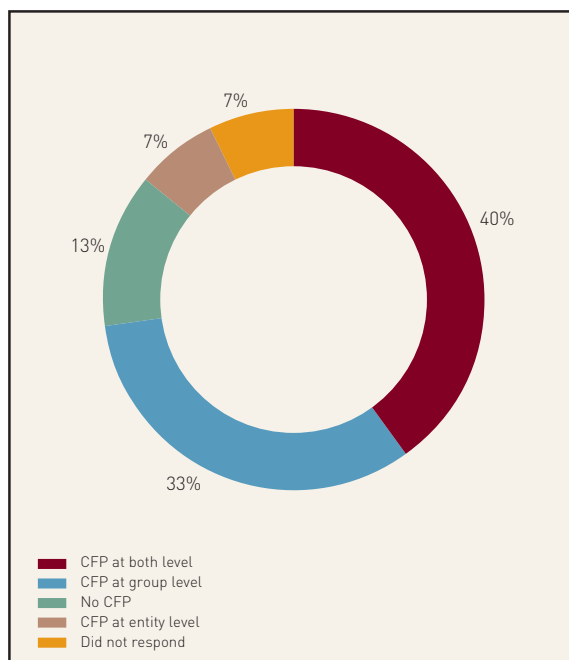
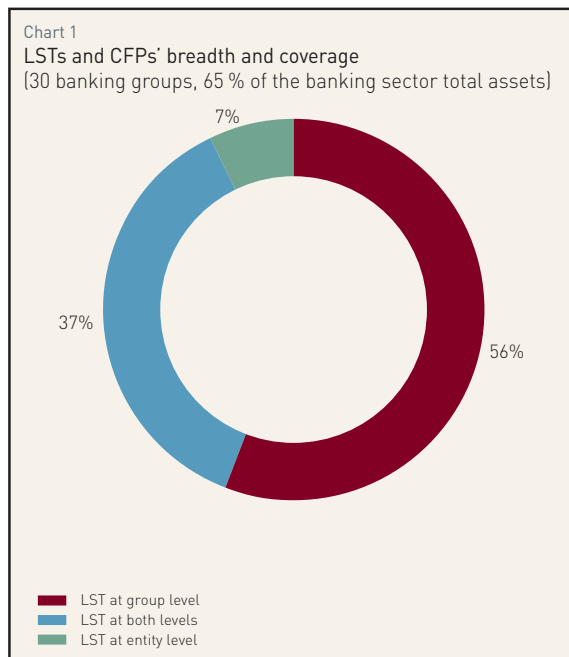
#### 3.1 INTRODUCTION

The revision of the legal framework<sup>16</sup> which defined the perimeter of the responsibilities of the Banque centrale du Luxembourg (hereafter the BCL) in the field of liquidity surveillance and the assessment of market operators brought with it new tasks for the BCL. This increased responsibility includes amongst others the evaluation of the soundness of liquidity risk management current practices in credit institutions. With this forward-looking approach, the BCL investigated two of the main pillars of liquidity risk management (LRM) practices: liquidity stress testing (LST) and contingency funding plan (CFP). This investigation took the form of a questionnaire, which was sent to a selected sample of Luxembourg credit institutions<sup>17</sup>.

This article shall consequently explore the results of the above-mentioned survey. We shall look at the implementation of LSTs and CFPs within the Luxembourg banking sector, the issues experienced during the current turmoil and the lessons to be drawn from this. Given that a liquidity shock is a “black swan” event, current risk management tools can underestimate its impact on banking business. To manage liquidity risk various authors suggest adopting LSTs and CFPs. The results of this survey prove that LST and CFP are widely adopted; however, banks rely mainly on the parent company for their implementation. We also found that local banks are rather passive as concerns development of these stress tests and plans on a local basis.

#### 3.2 LESSONS TO BE DRAWN FOR CREDIT INSTITUTIONS

The respondents have widely implemented LSTs and CFPs; however, their involvement in scenarios’ design and CFPs’ setup is often limited. This may be due to the effect of the centralization of liquidity risk management and to the presence of a large number of branches and subsidiaries in the domestic banking sector, highlighted by the fact that over half of banks are performing their stress tests at a group level. This does not imply that the Luxembourg entity is not involved in the exercise but the development phase is often not performed locally. A similar situation is also observed for CFPs, but to a lesser extent as local entities are more often involved in their own CFPs’ design. A limited number of respondents did not implement a CFP (see Chart 1).

