4 ANALYSES

1. AN ANALYSIS OF THE LINKAGES BETWEEN THE BANKING AND SHADOW BANKING SECTORS IN LUXEMBOURG

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I. INTRODUCTION

At the nexus of the banking and non-bank sectors lies, what the Financial Stability Board (FSB) refers to as, the "shadow banking" system. The risk-taking activities conducted by non-bank financial intermediaries, or "shadow entities", hold the potential to generate adverse consequences for the real economy. In order to address the risks related to shadow banking activities, during the November 2010 Seoul Summit[2], the leaders of the G-20 nations requested the Financial Stability Board (FSB) to develop a set of recommendations that could strengthen the oversight and regulatory framework of the shadow banking system. The FSB considers the shadow banking system to be comprised of *"credit intermediation involving entities and activities (fully or partially) outside the regular banking system"* or, phrased more succinctly, non-bank credit intermediation. To illustrate this definition, money market funds fall under the auspices of "shadow banking" particularly in view of their activities involving liquidity and maturity transformation. However, a full and encompassing definition of shadow banking has not yet been finalized at the international level. Although the FSB's definition endeavours to "cast the net wide", from a policymaker's perspective a more precise and practical definition is needed in order to support and facilitate effective policy decisions. Notwithstanding the adoption of a comprehensive and operational definition of shadow banking in a prudential context, the oversight and regulation of the shadow banking system needs to remain adaptive in order to capture the evolving nature of shadow banking activities and risks.

In its reply to the Commission's Green Paper on Shadow Banking[3], the Eurosystem noted that, within the context of the FSB's definition of shadow banking, institutions such as finance companies, hedge funds, investment funds and entities involved in activities related to securitization, repo and securities lending, and MMFs are captured. Indeed, the shadow banking system can be viewed as a dynamic and "moving target" that may vary according to jurisdictions and regulatory frameworks. In fact, the ECB estimates that within Europe the value of assets held by "shadow entities" constitutes approximately one-half of the total assets of the banking system. Furthermore, within the euro area, there tends to be a high degree of interconnectedness between the banking and shadow banking sectors with some segments of the shadow banking sector representing an important source of funding for regulated banks[4]. In some cases, banks' off–balance sheet liabilities of financial vehicles may be guaranteed in some way by the originating banks further increasing the degree of interconnectedness. These interconnections can exacerbate the risk of runs related to the short-term deposit-like funding of non-bank entities and the high levels of leverage oftentimes associated with the use of non-deposit sources of collateralized funding, particularly if assets are over-evaluated along with low margins and/or haircut levels on secured financing.

1 Financial Stability Department, Banque centrale du Luxembourg
2 The November 2010 Seoul Summit Document, November 2010, paragraph 41.
3 The Eurosystem's reply to the Commission's Green Paper on Shadow Banking: *http://www.ecb.int/paym/sepa/pdf/2012-03-3_Eurosystem_reaction_to_EC_Green_Paper.pdf*
4 ECB Occasional Paper No. 133; "Shadow banking in the euro area: An Overview," April 2012.

Given the degree of interconnectedness between banks and shadow banks, in light of the potential for systemic risk to materialize it is important for the Eurosystem to continually monitor and assess the financial stability implications of shadow banking activities. The recent crisis experience has shown that the shadow banking system in Europe is more resilient that those that operate in other areas suggesting that the regulations governing shadow banking activities may be more comprehensive here than in other areas of the world. Nevertheless, Europe must remain vigilant to adverse developments. Indeed, the Eurosystem's reply to the Green Paper clearly states the need for a permanent process at EU level to facilitate the collection and exchange of information related to shadow banking entities. At the European level, the most appropriate authority for this task is clearly the ESRB given its macro-prudential mandate and ability to act as a forum for information exchange.

Although increasing financial integration within the Union is an important agenda to pursue, the other significant factor to consider is that current regulatory frameworks are not uniform at the international level. The effect of these non-uniformities in regulatory regimes has the potential to induce regulatory arbitrage. Consequently, this study is motivated by the strong presence of investment funds and other "shadow banking" entities in Luxembourg in addition to the need to have a more informed picture of the linkages between banks and shadow entities. This study represents the first comprehensive analysis of the linkages between banks and the shadow component of the financial system in Luxembourg.

The study is organized as follows. In part 1, we examine the role that money market funds play in the national financial sector in addition to the structure and breakdown of their composition and counterparties. Part 2 of the report extends the assessment with a particular focus on investment funds other than MMFs. In part 3 the interconnections between banks and shadow entities are assessed using a network analysis technique. Lastly, we conclude. Throughout this note we try to emphasize areas where significant policy issues are at stake and the relevance of larger European initiatives and their possible implications for Luxembourg.

PART I: MONEY MARKET FUNDS

II. MONEY MARKET FUND REFORM

This section begins with a broad overview of the current regulatory issues related to MMFs both in Europe and internationally. Money Market Funds (MMFs) are a type of investment fund with the goal of preserving the principle value of the initial investment and, in some cases, are additionally used as a cash management tool[5]. Although individual fund strategies may vary, MMFs primarily invest in short-term government debt and commercial paper. Given these characteristics, MMFs are considered to exhibit strong similarities with bank deposits yet they offer more attractive yields than a bank deposit. Importantly, the one crucial difference between the two is that, even though MMFs are not supported by official deposit guarantees, their deposit-like nature results in the perception that they represent low-risk and low-return investments. However, the absence of an official backstop makes them susceptible to runs in the event of a sudden increase in investor risk aversion. In addition MMF investors are excluded from deposit guarantee schemes (DGS).

Money Market Funds (MMFs) in the U.S. were significantly and negatively affected by contagion after the failure of Lehman Brothers. One fund in particular, Reserve Primary Fund, actually "broke the buck" as

5 The use of MMFs as a cash management tool is briefly discussed in G. Gunnarsdottir and M. Strömqvist, "Money Market Funds and Financial Stability," Economic Review of the Swedish Riksbank, 2/2010 as well as in Z. Pozsar, (2011), "Institutional Cash Pools and the Triffin Dilemma of the U.S. Banking System", IMF Working Paper.

a result of its exposures to Lehman Brothers. Rather disconcertingly, Reserve Primary's exposure to Lehman was actually quite minimal, but the event nevertheless brought attention to the possible risks associated with MMFs. The Lehman episode, in combination with MMFs' importance as a short-term funding source, highlighted the financial stability risks underlying MMFs. These systemic risks are now at the forefront of the current policy reform initiatives both in Europe and the U.S.

In addition to the progress already made on regulating the money market industry to date[6], multiple initiatives directed towards addressing the risks posed by Money Market Funds and proposals for the reform of MMFs regulation are currently ongoing at both the International and European levels. This section of the report provides a concise summary of the ongoing reform initiatives in Europe and internationally.

1.1 International Reform Initiatives

In following with the outcome of the 2010 Seoul Summit, during the November 2011 Cannes Summit, the G-20 Leaders endorsed the Financial Stability Board's initial recommendations concerning regulatory reform of the money market fund (MMF) industry. More recently, at the Los Cabos Summit in June 2012, the G-20 Leaders once again reiterated their support for the FSB's shadow banking work and encouraged the FSB to submit their formal recommendations for reform in time for the G-20 Finance Ministers and Central Bank Governors meeting in November 2012.

The Financial Stability Board has identified five key areas where policy action is needed in order to mitigate the systemic risk arising from the shadow banking sector. In particular, the FSB document[7] stressed the need *"to reduce the susceptibility of money market funds (MMFs) to "runs""*. After this initial assessment, the FSB recommended that the regulatory framework for MMFs be enhanced in order to address sources of potential risk. Subsequently, the FSB mandated the International Organization of Securities Commissions (IOSCO) to explore and identify potential regulatory policies that could help to mitigate the risk posed by uncontrolled runs on MMFs as well as other systemic risks related to MMFs activities.

In following with this request, on October 9 2012, IOSCO issued a public document containing policy recommendations geared towards improving MMFs regulation[8] and a focus on greater harmonization across jurisdictions. The IOSCO document proposed a total of 15 Recommendations to facilitate MMFs reform. Among the more significant proposals were recommendations for CNAV[9] to convert to VNAV[10] funds where workable. Alternatively, IOSCO has proposed that safeguards should be introduced in order to ensure the resilience of CNAV funds in the face of significant redemption pressures.

In the U.S., money market funds are subject to minimum daily and weekly liquidity requirements in order that they can meet investors' redemption requests. Under U.S. regulation, both taxable and tax-exempt money market funds must hold 30 percent of their assets in cash, Treasuries, government securities with remaining maturities of 60 days or less, or securities that will either mature or are subject to be callable within five business days for purposes of weekly liquidity. Such requirements could be

6 Here we refer to the CESR (now ESMA) Guidelines as well as the IOSCO recommendations which will be discussed in more detail later.
7 FSB Consultative document, "Strengthening Oversight and Regulation of Shadow Banking: An Integrated Overview of Policy Recommendations," November 2012.
8 The Board of the International Organization of Securities Commissions, "Policy Recommendations for Money Market Funds: Final Report," October 2012.
9 CNAV is an acronym for Constant Net Asset Value.
10 VNAV is an acronym for Variable Net Asset Value.

considered for adoption in Europe, thereby shortening the current period from 97 days to 60 days and indirectly imposing a type of liquidity control as well as limits on maturity transformation. Therefore alternative policy recommendations to a mandatory VNAV move are available.

1.2 European Reform Initiatives

The structure of the money market fund (MMF) sector in Europe varies across Member States and some jurisdictions provide a definition of classification of what constitutes an MMF according to their domestic laws or regulatory frameworks. In an attempt to harmonize the definition of Money Market Funds in Europe, the Committee of European Securities Regulators (CESR)[11], has created two categories of MMFs including "Short-term Money Market Funds" and "Money Market Funds". In order to use the "MMF" label, each category of fund must comply with an established list of criteria.

The need for reform within Europe was recognized in the responses to the European Commission's Green Paper on Shadow Banking. The Eurosystem's response to the Commission's Green Paper raised the concern that *"...the financial crisis has also shown that runs on VNAV money market funds*[12] *can also occur."* Consequently, it is the Eurosystem's position that *"...any regulating initiative mandating the move to VNAV should be complemented by additional measures limiting maturity transformation and credit risk. Such measures have already been introduced in the EU and the US. The alternative of imposing bank-like capital and liquidity requirements on MMFs that promise constant NAV, could also be contemplated."*

Regarding a mandatory move from CNAV to VNAV for MMFs, it is not certain that this addresses adequately the risks attributed to CNAV funds. A report prepared by the U.S. Committee on Capital Markets Regulation states that *"...according to the ICI* [Investment Company Institute] *French floating NAV dynamic money funds ... lost about 40 percent of their assets over a three-month time span from July 2007 to September 2007."* Box 1 provides a summary of the ESRB's recommendations that have been addressed to the European Commission.

11 CESR was succeeded by ESMA as a new European authority in charge of securities and markets oversight.
12 This issue is discussed briefly in the report entitled "Interconnectedness and Contagion" prepared by the US Committee on Capital Markets Regulation.

Box 1:

RECOMMENDATIONS ON MMFS PROPOSED BY THE ESRB

Within the ESRB, an Expert Group on Money Market Funds was established to examine the need to issue Warnings or Recommendations in line with the ESRB's macro-prudential monitoring mandate[13]*. The Group has identified a set of four possible Recommendations related to CNAV versus VNAV funds, imposing liquidity requirements, enhancing public disclosure related to the marketing material of MMFs and improving reporting and monitoring standards.*

During the December 2012 meeting of the ESRB General Board, a recommendation to require MMFs to make a mandatory move to VNAV was approved and will be published in February 2013. This recommendation will now be sent to the European Commission who will publish legislative proposals for the UCITS framework and MMFs in early 2013.

The text of the ESRB's Recommendations on Money Market Funds follows:

RECOMMENDATION A – MOVE TO VNAV

The European Commission is recommended:

1. *to require MMFs to have a fluctuating net asset value;*

2. *to require MMFs to make general use of fair valuation and to restrict the use of amortized cost accounting to a limited number of pre-defined circumstances.*

RECOMMENDATION B – LIQUIDITY REQUIREMENTS

The Commission is recommended to ensure that the relevant Union legislation:

1. *complements the existing liquidity requirements for MMFs by imposing explicit minimum amounts of daily and weekly liquid assets that MMFs must hold;*

2. *strengthens the responsibility of the funds' managers regarding the monitoring of liquidity risk;*

3. *ensures that national supervisory authorities and funds' managers have in place effective tools, for example temporary suspensions of redemptions, to deal with liquidity constraints in times of stress resulting from both fund-specific and market-wide developments.*

RECOMMENDATION C – PUBLIC DISCLOSURE

The Commission is recommended to ensure that the relevant Union legislation:

1. *requires specific disclosure by MMFs, also in their marketing material, that draws the attention of investors to the absence of a capital guarantee and the possibility of principal loss;*

13 Separately from the ESRB, Every two years the ECB publishes the Euro Money Market Study which covers the structure and functioning of the euro money market. The published results are based on a survey conducted by the European Central Bank in cooperation with national central banks that are members of the Eurosystem. The Study incorporates data and tables from a regular data survey.

2. *requires that MMFs refer in their public disclosure to possible sponsor support, capacity for support or protection only if such support or protection is a firm commitment by the sponsor, in which case it must be recognised in that sponsor's accounts and prudential requirements;*

3. *requires MMFs to disclose their valuation practices, particularly regarding the use of amortised cost accounting, as well as to provide appropriate information to investors regarding applicable redemption procedures in times of stress.*

RECOMMENDATION D – REPORTING AND INFORMATION SHARING

1. *The Commission is recommended to ensure that the relevant Union legislation:*
   (a) requires that any instances of sponsor support that may have an impact on the price of the MMF are reported by the MMF or its manager, and the sponsor, to the competent national supervisory authority, together with a full description of the nature and size of such support;
   (b) enhances regular reporting by MMFs;
   (c) ensures that competent national supervisory authorities, where relevant, share the information referred to in points (a) and (b) with other national supervisory authorities within the same Member State, or from other Member States, the European Supervisory Authorities, the members of the European System of Central Banks and the ESRB;

2. *The Commission is recommended to promote the development of harmonised reporting and a harmonised data set as mentioned in paragraph 1(b), and the organisation of information sharing mentioned in paragraph 1(c).*

III. FINANCIAL STABILITY AND MONEY MARKET FUNDS

The systemic relevance of money market funds was clearly illustrated during the September 2008 run on MMFs that occurred during the 2007-2008 crisis episode. Even though MMFs were not directly responsible for the outbreak of the financial turmoil at that time, their systemic relevance and potential to amplify or exacerbate the existing turmoil lead to their identification as a driving factor in the broader stability of the financial system.