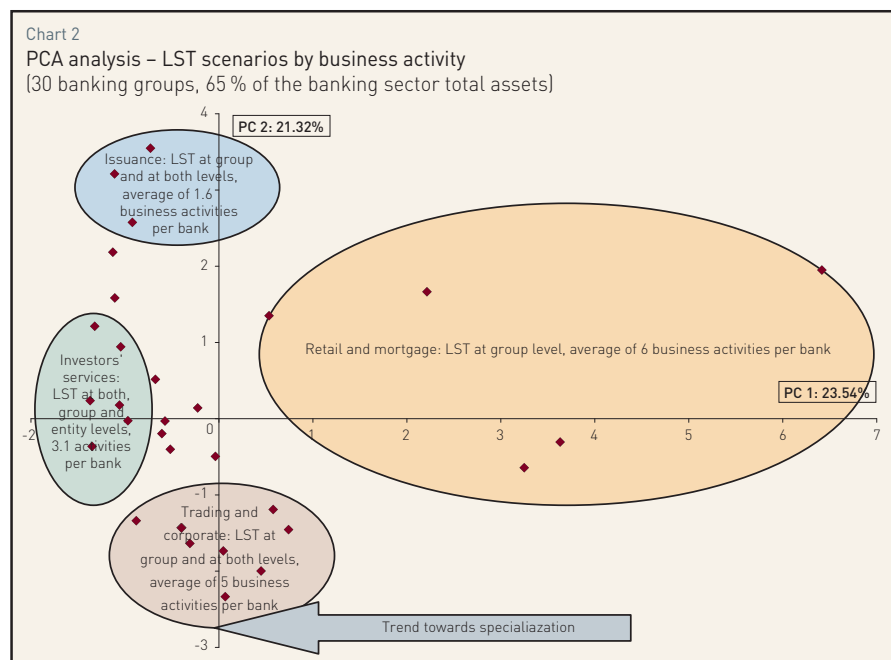


15 Banque centrale du Luxembourg

16 Loi du 24/10/2008, Mémorial A n°161 du 29/10/2008 p. 2250

17 For further information as regards the composition of the sample as well as the methodology used in the analysis we refer the reader to an upcoming working paper by F. Stragiotti.

In order to further investigate LSTs breadth and coverage within the Luxembourg banking sector, we have mapped the respondent banks in a bi-dimensional space according to their business activities by means of a data mining technique called principal component analysis<sup>18</sup> (PCA hereafter) (see Chart 2).



PCA defines at first the factorial axes PC1 and PC2, which contribute to the largest extent to the description of the variability within the sample<sup>19</sup>. Axis PC1's main components are business activities "retail" and "mortgage": banks located on the right-hand side of the chart are more likely to be active in both these business areas. On the opposite side of the chart, banks are active as investors' service providers. Likewise, PC2 integrates the dimension "trading" and "issuance" as indicated in the chart. Each bank is then plotted on the space defined by these axes. Each point represents a bank and its degree of proximity with the main components of the axes. The further these points are from the axes' origin (0, 0), the higher is their

explanatory power with respect to the whole sample variability. As shown in the chart, the directions of the arrows indicate the shift from a less to a more specialized approach to the banking business. Accordingly, it is possible to notice a shift from group level to coverage of LST at both (group and entity) levels<sup>20</sup>. This may indicate several things:

- Banks which are active in the retail and mortgage banking business often delegate the design and implementation of their LST to the parent company. This trend fades away as far as we move to the left-hand side of the chart (to other types of businesses).
- Banks seem to delegate the design of their LSTs to the parent company when the degree of specialization of their business is lower (i.e. the bank offers a wide range of different services). Banks whose core business is centered on few specific business activities tend to perform their LSTs also at an entity level. Some have a specific LST designed especially on the liquidity risks of the local entity. In particular, banks which are offering specific services to investors (fund management, custody, and depository) or which are active as issuance institutions were more likely to adopt LST at both levels. These latter activities are rather specific of the domestic financial center.

18 Data mining refers to a set of various statistical techniques which allow for the exploitation of large database repositories. Among these techniques we list multiple correspondence analysis, which integrate qualitative (discontinuous) variables as well as principal component analysis, which deals with quantitative (continuous) data. The advantage of these techniques is the possibility offered to visualize relationships between variables in an n-dimensional matrix by reducing this matrix complexity (from n to usually 2 or 3 dimensions). These new dimensions are better fit to capture the variability within the database.

19 PC stands for principal component. For graphical purposes we only use the first two principal components PC1 and PC2, which describe respectively 23.54% and 21.32% of the whole sample variability.

20 Unfortunately, the small dimension of the sample does not allow drawing more general conclusions, but this aspect of LRM deserves further investigation given the importance of performing LSTs which fully integrate liquidity risks carried out by local entities.

Complexity and frequency of stress tests should also be appropriate to the liquidity role of each credit institution within a financial group. From a central bank perspective LSTs should be aligned with the systemic relevance of each credit institution in financial markets as the failure of a systemically relevant large cross-border financial groups may pose a threat to financial stability<sup>21</sup>.

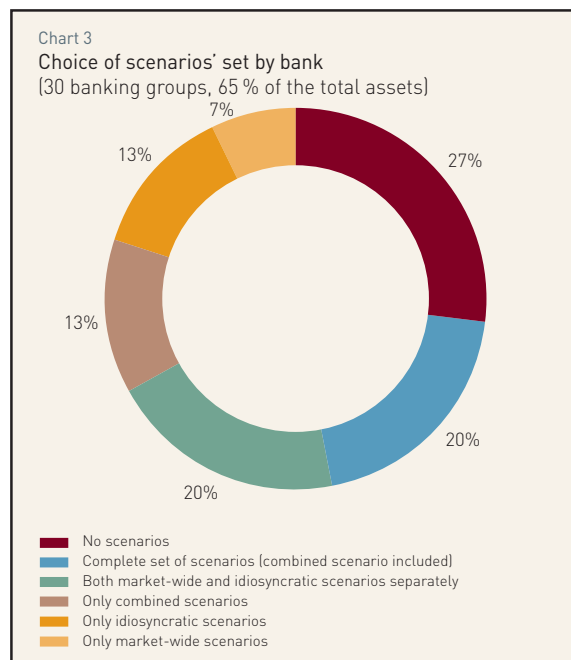
On aggregate, the high degree of centralization which characterizes the Luxembourg banking sector in terms of LRM may raise some uncertainty regarding the local degree of control/management of liquidity risk. Cross-border banking groups may have to assess if local entities carrying out locally specific business activities should implement tailored LSTs, in particular when these entities are relevant as group liquidity providers or perform specific activities within the group. This could either imply performing a part of the group's liquidity risk management activities at a local level or a closer interaction between the local entity and the parent company in this respect. Whatever the case may be, the centralization of LRM activities should not represent an alibi for local banks as concerns the performance of their due diligence in this field.

### 3.3 LIQUIDITY STRESS TESTING

As regards LSTs, Luxembourg banks do not often adopt combined scenarios (see Chart 3). Taking this approach may be rather short sighted, especially when you consider the increasing risk of interaction between financial markets and the entangled risk that a liquidity crisis may have.

The results highlight that the implementation of combined scenarios is confined to a limited share of all LSTs. Indeed, local banks seem to opt for idiosyncratic scenarios and to a lesser extent for pure (lacking any bank-specific feature) market-wide ones. The reasons for this choice may rely on the major presence in the local banking environment of subsidiaries and branches of international banking groups. These subsidiaries and branches in general do not manage their liquidity risk locally, as seen before. The lack of the autonomy (and the centralization of several LRM functions at a higher level) may lead Luxembourg entities to actually identify their liquidity risk as mainly related to a reputational risk. This risk may be linked to the occurrence of an idiosyncratic event, particularly at their parent company level (downgrade or bank-run). Furthermore, even when banks adopted a combined scenario, its assumptions were rather generic. In particular, the impact on local banks' liquidity positions of the interactions between these assumptions was not clearly quantified.

The majority of the respondents which relied exclusively on market-wide or idiosyncratic scenarios adopted a so-called "silo-based" approach. These banks based their scenarios on the following assumptions: idiosyncratic and market-wide events were uncorrelated (no cause-effect link) and at the same time their joint probability of occurrence was negligible. The current crisis has highlighted that these assumptions were not realistic. Combined liquidity shocks should particularly be monitored as they may have systemic effects on the financial system. A market-wide event may emphasize an idiosyncratic weakness at one or more specific credit institutions as well as an idiosyncratic event in one specific bank which may trigger a crisis of broader spectrum by contagion effect. In both cases, these risks should be considered when designing a liquidity scenario.