MMFs play a systemically important role as net liquidity providers to financial institutions as well as the wider financial sector in Europe, including private household investors. Since 2006, the European MMF industry was estimated to have approximately €1 trillion in assets under management[14] (AuM) with France, Ireland and Luxembourg accounting for 90% of the total aggregate market share. According to the ECB, however, as of end-2012 the total amount of AuM of euro area MMFs fell below €1 trillion for the first time since 2006[15]. The results of the ECB Study indicate that the fall in AuM seems to be a result of the continuing low interest rate environment along with a robust demand for bank deposits which benefit from the deposit guarantee schemes in place in a number of Member States.

14 J. Ansidei, E. Bengtsson, D. Frison and G. Ward, "Money Market Funds in Europe and Financial Stability," ESRB Occasional Paper Series, No. 1/June 2012.
15 Source: ECB Euro Money Market Study, December 2012.

Box 2:

FINANCIAL STABILITY RISKS OF MMFS IN EUROPE

According to the ESRB's Occasional Paper on Money Market Funds in Europe and Financial Stability, there are four main risks underlying MMFs and their activities:

A. MATURITY TRANSFORMATION

Money Market Funds in Europe may hold risky assets on their balance sheets that have a maturity date of one year or longer. However, the same funds also issue shares to investors that, in addition to being perceived as "safe," must be redeemable on demand. Under certain conditions, such a maturity mismatch may lead to the inability of the MMF to absorb losses in the event of a sudden investor withdrawal of funds. In the absence of an official liquidity backstop and a "bank-like" set of prudential regulation, MMFs are considered to be at risk of runs.

B. DEPOSIT-LIKE FEATURES

MMFs are "deposit-like" though they are not supported by any form of official guarantee as is the case for bank deposits. The perception that MMF shares are relatively "risk-free", combined with the widespread presence of CNAV funds, may result in the perception by investors that investing in an MMF provides a similar level of security as a bank deposit, but with a higher yield. However, there are clearly risks involved in MMF investment.

C. CASH-LIKE TREATMENT

Given that MMFs are also used as cash management tools, they may be perceived as cash-equivalent. Under International Accounting Standard (IAS) rules[16], "...cash and cash equivalents comprise cash on hand and demand deposits, together with short-term, highly liquid investments that are readily convertible to a known amount of cash and that are subject to an insignificant risk of changes in value."

D. INVESTORS AND RUN RISK

The failure of Reserve Primary illustrated the effects that a sudden investor run can have on an MMF as a result of redemption pressures. At least in the U.S. case, redemptions come primarily from institutional investors[17] which tend to be more risk averse than private investors. Additionally, institutional investors may possess greater resources for - and have access to - better MMF monitoring facilities which can lead them to redeem shares pre-emptively in comparison to private investors according to the "first-mover" advantage.

16 This corresponds to IAS rule 7.7 regarding cash and cash equivalents. Note that the IASB is considering eliminating the concept of cash equivalents which may help to mitigate some of the risks associated with MMFs.
17 Please see the Financial Stability Oversight Council's (FSOC) 2011 Annual Report.

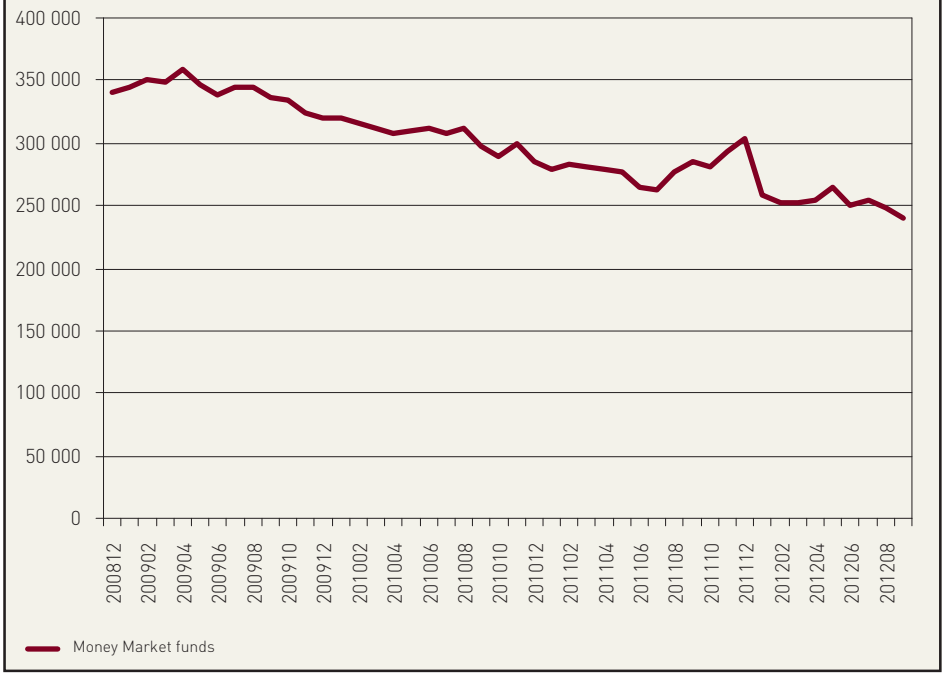
IV. THE IMPORTANCE OF MONEY MARKET FUNDS IN LUXEMBOURG

1.1 Overview of the Luxembourg MMFs Activity

According to IOSCO, the global MMF industry has a significant amount of assets under management and it is estimated to represent around US$ 4.7 trillion as of the first quarter of 2012[18]. By comparison, Luxembourg hosts a money market fund (MMF) activity with total assets under management (AuM) approaching €240 billion as of August 2012 as indicated in the accompanying figure 1. From the period displayed, it can be seen that MMF balance sheets have been in general decline since April 2009 albeit with a small but short-lived resurgence in the latter half of 2011 and early 2012.

For the total assets of MMFs in the euro area, a similar trend has been observed. Since approximately the end of 2008, euro area MMF total assets have been in near constant decline and, in 2012, dipped below €1 trillion for the first time since 2006. It is likely that the prevailing low interest rate environment is the primary factor driving this reduction in total MMF assets. The trend, therefore, seems to be occurring in a larger context and does not appear to be specific to Luxembourg.

Figure 1
Evolution of aggregate MMF balance sheet in Luxembourg, Dec. 2008 - Aug. 2012.
(millions €)



Source: BCL calculations

Recommendations for the reform of the money market fund sector can be expected to lead to structural changes in the functioning and composition of these markets. However, the precise effects of increased regulation are difficult to predict. Given the significant presence of MMFs in Luxembourg, it is important to analyse and assess the structure of this financial system component in order to achieve a better understanding of the possible impact of changes in the regulatory environment.

In Luxembourg, MMFs may be registered as a regulated Specialized Investment Funds (SIF)[19]. The legal form of a SIF can either be classified as a common fund (FCP – *fonds commun de placement*) or as an

18 Size estimate is based on statistics collected by the Investment Company Institute (ICI) and is considered to be approximate only.
19 SIFs have greater flexibility with regard to investment policy and reduced regulatory oversight in comparison to funds created under Part II of the Law of 20 December 2002 regarding undertakings for collective investment. SIF investment is also reserved for "well-informed" investors including "institutional" and "professional" investors.

investment company (SICAV – *Société d'investissement à capital variable* or SICAF – *Société d'investissement à capital fixe*). The regulation of MMFs in Luxembourg is in line with EU directives and ESMA standards.

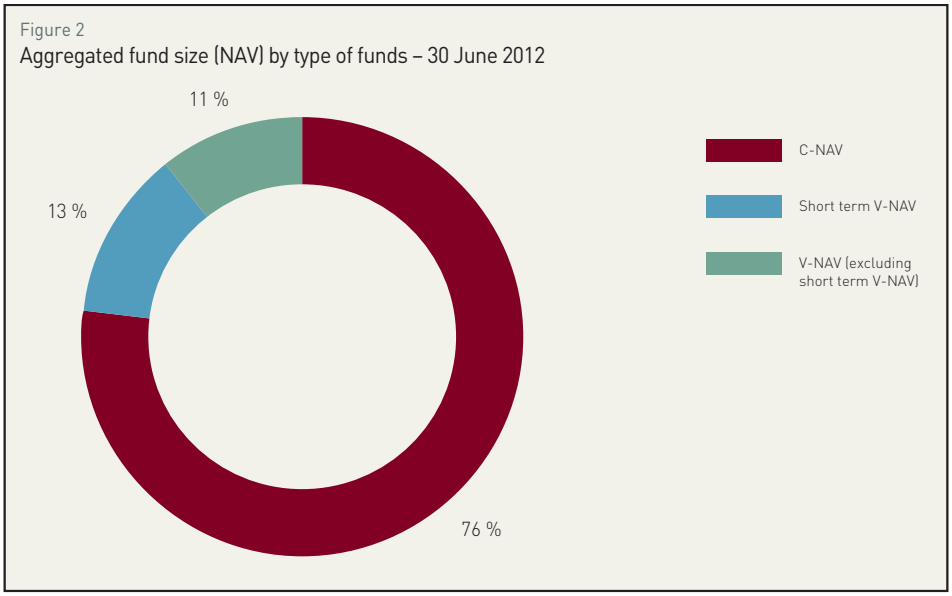
Money market funds play a key role for short-term bank funding but they also represent a source of funding for companies and governments. MMFs' prominent role as funding vehicles can, in part, be attributed to their reputation as a safe alternative to bank deposits and their use as a cash management tool by both corporations and private investors.

Despite the perception that MMFs are a low-risk investment, they do hold risky and some less liquid assets[20] in their portfolios, yet at the same time issue shares that are redeemable on demand (oftentimes on a daily basis). The resulting maturity mismatch between less liquid assets and daily redemption requests can leave MMFs with reduced ability to absorb losses and the lack of an official liquidity backstop further complicates the situation. Nevertheless, a negative shock to a significant MMF can quickly lead to broader spill-overs and negative systemic consequences for the beneficiaries of their short-term funding markets as well as banks.

1.2 CNAV and VNAV Funds in Luxembourg

In Luxembourg, two main categories of MMFs can be distinguished; constant net asset value (CNAV) funds which use amortised cost accounting to value their assets enabling a stable face value (e.g. of €1 or US$1 per share) to be maintained, and variable net asset value (VNAV) funds which principally use mark-to-market accounting. However, as of May 2010, CESR (now known as ESMA) published new criteria establishing two types of MMFs: "short-term money market funds" (STMMFs, which include both VNAV and CNAV funds) and "money market funds" (which are all VNAV funds).

Figure 2
Aggregated fund size (NAV) by type of funds – 30 June 2012



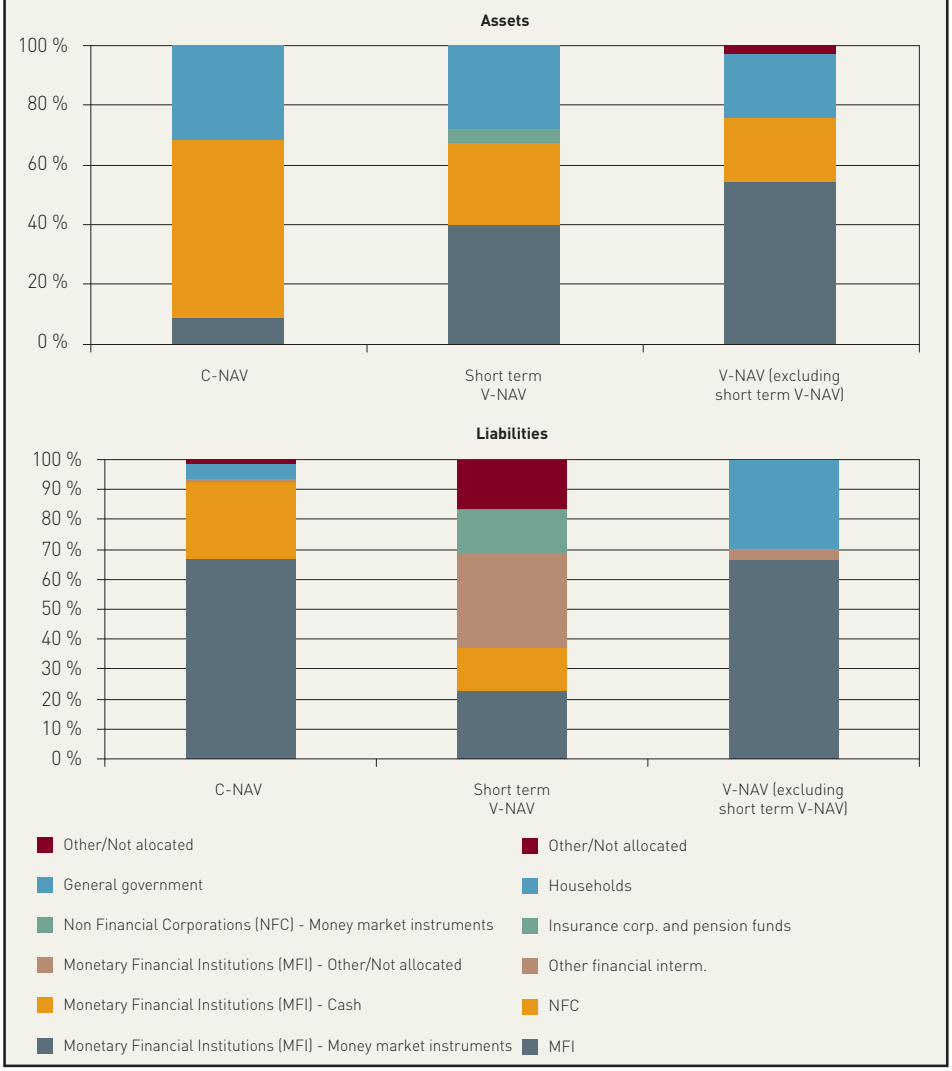
Data sources: CSSF (survey on 24 Luxembourg Money Market Funds and covering 75% of the total aggregated Luxembourg money market funds size); Calculation: BCL

Based on a survey[21] conducted by the Commission de Surveillance du Secteur Financière (CSSF) on 30 June 2012, for MMFs in Luxembourg C-NAV funds represent 76% of the aggregated size of the funds in the survey while short-term V-NAV and V-NAV amount to 13% and 11% respectively as illustrated in figure 2.