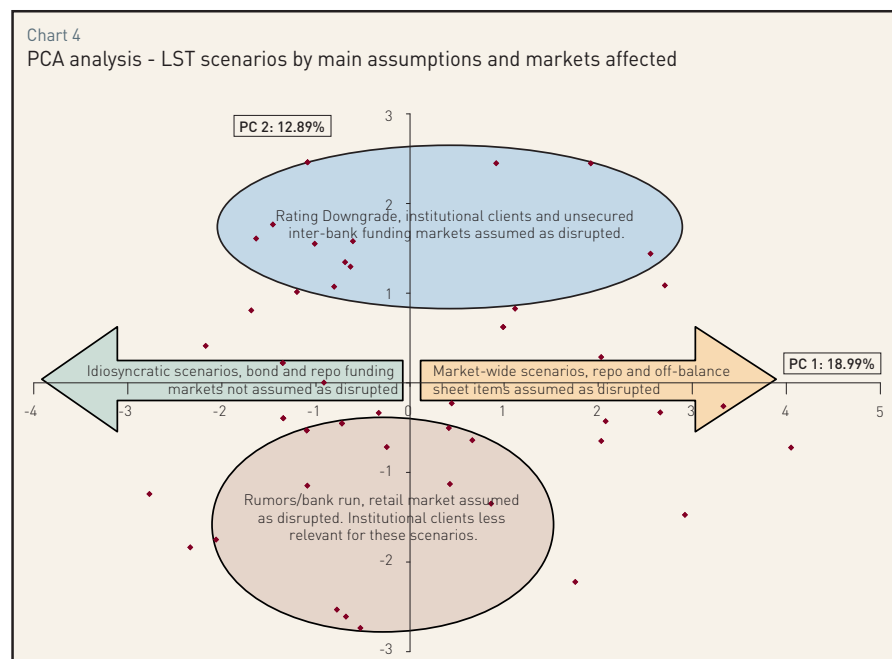


21 The events following Lehman Brothers' default have highlighted the risks entailed by the default of systemic banks.

### 3.4 STRESS TESTS SCENARIOS

In order to define similarities across *all* types of scenarios we ran a principal component analysis of the 50 (out of 61) scenarios for which we obtained a suitable set of information. We classified each scenario according to the following features:

- **Core dimensions:**
  - idiosyncratic
  - downgrade
  - rumors/bank run
  - internal crisis
- market-wide
  - liquidity squeeze
  - economic crisis
  - financial markets' crash
- **Markets assumed as disrupted in the scenario<sup>22</sup>:**
  - retail deposits
  - secured inter-bank market (repo)
  - unsecured inter-bank market (CD/CP, FX swaps, inter-bank deposits)
  - bond and covered bond market
  - structured finance market (securitization, ABS, CDOs)
  - institutional deposits (corporate/holdings/investment funds)
  - central banks
  - off-balance sheet items (including liquidity lines to conduits/SPVs)



We illustrate the relationships across these variables in a bi-dimensional space (see Chart 4). The purpose of the analysis was to define the type of scenarios run by the respondents in order to identify potential shortcomings in their implementation at a local level. PCA defines at first the factorial axes PC1 and PC2, which contribute to the largest extent to the description of the variability within the sample. These two axes on aggregate represent roughly 32% of the whole variability in our sample. The results indicated that banks located on the right-hand side of axis PC1 assumed the repo market as well as off-balance sheet items as disrupted. On the left-hand side we observe idiosyncratic scenarios, where banks assumed

bond and repo markets as accessible. Axis PC2 integrates the dimension "downgrade" as most relevant: banks located in the upper side most likely integrate this feature in their scenarios.

<sup>22</sup> As regards core assumptions about disrupted markets, these were gathered from the analysis of the questionnaire responses as well as from internal documents collected from local entities. Some funding markets/balance sheet items were aggregated.

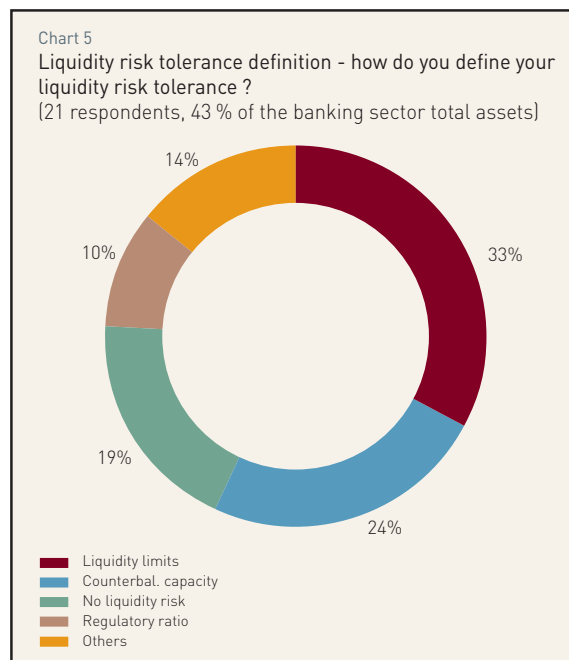
The *chart* highlights that downgrades usually imply the unsecured inter-bank as well as the institutional clients' channels as disrupted simultaneously. These sources of funding, as expected, are perceived by the respondents as the most sensitive to changes in rating. Scenarios featuring liquidity crises triggered by rumors mainly included the retail channel (lower side of the chart), whereas institutional clients were often not considered relevant. It seemed as banks drew a line between these two latter types of clients: but many customers may have become more sophisticated (or sensitive to financial information) than before the crisis. Changes in behaviors of several types of clients may deserve further investigation. Idiosyncratic scenarios usually assumed bond and repo markets as accessible. These assumptions seem rather strong under current market conditions and deserve careful revision.

Several respondents funded SPVs and other securitization vehicles, which requested their sponsoring banks to provide the needed liquidity. The impact of these off-balance sheet liquidity lines was not always considered in the respondents' scenarios. Furthermore, certain areas of the banking business should be better integrated within the banks' stress tests. One such area is the increase in online banking. Its role as a funding source for banks is growing and shall contribute to changes in banks' funding strategies with an impact for liquidity risk management. Several respondents assumed stickiness of retail deposits. Given the evolution of the banking products, this "stickiness" shall have to be tested, particularly when you consider that online banking does not enjoy the same characteristics of a traditional deposit, i.e. in the case of a bank-run<sup>23</sup>. Changes such as these are often not included in banks' LSTs. In light of current turmoil certain funding sources (such as securitization, commercial papers, online banking) shall have to be re-assessed as these sources may not be accessible to the same extent as they were before.

### 3.5 LIQUIDITY RISK MEASUREMENTS

As concerns liquidity risk tolerance, this is defined as the degree of uncertainty that a bank is willing to accept as regards its liquidity position in a certain interval of time. The large majority of the respondents quantified their liquidity risk tolerance (roughly 90% of the respondents). The most common measure of liquidity risk tolerance in our survey (33% of the respondents) is the setting of internal liquidity risk limits (see *Chart 5*).

These limits consist of lending volume indicators as well as long-term asset funded by stable funding sources, etc. which should not be trespassed during a predefined interval of time. This risk is also measured through the definition of equality between the expected future cash outflows and the counterbalancing capacity<sup>24</sup> over a predefined time horizon or band (as was favored by 24% of respondents). It is important for banks to be able to define the size of their counterbalancing capacity and the levels of these internal limits, even though these indicators are only recognized approximations for the definition of banks' liquidity risk tolerance. Best practices in this field would suggest setting these latter features (size and levels) by defining survival horizons according to scenarios outcomes (based on severe but plausible events). Few respondents (19%) declared to accept no liquidity risk: this implicitly would mean that these banks disposed of a sufficient portfolio of

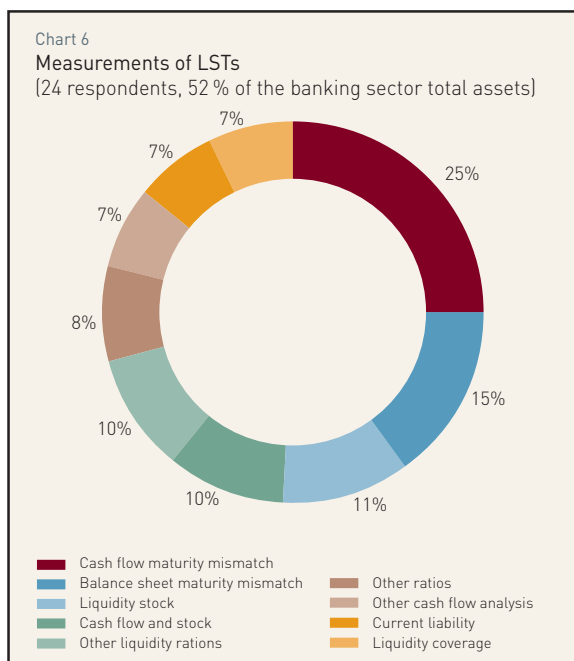


23 In particular if funds may be only accessible electronically and no retail branch is located within acceptable distance.

24 Defined as the sum of cash inflows with (or without) liquidity buffer.



liquid assets enabling them to fulfill the entire set of potential liquidity events on a continuous basis. This appears as a rather strong assumption. The respondents' approach highlighted that the largest share of the respondents did not define any survival horizon. The lack of clarity as regards the setting of the time horizon may expose a bank to an accrued risk during a liquidity squeeze if this latter event is protracted for a longer-than-expected duration.



The respondents seem to prefer to integrate into their LST measurement "toolbox" a selected set of liquidity indicators (see Chart 6). Rarely banks adopt a large number of indicators at once. Cash-flow gap analysis is commonly adopted but its ability to be a precise indicator may be rather questionable depending on the bank's business activity, for longer as well as shorter maturities bands. The adoption of a liquidity buffer may represent a form of "insurance" cost that banks may be required to sustain to protect themselves from abrupt changes in liquidity conditions.