20 MMFs invest in an array of money market instruments with very short maturities that are perceived by some to pose little investment risk. Such instruments include repos, as well as deposits. MMFs also invest in long-term assets, typically those close to their original maturity date, such as asset-backed commercial paper or floating rate notes.
21 Based on a sample of 24 Luxembourg money market funds covering 75% of the total Luxembourg money market funds size.

Additionally, as illustrated in figure 3, the data for national[22] counterparts of Luxembourg money market funds shows that the asset side of C-NAV money market funds is mainly composed of monetary financial institutions (MFI) in cash and general government whereas the share of money market instruments (MFI) is more important on the asset side of V-NAV and short-term V-NAV funds. Nevertheless, general government still represents an important share (more than 20%) of the asset side of all three types of money market funds. On the liabilities side, C-NAV and V-NAV (excluding short-term V-NAV funds) funds are characterized by an important share of MFI (around 65%) while liabilities of short-term V-NAV funds are more balanced between MFIs, NFCs, other financial intermediaries and insurance corporations/pension funds.

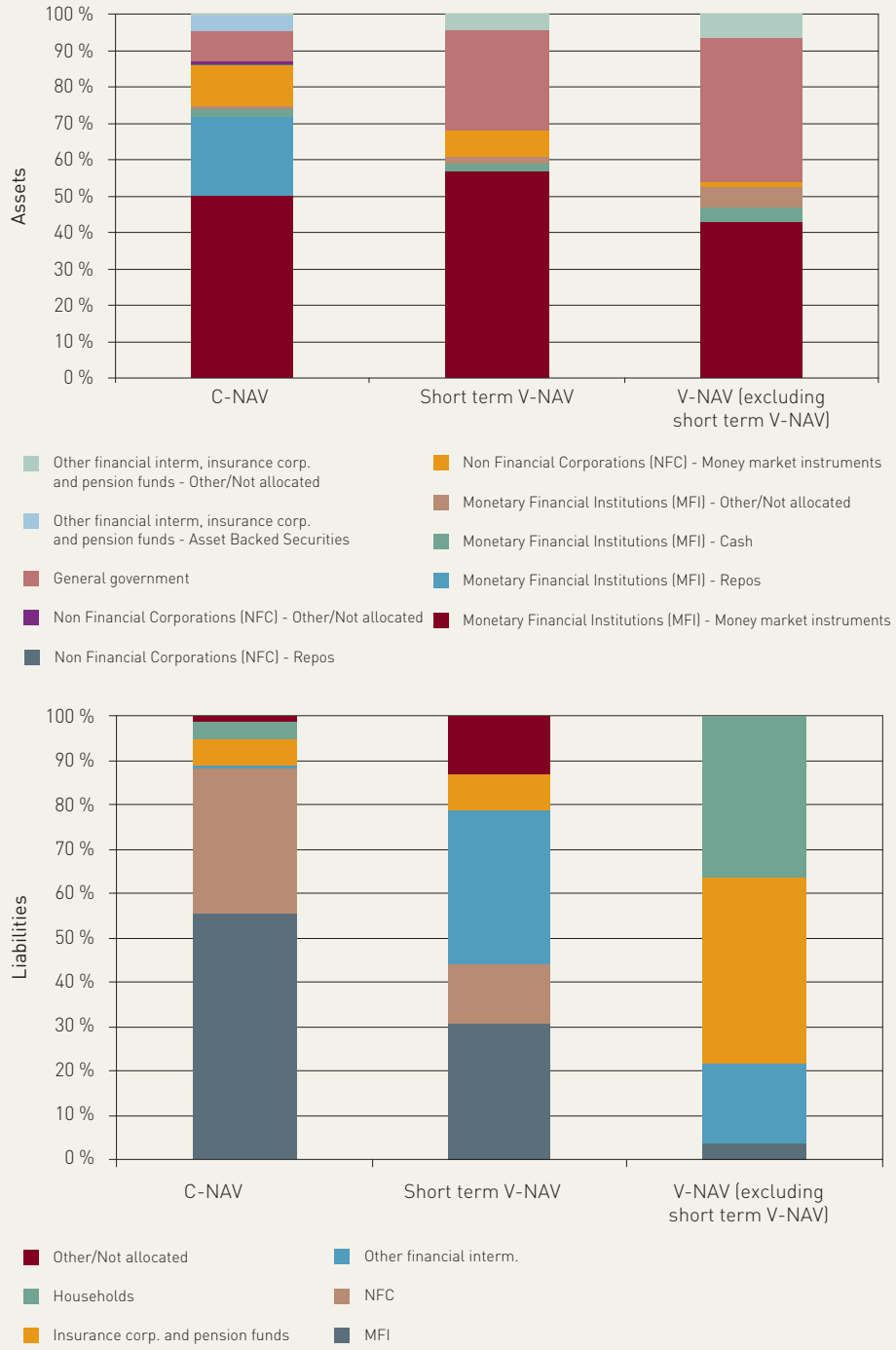
Figure 3
Breakdown of assets/liabilities of Money market fund by type of funds – 30 June 2012



Sources: CSSF (survey on 24 Luxembourg Money Market Funds and covering 75% of Luxembourg total aggregated funds size); Calculation: BCL

22 By national here we mean those counterparties originating in Luxembourg and who account for approximately 5% of total MMF assets.

Figure 4
Counterparts - Other Member States

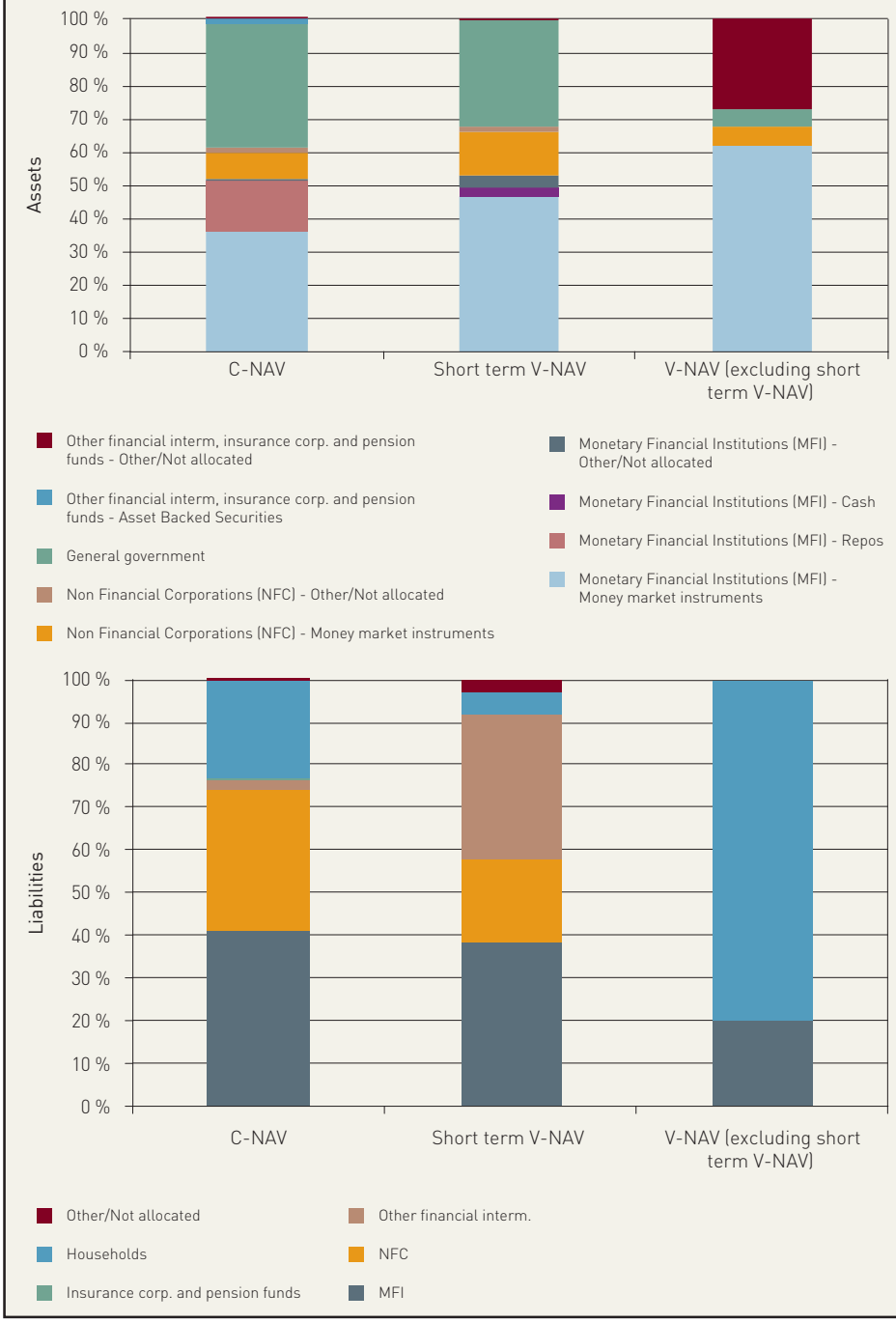


Sources: CSSF (survey on 24 Luxembourg Money Market Funds and covering 75% of Luxembourg total aggregated funds size); Calculation: BCL

With respect to assets and liabilities from other Member States, the asset side of C-NAV and V-NAV money market funds is essentially composed of money market instruments (MFI) as can be seen from figure 4. Moreover, general government debt still represents an important part of the asset side for both short-term V-NAV and V-NAV excluding short-term VNAVs funds. On the liabilities side, C-NAV funds are characterized by an important share of MFI (around 55%), the rest being non-financial corporations. However, the liability side of V-NAV funds (excluding short term V-NAV) is essentially composed of households and insurance corporation/ pension funds while the liabilities of short-term V-NAV funds is mostly characterized by MFIs and other financial intermediaries.

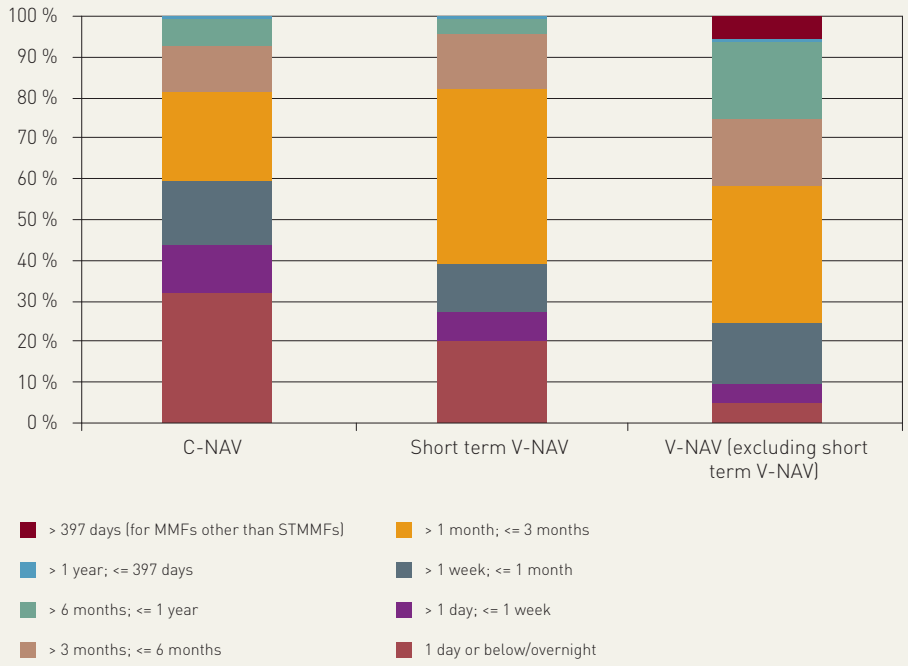
Looking now at figure 5 which provides a breakdown of aggregate data for the Rest of the World, the asset side of C-NAV money market funds is essentially composed of money market instruments (MFI), around 35%, and general government, less than 40%. From figure 5, the same pattern can be observed on the asset side of short-term V-NAV funds (money market instruments (MFI) representing more than 45% and general government more than 30%). V-NAV funds (excluding short-term V-NAV funds) are mainly composed of money market instruments (MFI) (more than 60%) and "not allocated" other financial intermediaries, insurance corporations and pension funds (more than 25%). On the liabilities side, V-NAV funds (excluding short-term V-NAV) are characterized by an important share of households (around 80%), the rest being MFIs. However, the liabilities side of C-NAV funds is composed of money market instruments, MFI, (around 40%), NFC (more than 30%) and households. Finally, liabilities of short-term V-NAV funds are split between MFI, NFC and other financial intermediaries.

Figure 5
Counterparts - Rest of the world



Sources: CSSF (survey covering 24 Luxembourg Money Market Funds and covering 75% of Luxembourg total aggregated funds size); Calculation: BCL

Figure 6
Breakdown of investments by residual maturity by types of money market funds – 30 June 2012
(% of investments which mature within the designated periods)



Sources: CSSF (survey covering 24 Luxembourg Money Market Funds and covering 75% of Luxembourg total aggregated funds size); Calculation: BCL

Figure 6 shows the breakdown of residual maturity by types of money market funds in June 2012. C-NAV funds tend to have almost 60% of their investments in instruments that mature within less than 1 month (compared to 40% and 25% for short-term V-NAV and V-NAV excluding short term V-NAV funds respectively).