Several banks already adopted liquidity buffers while others don't, given their reliance on their parent company as a funding source. Where liquidity stocks are composed of structured finance products banks should perform a thorough monitoring of the market liquidity of these financial instruments: mark-to-market evaluation should be preferred given the sudden nature of the potential use of the liquidity stock as contingency tool in case of asset liquidation. The assessment of market liquidity appeared to be rarely performed among the respondents. Further investigation is needed in this context for regulatory purposes. The lack of more complex measurement tools may both be a sign of a lack of interest in these ratios (such as liquidity value at risk). Nevertheless, even if these latter types of indicators may be retained as too abstract and of scarce practical use, they may provide efficient solution for LRM and their implementation should not be discarded a priori.

### 3.6 POLICY ISSUES IN LIQUIDITY STRESS TESTING

The disclosure and standardization of stress test results showed that respondents were indifferent to standardization while acknowledging the risks involved in the disclosure of such results. Reluctance to disclose LSTs' results may be traced back to issues related to the interpretation of these outcomes without a deep knowledge of their actual meaning (by a wider audience) in terms of liquidity risk for the bank. Despite the explicit contrariety of the respondents in disclosing stress tests' results<sup>25</sup>, this information may be found in quite a few annual reports published by these banks' parent companies. This contradiction may be explained by two opposite reasons:

- Banks which publicly disclose their LSTs' outcomes may have indeed an interest in doing so, if they have a better liquidity position: this might represent a competitive advantage in comparative terms
- Banks may feel obliged to disclose LSTs' results given that the lack of this information may be detected and interpreted by market participants as a sign of a negative liquidity position

<sup>25</sup> The Task Force in Liquidity Stress Testing and Contingency Funding Plan's report highlights the persistence of this phenomenon at a European level, by investigating a larger sample.

This ambiguity confirmed by the results of the survey, implicitly raises the issue of harmonization of certain elements of LSTs across banks. The majority of the respondents seems to be in favor of such standardization, those who disagree have also rather strong arguments (such as the need of a broad knowledge of the banking business, its funding profile, its liquidity risk tolerance, etc...). Several respondents in other parts of the survey stressed the risk of disclosing any information which may be misinterpreted by market participants: LSTs' outcomes may just be one of these. Nevertheless, transparency must be ensured among market participants so that investors could take informed decisions. This issue may be partly addressed by referring to different standardized scenarios/scope/time survival horizon for different banks adopting similar business models or having similar funding profiles. This matter should be further investigated by the competent organizations. Concerted rounds of macro-stress tests coordinated by the central banks to assess bank-specific liquidity issues or a broader systemic liquidity risk may be implemented on a selected sample of banks or on the whole financial sector if needed.

### 3.7 CONTINGENCY FUNDING PLANS

Liquidity stress testing outcomes, in general, lead to the setup of a contingency funding plan. A close relationship between these two LRM tools should in principle be envisaged. Banks should identify potential liquidity risks, draw appropriate scenarios and define a contingency funding plan accordingly. CFP should dispose of a set of triggers for activation. Triggers should mirror in principle the key aspects of the various predefined stress test scenarios. It appears as the respondents rely among others on bad media coverage (external), liquidity limits breach (internal) triggers and variables as "early warning" indicators (price volatility, asset quality deterioration, systemic liquidity squeeze, etc...). Triggers originating from financial markets' observation were mainly referring to events having an impact on the bank's business, particularly on the funding profile (such as credit spread increase and interest rates shift). Operational triggers seem to be less relevant in this field.

Local credit institutions seem to adopt mainly idiosyncratic triggers for liquidity risk monitoring purposes. Banks prefer to detect issues related to bank-specific events such as limit breaches, downgrades, rumors, etc... rather than receiving market feedbacks. These results raise some questions:

- Is liquidity risk mainly a bank-specific risk? If this would be true, monitoring internal limits would suffice to control and monitor the bank's liquidity risk
- Is liquidity risk also a risk originating in the market? If this is true, market liquidity matters for liquidity risk and a broader monitoring activity is needed
- Is it possible for banks to separate funding and market liquidity risk and truly monitor these two components separately? If this is not the case, a combined approach should be preferred

The current crisis seems to point to a broader monitoring activity of liquidity risk. Banks should internally assess their degree of exposure to liquidity risk which may actually originate from external markets' events. This investigation should deserve further insight from a larger banking sample.

CFPs were usually structured according to levels: several respondents indicated some escalation procedure (on average 2 escalation levels could be detected) as well as various alarm levels (sometimes defined by a light system, sometimes according to the severity of the impact on the bank – large or small). The CFPs are rather diverse: they may vary from more to less formalized documents. The responsibility for activation lies mainly with the treasury department and eventually with the board of directors and the asset/liability committee. Some bank allocates the tasks for activation to different departments depending on the type of crisis. In general, each CFP could be summarized as belonging to the following 4 subgroups:



- The bank defines two (typically) or more crisis levels (acute vs. mild crisis). A set of actions is explicitly described for each of these types of crisis
- The bank defines a set of actions to be taken progressively, according to the escalation of the crisis gravity. These actions include measures that apply to assets (sale of liquid assets, stop/reduction of credit portfolio) and liabilities (increase funding through central banks' operations)
- The bank merely relies on the parent company through an increase in intra-group funding
- The bank cannot define a set of measures: actions will be defined when/if a crisis arises

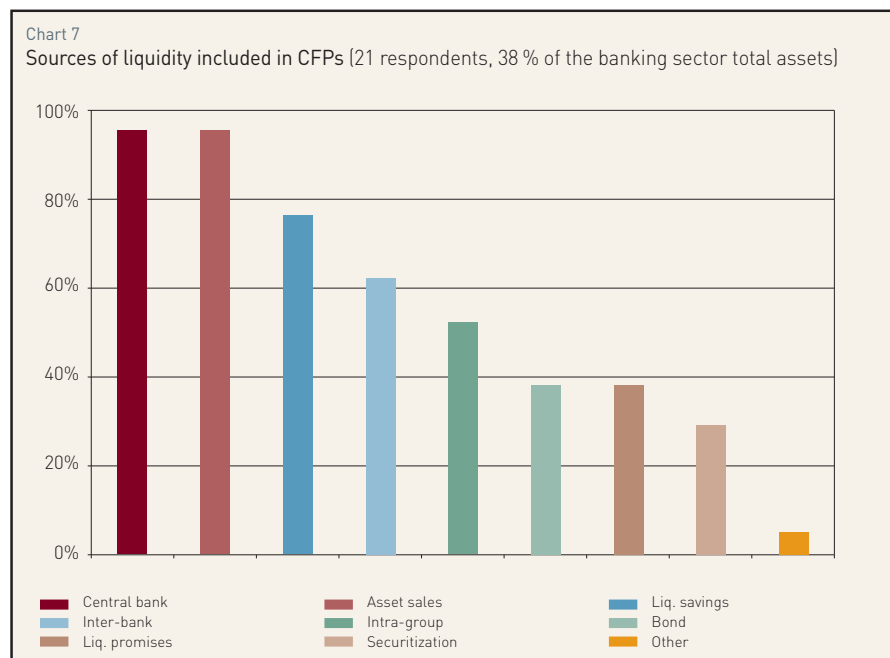
An important aspect of CFP is communication. The respondents highlight this facet in several different responses. In general, CFPs integrate formally covered procedures for communication with external stakeholders (media, regulators, counterparties). Few respondents prefer not to disclose any information in case of liquidity crisis as any information may trigger further liquidity issues by attracting negative media coverage. CFPs are rather different from each other, from relatively simple to complex ones. As there is no accepted common view on CFPs' structure, each bank should arrange its CFP according to its internal organization (in terms of culture and hierarchical structure). It appears as a more detailed CFP, while less flexible may offer a more readily available and operational set of actions.

### 3.8 LESSONS TO BE DRAWN FOR CENTRAL BANKS

As concerns central banks, their major role as liquidity provider was highlighted in the questionnaire. Credit institutions highlight that central banks were considered an important source of funding in banks' CFPs (see Chart 7). Central banks' money was considered a fully accessible source for liquidity. The current crisis has forced central banks to react to the liquidity squeeze with their available tools (e.g. the broadening of available collateral). These measures should not be perceived as permanent. In the current market conditions these measures have helped to foster financial stability in the Euro area. Going forward banks should manage carefully their liquidity risk and should not rely on central banks' money. Banking groups that have a centralized liquidity management have indicated in the survey that they can easily transfer

funds among entities. These groups that have centralized LRM may have on occasion not taken into account the funding received from central banks in areas outside their domestic market.