Under the ESMA guidelines, the maximum residual maturity for short-term money market funds is 397 days while it is 2 years for money market funds. It has to be noted that, in the European context, ESMA only allows the use of a constant net asset value (C-NAV) for short-term money market funds arguing that the risk of mispricing is greater when the average residual maturity of assets held by money market funds gets longer.

The weighted average maturity (WAM) is a measure of the average length of time to maturity of all of the underlying securities in a fund. The calculation is weighted to reflect the relative holdings in each instrument, assuming that the maturity of a floating rate instrument is the time remaining until the next interest rate reset to the money market rate. From a practical standpoint, the WAM is used to measure the sensitivity of a money market fund to interest rate changes. In Europe, under the ESMA guidelines, the weighted average maturity (WAM) for short-term money market funds is 60 days whereas it is 6 months for other money market funds.

Another measure in use, the weighted average life (WAL) is the weighted average of the remaining life (maturity) of each security held, meaning the time until the principal is repaid in full (disregarding interest and not discounting). Contrary to the WAM, the calculation of the WAL for floating rate securities and structured financial instruments does not permit the use of interest rate reset dates and instead only uses a security's stated final maturity. In practice, the WAL is used to measure the credit risk, as the longer the reimbursement of principal is postponed, the higher is the credit risk. It is also used to limit the liquidity risk. According to ESMA guidelines, the weighted average life (WAL), maximum is set at 120 days for short-term money market funds and 1 year for other money market funds.

Box 3:

SUMMARY OF CESR GUIDELINES FOR A HARMONIZED MMF DEFINITION

In May 2010 CESR (succeeded by ESMA as a European authority) established a set of criteria with the intention to create a harmonized definition of MMFs in Europe. The CESR guidelines established a dual classification for MMFs consisting of "Money Market Funds" (MMFs) and "short-term money market funds" (ST-MMFs). The ESMA Guidelines impose strict standards on MMFs in terms of their sensitivity to interest rate risk, their liquidity requirements, the maturity of assets held by MMFs and credit risk exposures. From a prudential perspective, ST-MMFs operate with very short WAM and WAL while MMFs operate with longer WAM and WAL giving rise to important and characteristic policy considerations for each category of fund (i.e. maturity transformation, etc...)

The CESR standards also impose requirements on the specific information disclosures with particular emphasis being placed on MMF shares differences with actual bank deposits. Under the guidelines it is required that MMF documentation is clear in delineating that the objective of the fund is to preserve the initial capital investment and not for the fund to be construed as a capital guarantee. Additionally, MMFs are also required to provide disclosures on the impact of their long average duration on the risk profile of the particular fund.

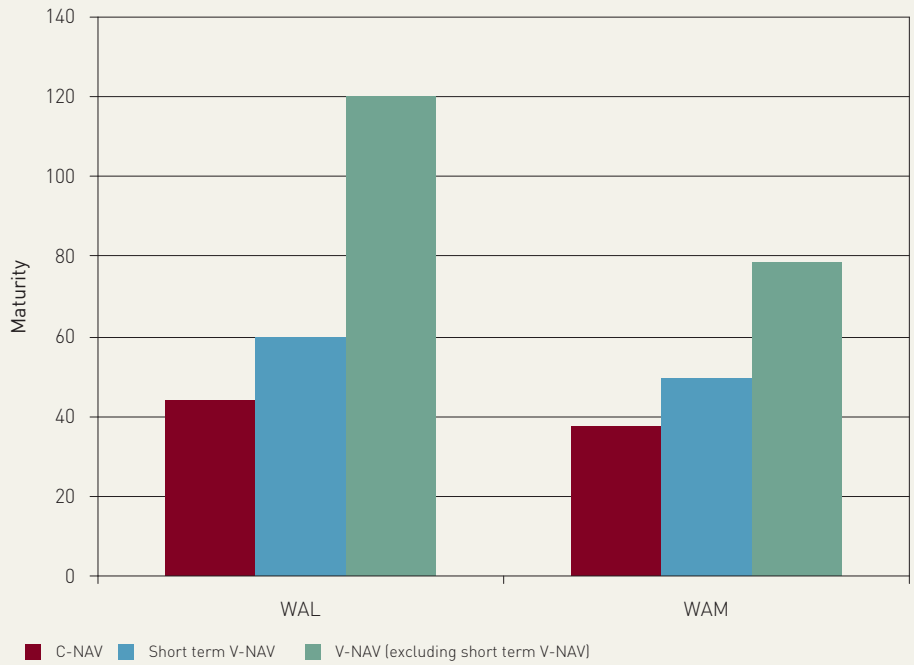
The CESR guidelines entered into effect in July 2011.

For the Luxembourg data, one can see from figure 7 that on 30 June 2012, the WAL amounted to 44 days for C-NAV funds, 60 days for V-NAV funds (excluding short-term V-NAV) and slightly less than 120 days for short-term V-NAV funds. The WAM was 37 days for C-NAV funds, 49 days for V-NAV funds (excluding short-term V-NAV) and less than 78 days for short-term V-NAV funds.

As regards the breakdown of securities held by Luxembourg money market funds by countries on 30 June 2012, figure 8 below shows that the US represents 32% while France 13%, the UK 11%, Germany 9% and the Netherlands 9%.

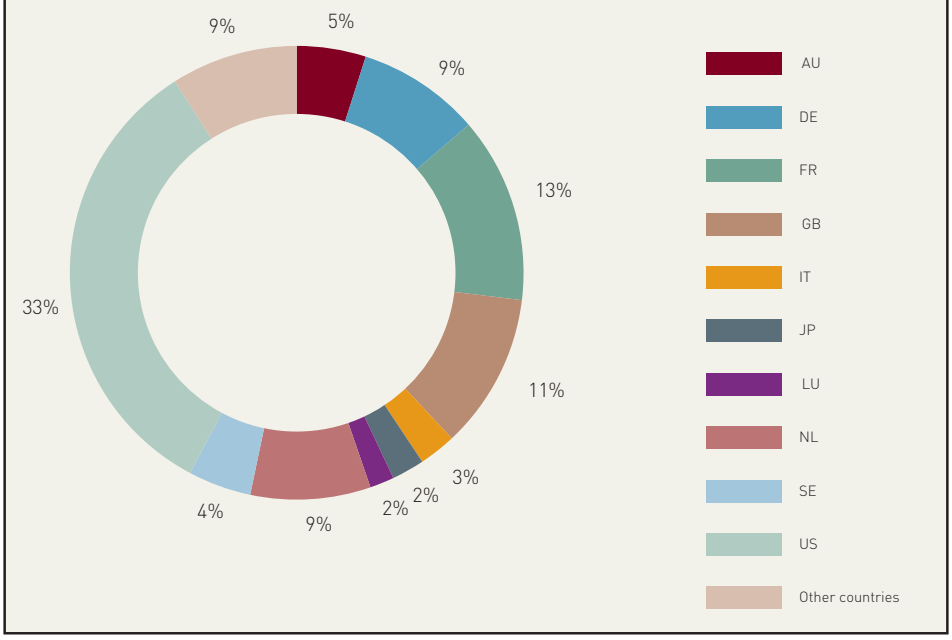
As regards the breakdown of securities held by Luxembourg money market funds by currencies on 30 June 2012, according to figure 9 it appears that the share of the USD

Figure 7
Weighted average life (WAL) and Weighted average maturity (WAM) by types of money market fund – 30 June 2012



Sources: CSSF (survey covering 24 Luxembourg Money Market Funds and covering 75% of Luxembourg total aggregated assets size); Calculation: BCL

Figure 8
Breakdown of securities held by Luxembourg money market funds by countries – 30 June 2012



Source: BCL (covering only the 13 main money market funds)

represents 52%, while the Euro only 32% and the GBP 10%.

The predominance of USD funding may raise certain financial stability issues for Luxembourg, particularly given the issues related to the budget deficit and public debt in the U.S. that could fuel asset price declines and impact the value of securities held by MMFs in Luxembourg; particularly those funds with a large percentage of USD securities holdings.

V. BANK FUNDING IN LUXEMBOURG

Banks rely on MMFs as a key source of short-term funding[23] and exhibit strong interconnections not only with companies and governments but also banks and other components of the financial system. Due to their perceived status as a safe alternative to bank deposits, MMFs are also employed by companies and households as a cash management tool. For these reasons, MMFs are considered systemically important from a financial stability perspective. Subsequently, changes to the European regulatory framework for MMFs may have unexpected effects on MMFs and, by consequence, banks' short-term funding models. Amongst the possible adverse side-effects could be increased risks for investors and an increase the funding costs of banks, illustrating some of the financial stability concerns of the new regulatory initiatives.

In this section, we analyze the use of MMFs in their capacity as a funding tool for Luxembourg credit institutions and find that foreign counterparties play a large role in bank funding in comparison to Luxembourg domestic counterparties.

1.1 MMFs as Sources of Bank Funding

MMFs are significant providers of short-term funding to the banking. Under the current EU regulatory framework, MMFs are subject to the UCITS[24],[25] rules on eligible assets, leverage, diversification and counterparty risk. These aspects of MMFs contribute to their use as short-term funding vehicles.

Based on the aggregated balance sheets of Luxembourg credit institutions, the following graphs illustrate the strong international dimension of the Luxembourg financial sector and show the importance of foreign counterparts in the sources of funding of banks, i.e. 58% in December 2008 and 60% in June 2012,

23 It is important to mention that the analyses provided in this paper do not take into account off-balance sheet data.
24 UCITS is an acronym for Undertakings for Collective Investment in Transferable Securities.
25 However, prior to the ESMA guidelines published in May 2010, there was no regulatory framework for MMFs at the European level.

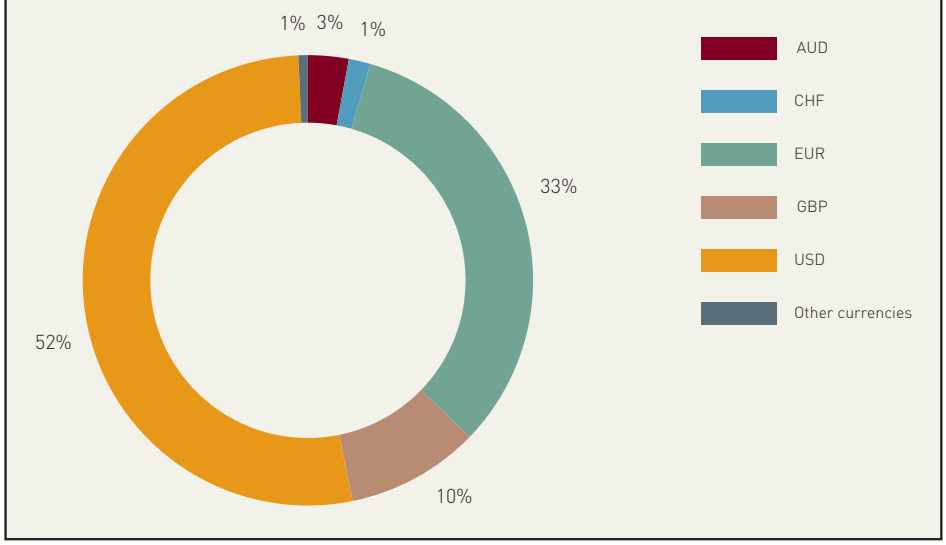
compared to Luxembourg domestic counterparts. In June 2012, sources of funding of Luxembourg banks coming from the latter amounted to €266 137 million, while funding originating from *foreign counterparts* totals approximately €396 334 million. In 2008, these sources of funding represented €343 976 million and €467 453 million in December 2008, respectively.

With respect to *domestic counterparts*, Luxembourg credit institutions represent 37% of the domestic sources of funding and only 15% of the total sources of funding of banks as of June 2012 (respectively 22% and 9% as of December 2008). The share of Luxembourg non-monetary investment funds in banks' funding amounts to 23% of the domestic sources of funding and 9% of the total sources of funding as of June 2012 (respectively 18% and 7% in December 2008) while Luxembourg money market funds account for 4% of the domestic sources of funding and only 2% of the total sources of funding as of June 2012 (respectively 9% and 3% as of December 2008).

As regards foreign counterparts, foreign credit institutions represent 42% of the total sources of funding of Luxembourg banks (40% in December 2008). The share of foreign non-monetary investment funds in Luxembourg credit institutions' funding amounts to 2% of the total sources of funding in June 2012 and in December 2008. The decline of 2% in foreign counterpart shares of funding seems likely to be induced by small changes in funding sources perhaps due to the low interest rate environment or other more mundane causes. Nevertheless, it warrants continued monitoring.