Given the weight allocated to central banks' operations in LSTs and CFPs it seems reasonable to assume that central banks should be involved in macro and micro liquidity supervision. From a macroeconomic stability point of view, central banks should perform aggregate liquidity stress tests and scenario analysis and eventually distribute these outcomes to supervisors and ultimately to banking establishments themselves. This could:





- Raise awareness regarding second round and liquidity hoarding behaviors
- Increase the range of diversification of CFPs' funding sources
- Clarify the set of the most important current and future risk factors within the domestic financial sector
- Elaborate various scenarios that banks could potentially use to develop within their institutions to address liquidity risk
- Consider the potential advantages and disadvantages of certain funding strategies during liquidity crises

As central banks have a potential role of lender-of-last-resort they should be involved in liquidity monitoring at a supervisory level. The latest events have highlighted that this theoretical role is more practical than it was thought before. It is for this reason that central banks should have access to liquidity data in order for them to be able to process data quickly and effectively to respond to a banking crisis. A number of studies underline the critical role of time to intervene. In this context, agreements with the supervisory authorities should be put in place. It should be accompanied with regular reporting so that central banks are able to assume and fulfill their role in liquidity crises. This applies to large and small countries as well as large and small banks: liquidity risk may spread fast through various channels and dimension did not seem to matter during the latest turmoil.

### 3.9 CONCLUSIONS

This analysis investigated LSTs and CFPs breadth and implementation techniques in the Luxembourg banking sector. The responses indicated that despite LRM techniques are implemented on a local basis, LSTs' scenarios are mainly designed elsewhere and, where the case applies, only implemented locally. This practice may represent a risk for the local subsidiaries and branches of cross-border banking groups in terms of liquidity risk appraisal. A certain involvement of local entities in scenarios' design should be envisaged in the nearest future to avoid systemic risks. Improving the degree of accuracy (e.g. through back-testing of the model's parameters) of the LSTs' models and measurement methods (e.g. by adopting best practices' indicators) may also improve the respondents' LRM efficacy. Furthermore, the introduction of more general combined scenarios is perceived as a current need: all these aspects are cited in banks' "to-do" lists of future developments.

CFPs are usually adopted locally but the triggers appear to lack an in-depth analysis of the market liquidity aspects' particularly for banks active as portfolio manager for the parent company. A closer alignment between scenarios and triggers should be attained in order to increase the efficiency of LRM internal processes. Sources of funding in CFPs are concentrated in few categories and they may encounter issues related to diversification. In this context, a certain degree of autonomy as concerns funding strategies should be considered depending on each bank's business model. LST and CFP need deeper investigation and analytical knowledge as a well-designed LST and an efficient CFP may allow a healthy bank to sustain even a severe liquidity squeeze and avoid bankruptcy: these should be rather convincing arguments.

All the results of the data mining analyses are obtained through the use of the open-source software Tanagra (for more information: [www.http://eric.univ-lyon2.fr/~ricco/tanagra/en/tanagra.html](http://eric.univ-lyon2.fr/~ricco/tanagra/en/tanagra.html)).



#### **Bibliography:**

**Banque de France:** “*Special issue: liquidity*” (February 2008). Available at Banque de France: [http://www.banque-france.fr/banque\\_de\\_france/gb/publications/rsf/rsf\\_022008.htm](http://www.banque-france.fr/banque_de_france/gb/publications/rsf/rsf_022008.htm)

**Basel Committee on Banking Supervision:** “*Liquidity risk: management and supervisory challenges*” (February 2008). Available at BIS: <http://www.bis.org/publ/bcbs136.pdf?noframes=1>

**Basel Committee on Banking Supervision, the Joint Forum:** “*The management of liquidity risk in financial groups*” (May 2006). Available at BIS: <http://www.bis.org/publ/joint16.pdf>

**Brunnermeier, M. K. and Pedersen, L. H.:** “*Market liquidity and funding liquidity*” (March 2007). CEPR Discussion Paper No DP6179. Available at SSRN: <http://ssrn.com/abstract=1133823>

**Committee of European Banking Supervisors:** “*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*” (June 2008). Available at C-EBS: [http://www.c-ebs.org/getdoc/9474df47-8e3f-4130-b3d7-58046b5215d5/CP19\\_Liquidity.aspx](http://www.c-ebs.org/getdoc/9474df47-8e3f-4130-b3d7-58046b5215d5/CP19_Liquidity.aspx)

**European Central Bank:** “*EU banks’ liquidity stress testing and contingency funding plan*” (November 2008). Available at ECB: <http://www.ecb.int/pub/pdf/other/eubankliquiditystresstesting200811en.pdf>

**Matz, L. and Neu, P.:** “*Liquidity risk measurement and management: a practitioner’s guide to global best practices*” (2007) Singapore: Wiley. ISBN 0-470-82182-5, S. 327-359.

**Rouabah, A.:** “*Quelles perspectives pour les banques luxembourgeoises dans un marché européen décloisonné ? – une analyse selon la méthodologie Delphi*” (Mai 2000) Document de travail/working paper n° 00-1, CREA and CRP Gabriel Lippmann