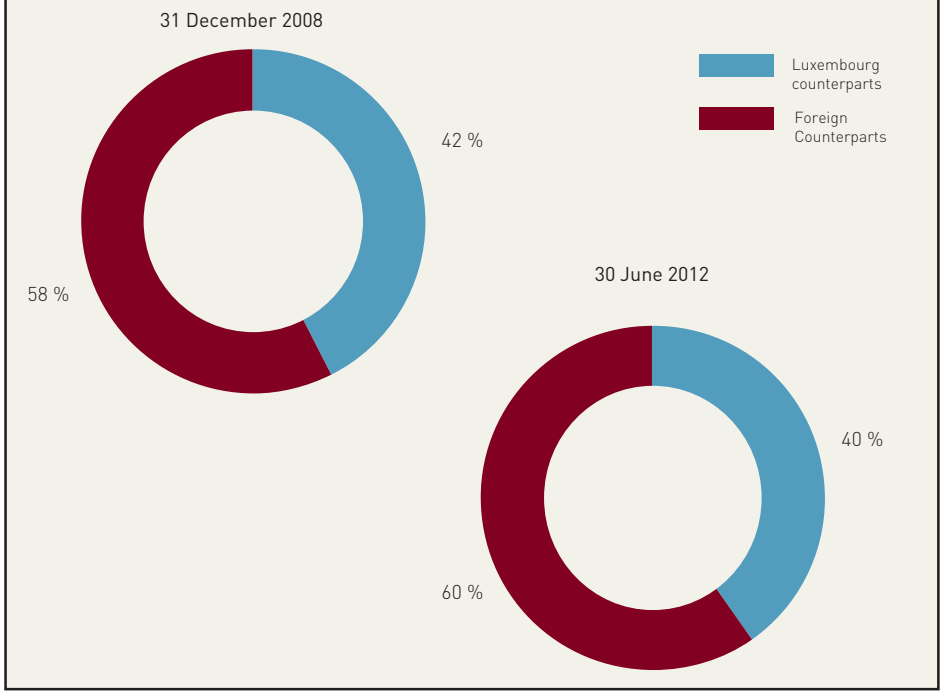
Figure 11 provides a bar chart with the breakdown of funding sources of Luxembourg credit institutions

Figure 9
Breakdown of securities held by Luxembourg money market funds by currencies – 30 June 2012



Source: BCL (covering only the 13 main money market funds)

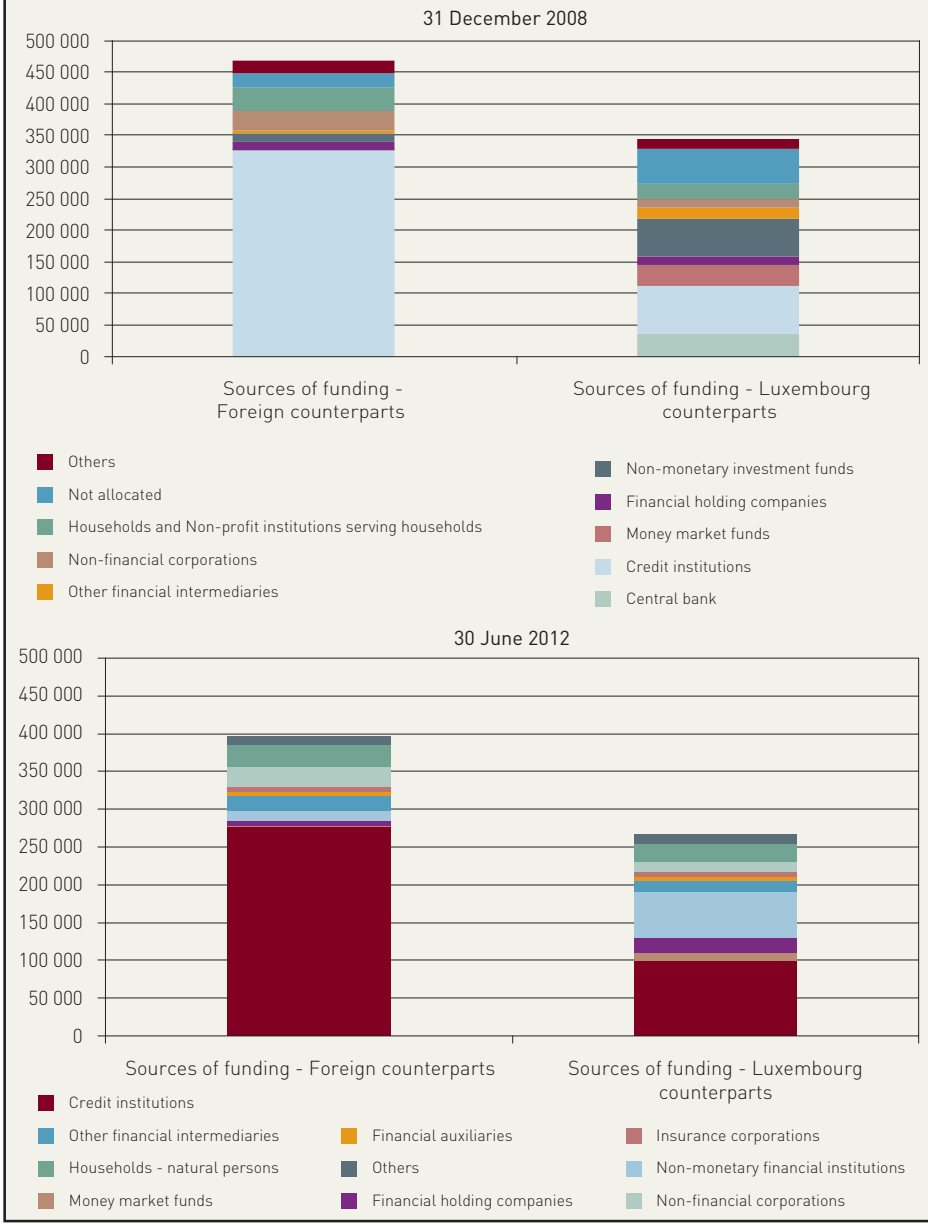
Figure 10
Sources of funding of Luxembourg credit institutions – Luxembourg and foreign counterparts



Source: BCL - Sources of funding cover loans and debt securities issued by Luxembourg credit institutions

by counterparty. In December 2008, foreign credit institutions were the largest foreign providers of funding to Luxembourg credit institutions and were followed by households and non-financial corporations. As of June 2012, the composition of funding sources has not changed appreciably and foreign credit institutions remain the dominant funding provider, followed by households and non-financial corporations. The breakdown mirrors the situation in 2008. Overall, funding to Luxembourg credit institutions has declined since 2008, perhaps reflecting a preference among private investors for higher yielding investments or alternative funding choices and/or shifting preferences.

Figure 11
Breakdown of the sources of funding of Luxembourg credit institutions by counterparts
(Luxembourg / Foreign countries) million Euros



Source: BCL - Sources of funding cover loans and debt securities issued by Luxembourg credit institutions

The composition of domestic sources of funding (i.e. funding from Luxembourg counterparties to Luxembourg credit institutions) differs in comparison to the composition of foreign funding sources. In 2008, the top three funding sources were credit institutions, non-monetary investment funds and households. Central banks were also observed to play a role as funding providers in 2008 as illustrated in the associated bar chart of figure 11, although as of 2012, their importance as a funding source has declined against the background of an overall decline in total funding amounts to credit institutions between 2008 and 2012. Nevertheless, domestic non-monetary financial institutions also remain a key funding provider to credit institutions in Luxembourg.

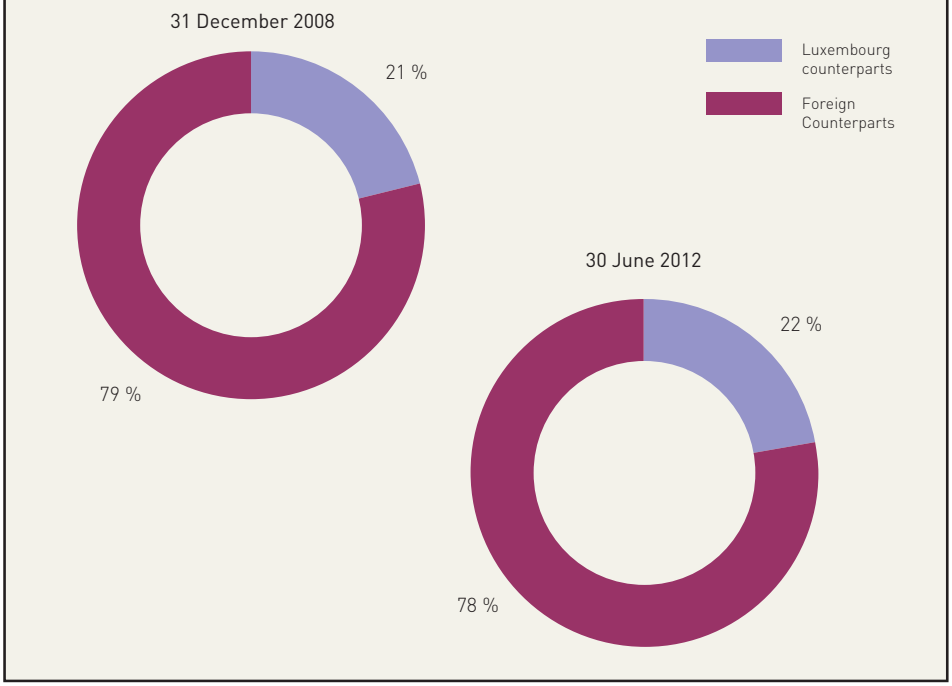
1.2 Credits

The international dimension of the Luxembourg banking sector is also reflected in the breakdown of the claims and debt securities held by Luxembourg credit institutions as Luxembourg counterparts only represent 22% of the total claims and debt securities held by domestic banks as of June 2012 (the value was 21% in December 2008). In June 2012, claims and debt securities from domestic counterparts held by Luxembourg banks amounted to €165 586 million while claims and debt securities from

foreign counterparts represented €577 599 million (respectively €185 686 million and €692 713 million in December 2008). Figure 12 consists of two pie charts illustrating the partition between domestic and foreign debt securities held by Luxembourg credit institutions. There are no substantial differences in the percentages for 2012 compared to 2008.

As regards domestic counterparts, Luxembourg credit institutions represent 22% of the domestic claims and debt securities and only 5% of the total claims and debt securities held by Luxembourg banks as of June 2012 (respectively 40% and 8% as of December 2008). The share of Luxembourg non-financial corporations amounts to 8% of the domestic claims and debt securities and 2% of the total claims and debt securities held by Luxembourg credit institutions as of June 2012 (respectively 10% and 2% as of December 2008) while Luxembourg "other" financial intermediaries represent 9% of the domestic part and 2% of the total portion as of June 2012 (respectively 4% and 1% as of December 2008).

Figure 12
Claims and debt securities held by Luxembourg credit institutions – Luxembourg and foreign counterparts



Source: BCL – Credits cover claims and debt securities held by Luxembourg credit institutions (data for December 2008 includes shares of money market funds held by credit institutions).

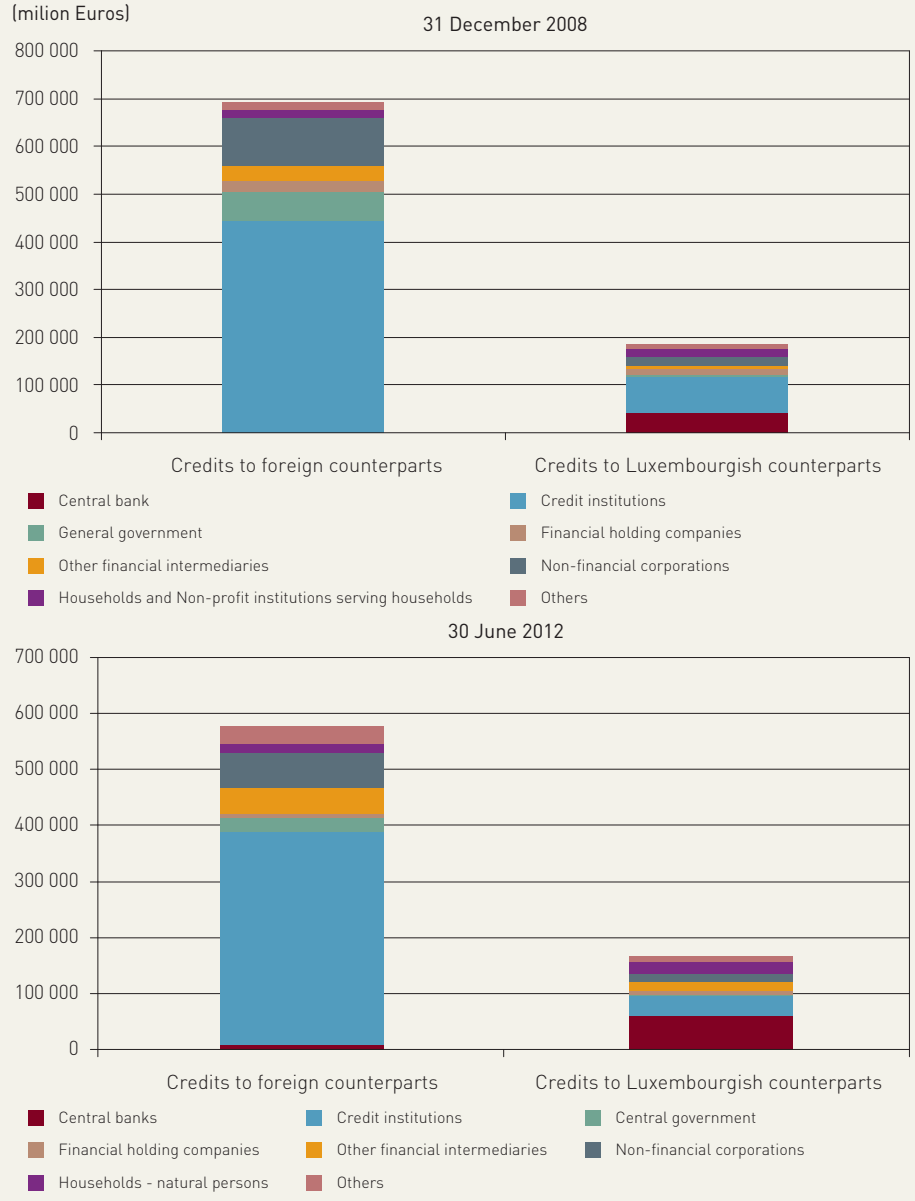
As regards foreign counterparts, foreign credit institutions represent 51% of the total claims and debt securities held by Luxembourg credit institutions as of June 2012 and December 2008. The share of Luxembourg non-financial corporations amounts to 8.5% of the total claims and debt securities held by Luxembourg credit institutions as of June 2012 (respectively 12% as of December 2008) while Luxembourg other financial intermediaries represent 6% as of June 2012 (respectively 4% as of December 2008).

Figure 13 provides a breakdown of the credits granted by credit institutions in Luxembourg to both foreign and domestic counterparties (in € millions).

The breakdown by credits granted to foreign counterparties presents a consistent picture between the situation in December 2008 and that in June 2012. Although the overall amount of credits declined during the four year period from €700,000 million to just under €600,000 million, foreign credit institutions remained the largest borrowers followed by non-financial corporations. Credits to foreign other financial intermediaries increased while for central governments it declined which can likely be attributed to increased sovereign risk and its feedback with the financial sector.

For credits extended to Luxembourg counterparts, the situation is similar albeit with some minor changes between the two periods under consideration. The period from 2008 until 2012 can be

Figure 13
Breakdown of the credits granted by Luxembourg credit institutions – Luxembourg and foreign counterparts
(milion Euros)



Source: BCL Credits cover claims, debt securities and shares of investment funds held by Luxembourg credit institutions

characterized by an overall decline in the amount of credits granted to domestic credit institutions but with an increase in deposits and reserves within central banks.

PART 2: INVESTMENT FUNDS

Investment funds are a key component of the shadow banking sector given their involvement in the credit intermediation activity that takes place outside of the regular banking system. Such financial intermediation activities can help to provide a valuable alternative to bank-based funding in addition to facilitating the supply and flow of credit to the real economy, thereby contributing to sustainable economic growth. However, such activities are not without an element of risk especially in view of the fact that these funds do not benefit from access to official liquidity facilities from central banks.

Investment funds engage in maturity transformation by granting long-term credit financed through short-term funding and leverage. The mismatch in the maturities results in the transformation of short-term liabilities into long-term assets leading to possible instabilities in the event of investor requests for withdrawals[26]. In the case of investment funds, large banks may have significant dealings with the funds thereby creating a network of interconnectedness between banks and investment funds, or "shadow" entities. However, especially in the case of sponsors, banks lack adequate capital to support the total amount of off-balance-sheet liabilities that may be associated with interlinked shadow banks. Consequently, it is important for regulators and

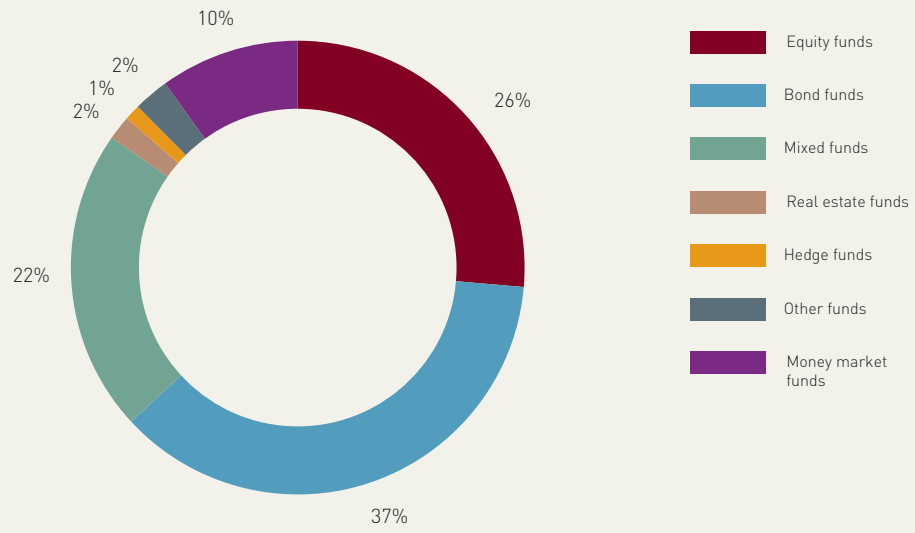
26 Whereas under current liquidity coverage ratio (LCR) regulations, banks are required to hold an amount of liquidity for periods up to 1 month in order to meet the demand for investor withdrawals, investment funds are not currently subject to such LCR requirements, giving rise to the risk of investor runs.

authorities to collect the necessary information in order to monitor and assess the magnitude and characteristics of these interlinkages since they can lead to the formation of systemic risk and contagion channels with resultant adverse feedback to the regulated banking sector.

In this section, we examine the characteristics of investment funds in Luxembourg by considering the composition of their aggregate balance sheets, sources of funding, and the amount of claims and debt securities they hold. Based on aggregated data of Luxembourg investment funds in June 2012, figure 14 shows that money market funds only represent 10% of the aggregated balance sheet of Luxembourg investment funds while bonds funds and equity funds amount to 36% and 26% respectively.

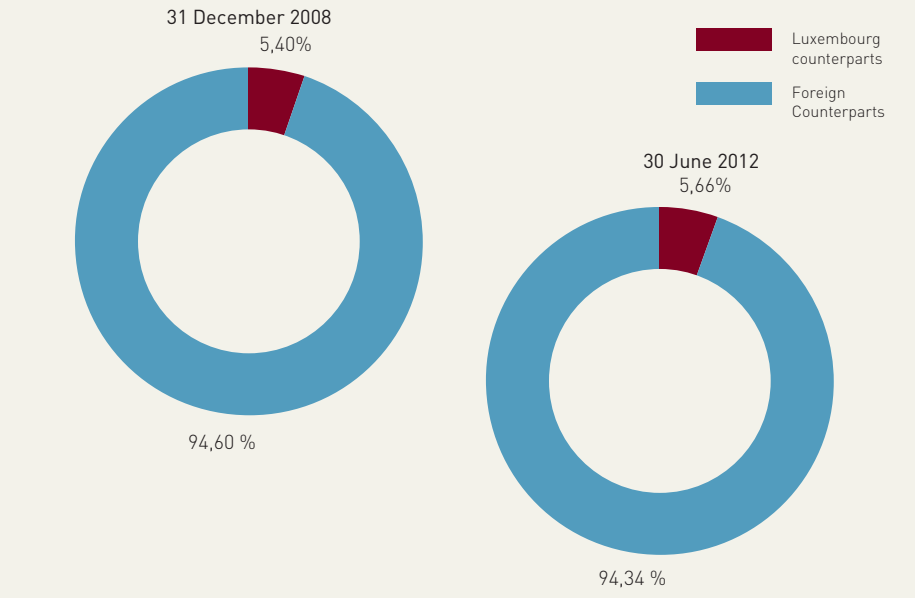
Although not indicated in the figure, the collected data show that between December 2008 and September 2012, the aggregated balance sheet of money market funds slowly declined from €340 billion to €240 billion while the opposite trend was observed for mixed funds, bonds funds and equity funds. Figure 15 shows that for the aggregate balance sheet of Luxembourg investment funds, the three primary components by type of fund are bond funds, equity funds and mixed funds. Money market funds account for approximately 10% of the total balance sheet while hedge funds, real estate funds and other funds make up the remainder but are not significant in terms of the total. Given the aggregated nature of the data, it is not possible to determine if there are fund-specific factors underlying the breakdown.

Figure 14
Aggregated balance sheet of Luxembourg investment funds by type of funds – 30 June 2012



Source: BCL

Figure 15
Sources of funding of Luxembourg investment funds – Luxembourg and foreign counterparts



Source: BCL - Sources of funding cover debt and shares issued by Luxembourg investment funds. Investment funds cover money market funds, equity funds, bonds funds, mixed funds, real-estate funds, hedge funds and other funds. Not allocated amounts of investment funds' sources of funding have been split between Luxembourg and foreign counterparts as 5% and 95% respectively, approximated according to several indicators from different BCL databases.

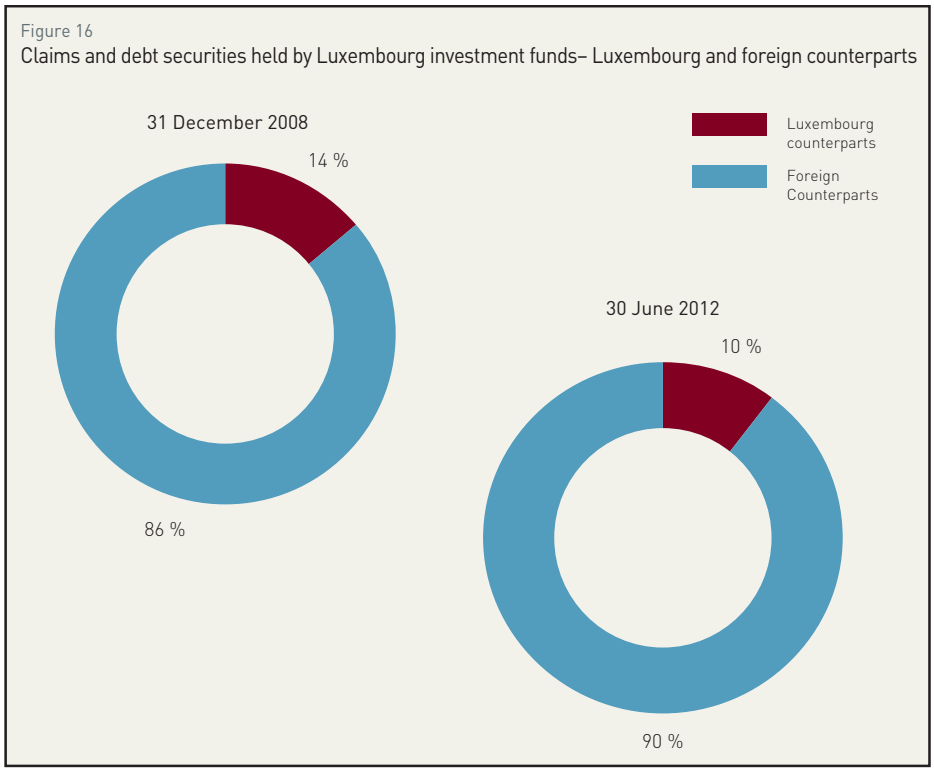
1.1 Credits and Sources of funding

Luxembourg investment funds are characterized by a strong international dimension as most of the sources of funding originates with foreign counterparts. The allocated part of the funding sources of investment funds; €31 084 million in June 2012 and €45 927 million in December 2008 is almost entirely coming from other domestic and foreign credit institutions. Nevertheless, it has to be noted that the issued shares of Luxembourg investment funds, representing €2 230 306 million in June 2012 while their level was €1 561 048 million in December 2008, are reported as "not allocated". Given their important amounts, the shares of investment funds have been taken into account in the sources of funding of investment funds so as to reflect the real links between investment funds and the other sectors, domestic and foreign. This is particularly evident in figure 15 showing the overwhelming sources of funding coming from foreign counterparts. Furthermore, the allocation in 2012 has changed little since December 2008.

1.2 Credits

The international dimension of Luxembourg banking sector is also reflected in the breakdown of the claims and debt securities held by Luxembourg investment funds as illustrated in figure 16. Luxembourg counterparts only represent 10% of all the claims and debt securities held by domestic banks as of June 2012 (14% in December 2008). In June 2012, claims and debt securities held by Luxembourg investment funds towards domestic counterparts amounted to €132 716 million while foreign counterparts represent €1 173 529 million (respectively €134 926 million and €832 493 million in December 2008).

Figure 16
Claims and debt securities held by Luxembourg investment funds– Luxembourg and foreign counterparts



Source: BCL

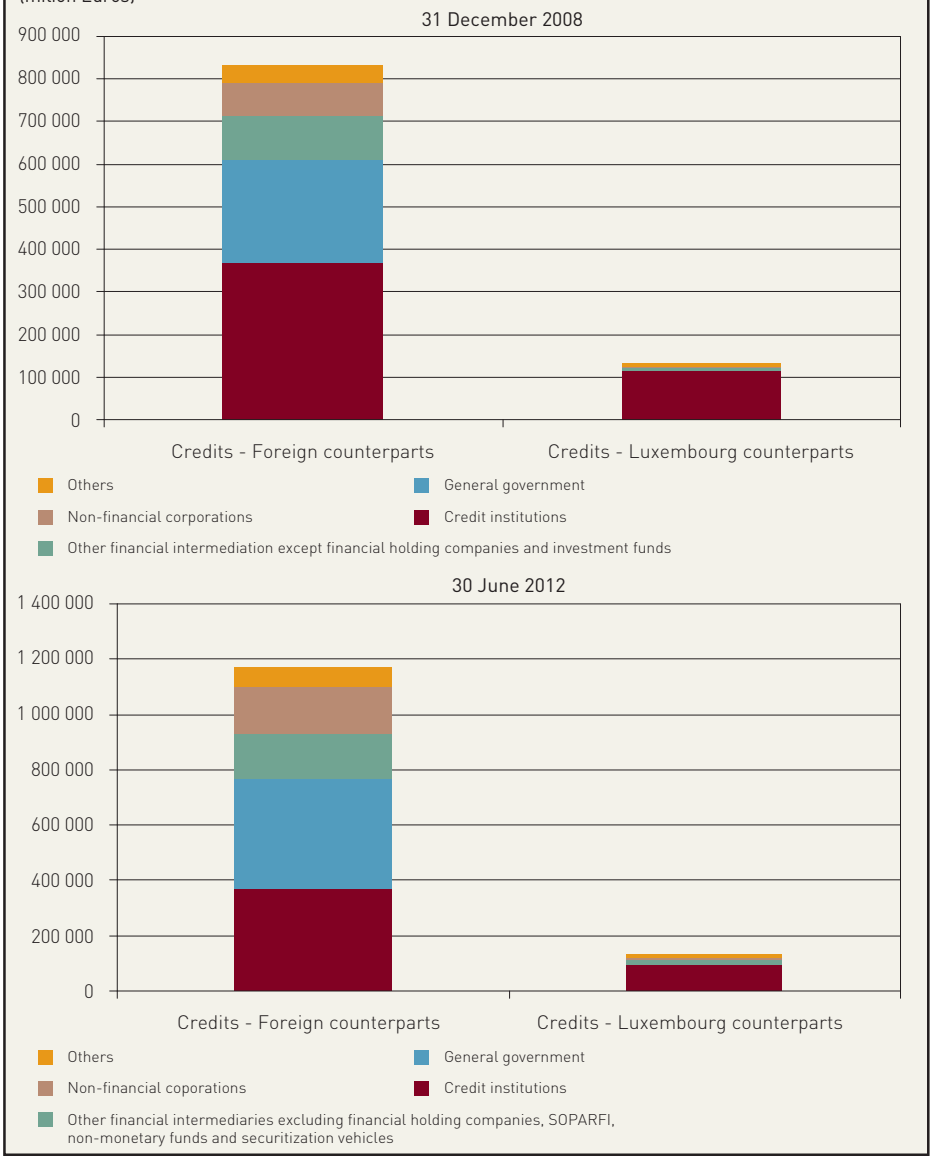
As regards domestic counterparts, Luxembourg credit institutions represent 72% of the domestic claims and debt securities held by Luxembourg investment funds and only 7% of the total claims and debt securities held as of June 2012 (respectively 86% and 12% as of December 2008).

Figure 17 provides a breakdown of claims and debt securities held by Luxembourg investment funds. Regarding foreign counterparts, banks represent 28% of the total claims and debt securities held by Luxembourg investment funds as of June 2012 (respectively 38% in December 2008). General government amounts to 30% of the total claims and debt securities held by Luxembourg investment funds as of June 2012 (respectively 25% as of December 2008). Non-financial corporations represent 13% of the total claims and debt securities held by Luxembourg investment funds as of June 2012 (respectively 8% as of December 2008). Foreign counterparts clearly account for

the majority of claims and debt securities held by Luxembourg investment funds and vastly outweigh Luxembourg domestic counterparts.

In a similar manner to banks, run risks are also present for investment funds and MMFs since they may take on leverage and engage in maturity-transformation as part of their shadow banking activities. Such risk, if not appropriately monitored, can lead to procyclicality thereby increasing the credit supply as well as asset prices. Consequently, "boom" periods can be followed by severe downturns whereby asset prices decline sharply and credit channels become restricted leading to a generalized loss of confidence and increased uncertainty. Similar effects were observed following the collapse of Lehman brothers. The multiple failures of the originate-to-distribute model negatively impacted not only the asset-backed commercial paper (ABCP) markets, but spilled over into structured investment vehicles (SIVs) and lead to a run on the Reserve Primary Fund in the U.S. The latter required the intervention of the U.S. Government in order to limit the impact on financial stability and the spill-overs to the MMF industry. Along with the European Commission's Green Paper on Shadow Banking[27] the episode with Reserve Primary provided some of the impetus in Europe to initiate new reforms for MMFs.

Figure 17
Breakdown of claims and debt securities held by Luxembourg investment funds – Luxembourg and foreign counterparts
(milion Euros)



Source: BCL – Credits cover claims and debt securities held by Luxembourg investment funds

Given the potential severe risks associated with these systemic effects, it would seem appropriate to apply effective prudential regulation and oversight arrangements to the shadow banking system, including MMFs. In the next section, we study the interconnectedness of the shadow banking industry in Luxembourg in order to determine the importance and structure of the industry domestically. Such information could be used as input into designing suitable supervisory frameworks and policies.

27 The Green Paper concludes that "...money market funds (MMFs) and other types of investment funds or products with deposit-like characteristics [...] make them vulnerable to massive redemptions ("runs")".

PART 3: BANKS' INTERCONNECTEDNESS WITH THE SHADOW BANKING SECTOR

1.1 Brief Overview of Interconnectedness Analysis

The lessons learned following the financial crisis underscored the importance of the linkages and interconnections between institutions. Such analyses can provide authorities with an indication of not only how resilient the financial system is to the spread of contagion, but also offer insight into what the potential triggers of contagion may be. Conducting such an assessment is important since although an interconnected system may appear robust, it could be in fact, quite fragile. By improving supervisors' assessments of financial interlinkages, this type of analysis facilitates the macro-prudential assessment of systemic risk arising from interconnectedness.

In the analysis that follows, the interconnectedness network consists of a series of nodes that represent banks or financial institutions along with their linkages which are indicated by the lines joining the different nodes. The thickness of the connecting line can be used to indicate strength of the connection in terms of the level of exposure, for example. In this context, the lines can be thought of as balance sheet links between institutions. The network defined by these nodes and links, along with any clustering or node size[28], provides an indication as to the structure of the system at the aggregate level and the possible network dynamics. This is considered to be important information as even the failure of small but highly interconnected institutions can have negative consequences for the rest of the financial system if they are amplified through the spread of contagious effects.

1.2 Measures of Centrality

In the context of network analysis, centrality provides a measure of the relative importance of a node within the network structure. Although there are numerous measures of centrality, a core group of measures are generally used in the analysis of financial system interconnectedness and contagion channels. In no specific order, the four commonly used measures are:

(i) degree centrality,
(ii) pagerank centrality,
(iii) betweenness centrality and;
(iv) closeness centrality.

Degree centrality is a fairly straightforward measure of the "connectedness" of a node in the network. The degree centrality of a given node is calculated as the sum of both the in-going and out-going connections to that node. Consequently, this measure provides an indication of how connected the node is within the network, irrespective of the type of linkage.

The following formula by Feeman gives the degree centrality of a node:

$$C_D = \frac{\sum_{i=1}^{G}\left(C_D(n^*) - C_D(i)\right)}{(n-1)(n-2)}$$

28 One important network characteristic is the concept of "centrality" which gives an indication of the position of a given node within the network. Centrality provides an indication as to which nodes in the network can be considered as systemically important.

Where $C_D(n^*) = \deg(n^*)$ and n^* and i are the node under consideration and nodes connected to n^*, respectively. G is the total number of nodes in the network.

Betweenness centrality is determined based on a node's position as "intermediary" between other connected nodes in a network. Specifically betweenness is equal to the total number of "shortest paths" between other nodes that pass through the given node. Therefore, a node's betweenness measure will be considered high not because it has a high degree centrality, but rather because it plays a significant role as intermediary in the available possible network paths. The betweenness centrality measure is defined as:

$$btw_i = \frac{\sum_{j,l} \frac{a_{jl,i}}{a_{jl}}}{(n-1)(n-2)}$$

Where $a_{jl,i}$ is the number of paths running between j and l through i, a_{jl} is the total number of the shortest paths between j and l,k and n is the total number of nodes in the network.

Closeness centrality is calculated as the inverse of the "farness" measure of a node. The farness of a node in a network is defined as the sum of the length of the shortest paths between the given node and all other nodes in the network. The closeness is simply the inverse of the farness. It is possible to normalize this measure by dividing farness by the total number of nodes excluding the node under consideration.

The Pagerank centrality measure is also popular as a quantitative method for ranking website pages and is the method employed by the Google search engine. Pagerank centrality is a tool with its origins in directed graph theory and can be considered as a generalization of eigenvector centrality[29].

It is important to mention that network analysis as applied to financial systems is still at a relatively early stage of development and is not yet considered suitable as a stand-alone input into policymaking decisions. Nevertheless, in the presence of other information, and indicators it can help to build an aggregate picture providing a view on the overall stability of a financial system[30]. It therefore warrants further research in order to adopt the analysis into the supervisory toolbox.

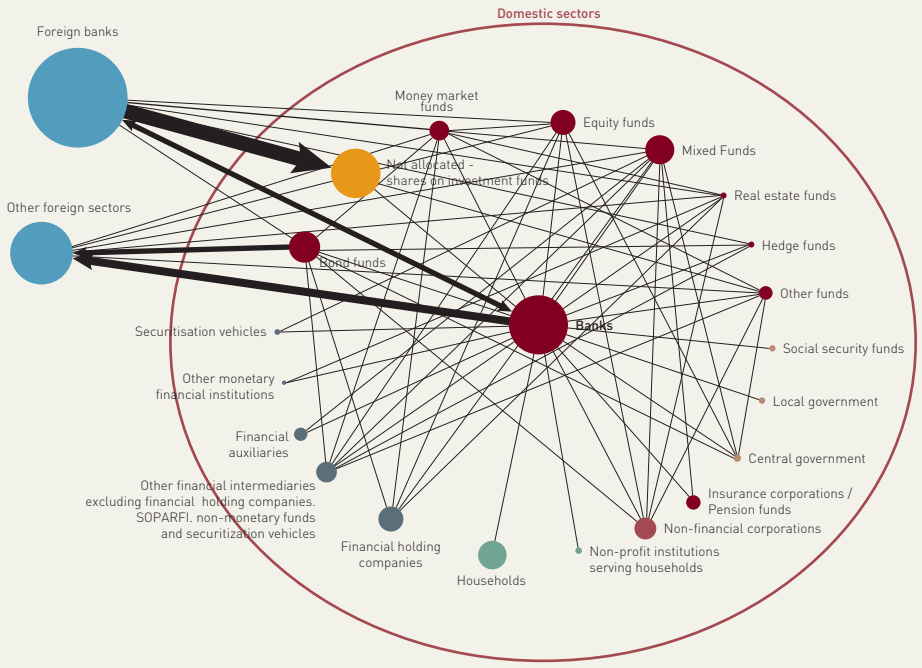
1.3 All sectors

A network has been constructed so as to be able to assess the interlinkages between the Luxembourg banking sector and the other sectors of the economy, and in particular the importance of investment funds for the funding of the Luxembourg banking system. The network is based on data from the aggregated balance sheets of Luxembourg banks and investment funds. The links between the sectors represent the gross amounts i) for credits: claims and debt securities held by a sector and ii) for debts: loans and debt securities issued by a sector. The size of each node represents the share of this particular sector in the sources of funding of Luxembourg banks (central bank being excluded). Not allocated amounts of investment funds' sources of funding have been split between Luxembourg and foreign

29 Eigenvector centrality provides a measure of the influence of a node within the network by assigning relative scores to all nodes in a network. Connections to high scoring nodes increase the eigenvector centrality of the node being considered.

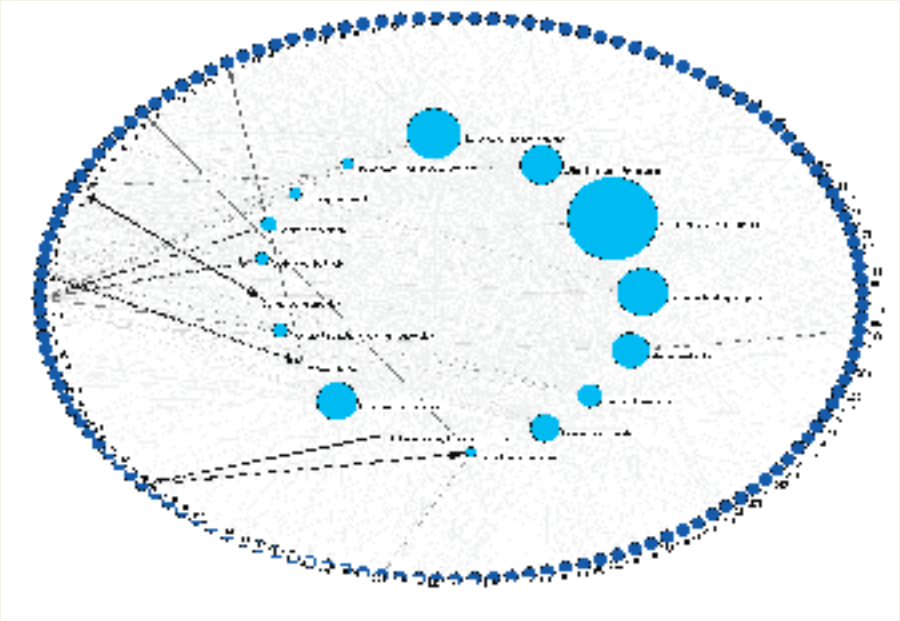
30 Indeed, Borio and Drehmann (2009) "Towards an Operational Framework for Financial Stability: "Fuzzy" Measurement and its Consequences", BIS Working Papers 284, suggest that the interconnected components of the financial system deserve to be monitored and understood along with common exposures.

Figure 18
Network of credits and debts between Luxembourg sectors and foreign counterparts – 30 June 2012



Source: BCL (based on data from the aggregated balance sheets of Luxembourg banks and investment funds).

Figure 19
Domestic network of credits and debts between individual Luxembourg credit institutions and other Luxembourg sectors – 30 June 2012



Source: BCL (based on data from the individual balance sheets of Luxembourg credit institutions towards Luxembourg counterparts).

counterparts as 5% and 95% respectively, approximated according to several indicators observed. Consequently the size of the node "Not allocated" has been chosen more or less arbitrarily as it does not correspond to a source of funding of Luxembourg banks.

Figure 18 below confirms the strong links between Luxembourg banks and investment funds with foreign banks and other foreign sectors. Therefore, based on the available data, from a systemic risk perspective it seems that the source of potential contagion originates from outside Luxembourg rather than domestically.

1.4 Individual banks

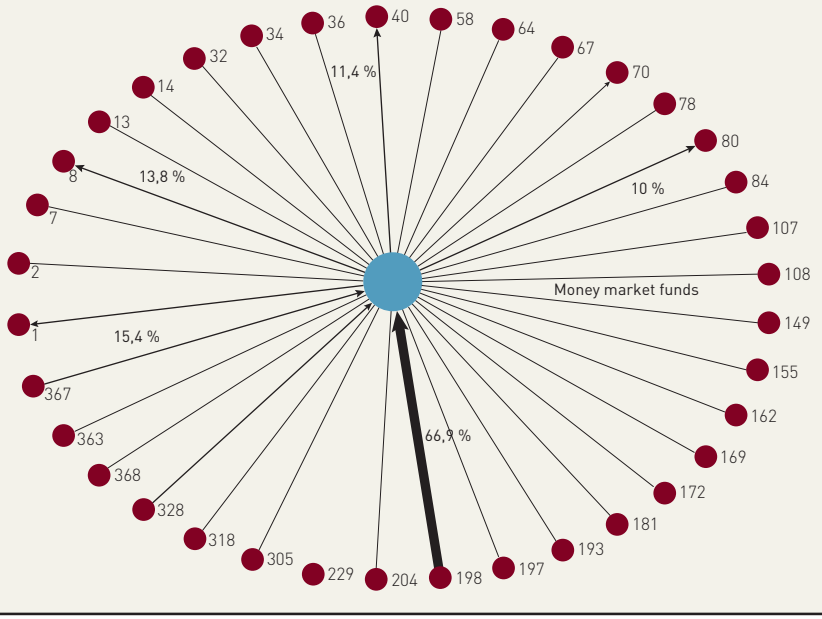
Based on the individual balance sheets of Luxembourg credit institutions, a domestic network has been constructed to represent the links between Luxembourg banks and other domestic sectors. Individual banks are represented on the external circle. The links between the individual bank and the sectors cover i) for credits: claims and debt securities held by an individual bank towards a sector and ii) for debts: loans and debt securities issued by an individual bank that are held by a specific sector. The size of the node of the sectors represents the share of this sector in the total domestic sources of funding of Luxembourg credit institutions or central banks. The links are weighted as a percentage of the total credits / debts of each sector towards the domestic banking sector.

The corresponding figure 19 below shows which sectors are the most

important in the domestic funding of Luxembourg banks, according to the size of the nodes (in line with figure 18) as well as the most active individual banks for each sector, according to the width of the line coming from / going to the bank. It appears that only a limited number of banks have strong links with other components of the financial sector and the real economy. Consequently, they warrant to be closely monitored.

To have a better assessment of the interlinkages between the banks and some specific sectors, figure 20 represents a sub-network of figure 19, illustrating the links between individual Luxembourg banks and the domestic money market funds sector. As the links between the banks and the money market fund sector are weighted as a percentage of the total credits / debts of the Luxembourg money market funds sector towards the domestic banking sector, we can observe that only few Luxembourg banks are playing an important role for the money market funds sector. As an example, the credits granted by one bank to Luxembourg MMFs represent almost 67% of all the credits from Luxembourg banks to Luxembourg MMFs, while another bank represents 15.4%. In the same way, the debts of one Luxembourg bank amount to 13.8% of the total debt of Luxembourg banks towards domestic money market funds, while debts from two other banks represent 11.4% and 10%. Consequently, only three Luxembourg banks play an important role for the funding of Luxembourg MMFs (banks that are granting more than 5% of the total credits granted by Luxembourg banks to domestic money market funds) and nine Luxembourg banks play an important role in the credits granted by money market funds to domestic banks (banks whose debt is representing more than 5% of the total debt of Luxembourg banks towards domestic money market funds).

Figure 20
Domestic network of credits and debts between individual Luxembourg credit institutions and the Luxembourg money market funds sector – 30 June 2012



Source: BCL (based on data from the individual balance sheets of Luxembourg credit institutions towards Luxembourg counterparts). Individual banks are represented on the external circle. The links between the individual bank and the money market fund sector cover i) for credits: claims and debt securities held by an individual bank towards Luxembourg money market funds and ii) for debts: loans and debt securities issued by an individual bank that are held by Luxembourg money market funds.

Having described the importance of a sample of Luxembourg banks for the domestic money market funds industry, it is also interesting to assess the importance that money market funds represent for domestic banks. Considering the claims towards domestic money market funds and debt securities issued by domestic money market funds that are held by an individual bank (respectively the debts of Luxembourg banks towards money market funds) out of the total of claims and debt securities issued by all counterparts held by the bank (respectively total of debts of the bank to all counterparts) we find that only one bank is above the threshold of 5%, whereas on the liabilities side, eleven banks are above the 5% threshold; including two that reach 39% and 68%. With respect to the share of the claims towards domestic money market funds and debt securities issued by domestic money market funds that are held by an individual bank (respectively the debts of Luxembourg banks

towards money market funds) out of the total assets of the bank we see that only one bank remains above the threshold of 5%, whereas on the liabilities side, nine banks are above the 5% threshold (including two that reach 39% and 54%). Looking more closely at the banks that are above the threshold of 5%, it would appear that these banks can be characterized by having a rather small balance sheet. More precisely, for the bank that is above the 5% threshold, on the asset side is a branch with total assets below 250 million euros. Correspondingly, on the liabilities side, one of the two banks has a total amount of assets below 200 million euros whereas the other one is below 1 000 million euros.

VI. CONCLUSION

The ongoing reform initiatives both in Europe and on the international landscape provide strong incentives for national macro-prudential authorities to understand the structure and functioning of the shadow banking sector and its interlinkages with their domestic banking sectors. Given the ongoing development of future regulatory frameworks, it is expected that changes to the regulatory environment may lead to structural changes in the operation and linkages between banks and shadow banks in certain jurisdictions. Small, open economies in countries such as Luxembourg and Ireland are likely to be strongly affected by the forthcoming changes. For this reason, we have undertaken an analysis of the interconnections between banks, investment funds and MMFs using a new and detailed dataset collected for Luxembourg in order to "survey the landscape" and assess the linkages between various sectors.

The data underscore the strong presence of foreign counterparties in the Luxembourg banking sector in comparison to the relatively small domestic component. In this context a withdrawal or retrenchment of foreign funding sources could result in strong and negative consequences for the domestic financial services industry. Furthermore, given the contribution of the financial sector to Luxembourg's total GDP, such an outcome could also feedback onto the real economy resulting in economic repercussions in almost all domestic sectors. However, the negative downside may be mitigated to the extent that only a few domestic banks have strong linkages to the MMF industry. Nevertheless, it is important to continue to monitor and assess the shadow banking sector in Luxembourg in order to be aware of the potential financial stability implications.

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2. THE DETERMINANTS OF SHORT TERM FUNDING IN LUXEMBOURGISH BANKS

By Dirk MEVIS[31]

This contribution attempts to empirically identify the determinants of Luxembourgish banks' reliance on short term funding. The emphasis lies on making the link to developments in the macroeconomic environment and the build up of systemic risk while institution-specific factors are being controlled for. The paper provides evidence for a close link between exuberant credit developments at the aggregate level and short term funding of banks. This finding supports the view that one possible channel for increasing vulnerabilities during a lending boom may run through increased reliance of banks on short term funding. When it comes to bank specific variables, bank size has an important effect on the tendency to contract short term funding. This result is in line with recent work on pro-cyclical leverage in the banking sector. The results also imply that currently discussed regulatory restrictions on the funding structure of banks could mitigate the build up of vulnerabilities.

I. INTRODUCTION

It is widely acknowledged that strong reliance on short term funding was a major component of the vulnerabilities in bank balance sheets that unwound during the recent financial crisis. While maturity transformation is an essential component of financial intermediation, the question arises whether banks have relied on short term funding excessively in the years preceding the crisis and whether and how the build up of financial risks at the aggregate level materialized on the balance sheets of the individual credit institutions. The answer to these questions could help to better understand the mechanics of the build up of systemic risks within the banking sector.

Short maturity funding bears the risk that credit institutions become unable to roll over their funding in the case of abrupt disruptions, for example if asset market turmoil arises. During the financial crisis that started in 2007 and erupted strongly at end-2008, several such market breakdowns could be observed like e.g. most prominently the market for asset backed commercial paper in the United States and, when confidence suddenly vanished, the freeze up of unsecured interbank markets.[32] The sudden dry-up of liquidity in several markets for short term funding, including in unsecured interbank markets, caused difficulties for those institutions that were structurally exposed to this kind funding. These difficulties further deteriorated the confidence of market participants, leading to even lesser availability of short term funding and further spreading of the crisis. While funding at longer maturities does not require such frequent roll over and can in case of a short lived panic be maintained, funding at shorter maturity is likely to be more prone to market turmoil, even if in principle the source of the turmoil is unrelated to the institution using this funding. Given the higher frequency of required roll over, a shock to the general level of confidence will put this source of funding at risk. If an institution is structurally dependent on short term funding, it will then face funding liquidity problems.[33] Empirically, Vazquez and Federico (2012) find evidence that higher reliance on short term funding significantly increases the likelihood of bank failure.

Yet, maturity transformation by banks is an essential element of financial intermediation and the practice of engaging in short term funding is inherent in the system to a certain degree. Hence, short

31 Financial Stability Department, Banque centrale du Luxembourg
32 For a more elaborate description of the sequence of events see e.g. Brunnermeier (2009).
33 See e.g. Brunnermeier and Peddersen (2009) for a more elaborate description of the concept of funding liquidity.

maturity funding was not viewed as particularly risky in the run up to the crisis. The sudden materialization of the crisis then painfully demonstrated that aside from the behavior of individual institutions, the circumstances in the system impact the definition of a sound funding structure and these circumstances can change abruptly.

The importance that is being attached to a stable funding structure is also mirrored in the recent regulatory effort attached to liquidity regulation. For example, in response to concerns about vulnerabilities in the funding structure, the Basel Committee of Banking Supervisors[34] introduced liquidity standards to permanently monitor the structure of bank funding - the Net Stable Funding Ratio. The macroprudential perspective on supervision highlights the risks inherent in the financial system in the aggregate, their cyclical development, and their relation to the behavior of individual institutions.

The pro-cyclical behavior of financial sector leverage and its implications for the stability of the financial sector as a whole has gained increasing prominence in economic research more recently. This theory emphasizes the active balance sheet management of banks and their tendency to expand balance sheets in times of asset price increases. Adrian and Shin (2009), show that very pro-cyclical banks (e.g. the former U.S. investment banks) fund the expansion of their balance sheets with additional leverage rather than through equity issuance. One possible conjecture arising from this framework is that in the case of an asset price boom, banks tend to shift their funding mix towards more flexible short term funding and that, as a result, vulnerabilities would build on the balance sheets of individual institutions.

According to Brunnermeier (2009), short term funding of credit institutions increased in the years leading up to the crisis as these institutions attempted to fund the extension of their balance sheets by tapping into the demand from money market funds. Aggregate numbers for the euro area seem to support this claim. ECB (2009) reports that in the period from 2003 to 2007, as the growth in euro area retail bank deposits were not sufficient to keep up with the growth of bank balance sheets (an increase of 53 %), banks resorted increasingly to other - more short term - sources of funding including securitization, covered bonds and interbank liabilities.

While the magnifying effects of leverage in a crisis have been investigated, this contribution takes a step back and adds to the literature by tracing the links between the buildup of aggregate risk and the vulnerabilities embedded in the funding structures of banks.

It empirically investigates these relationships for Luxembourgish banks. The Luxembourgish financial sector is very large in comparison to the economy and banks in Luxembourg are mostly foreign owned. Total assets of the banking sector in Luxembourg amounted to € 796.6 billion in December 2011. Total financial sector assets (which includes money market fund industry but not investment funds) were at € 1099.3 billion in December 2011 which is about 3,28 % of total euro area financial sector assets. The study of the funding structure of Luxembourgish banks is of particular importance since they typically act as liquidity providers to their foreign parent companies.[35]

The emphasis of this contribution lies on making the link to developments in the macroeconomic environment and the build up of systemic risk while institution-specific factors are being controlled for. Recent literature on identifying low frequency leading indicators to financial crisis have found a strong role

34 See BCBS (2010).

35 The BIS reports for example that by june 2011, some 63.6 % of assets of Luxembourgish banks were located inside Europe while only 51.8 % of liabilities were held in the same region. In this statistic Europe is defined as: Germany, Belgium, France, Italy, Luxembourg, The Netherlands, United Kingdom, Sweden, Switzerland, Austria, Denmark, Ireland, Spain, Finland, Portugal, Greece, Guernsey, Jersey, Isle of Man, and Cyprus.

in this respect for credit to gdp-based indicators, leverage and asset prices.[36] The literature focuses on relating these indicators in the aggregate to a binary realization of a banking crisis but does not make the link to the behavior of individual banks directly.

II. BACKGROUND

Funding liquidity risk has been identified as one of the main vulnerabilities of financial intermediaries during the recent crisis. In particular, it provides a way in which vulnerabilities can spread throughout the system due to close linkages with market liquidity and feedback effects within the smooth functioning of financial markets. Brunnermeier and Peddersen (2009) show how shocks to specific funding markets can quickly spread - due to their effect on traders and the market liquidity of the assets they trade - across the system. Short term funding is particularly prone to confidence shocks as, by definition, it has to be rolled over frequently.

A glance at short term funding in Luxembourgish banks (Figure 1) shows a clearly cyclical pattern. The cyclical behavior of short term funding promotes the conjecture that the decision by banks to contract short term funding could also, to some extent, be driven by factors of the macro-environment beyond GDP growth and the interest rate. In particular, the economic theory on pro-cyclical leverage raises issues of macroprudential concern as the build-up of leverage in the financial sector in aggregate gives rise to concerns about increasing systemic risk and vulnerabilities that may affect the financial sector as a whole.[37]

Brunnermeier (2009) notes that maturities of bank funding shortened in the period leading up to the crisis. This later reinforced the liquidity crunch in 2007-8. Allen and Gale (2007) also note that in the run-up to the liquidity crisis 2007-08, the maturities of funding employed by banks has continuously shortened. In addition, Adrian and Shin (2009) emphasize that credit institutions (in particular investment banks) funded the massive expansion of balance sheets by use of short term repo funding. The theory of active balance sheet management – as developed in particular by Adrian and Shin (2009), Shin (2010), Adrian and Shin (2011) – provides an avenue through which shortening funding maturities connect to increasing aggregate risk and leverage cycles.

Active balance sheet management builds on a model in which individual banks maximize the return on equity through variations of the size of their balance sheet. If asset prices increase in an upswing, banks' balance sheet capacity (i.e. the amount of leverage they can carry with a given level of equity) increases and thus they expand their balance sheet by adapting leverage. This leads to pro-cyclical behavior of leverage in the aggregate. The mechanism boils down to a positive feedback loop between receding risk aversion, increasing asset prices and lower collateral requirements.

The question arises of how the extension of leverage is ultimately funded and whether this leads to an increase of vulnerabilities on the balance sheets of banks on top of the increase in leverage. Shin (2010) distinguishes explicitly between core and non-core liabilities of banks.

Total Liabilities = Equity + core liabilities + non-core liabilities

To put it in a simplified way, core liabilities are those towards the non-financial sector while non-core liabilities are those held between financial intermediaries. As core liabilities grow only slowly with real

36 See for example IMF (2011), Lund-Jensen (2012) and Borio and Drehman (2009).
37 See for example Bank of England (2009).

growth in the economy and equity is sticky, an adjustment of bank balance sheets during a lending boom has to take place mostly via non-core liabilities.

In this context, banks could adjust their balance sheet size by making increased use of flexible short term funding. Adrian and Shin (2011) argue that in the upswing of the asset-leverage cycle, intermediation chains - i.e. the number of financial intermediaries between the ultimate lender and the ultimate borrower - become longer due to constructions like securitization which extend the possibility of banks to create liquidity. Whereas a basic financial system would feature one ultimate lender, one bank and one ultimate borrower (i.e. a system with only core liabilities in the banking sector) a lengthened intermediation chain could create much more complex relationships between the ultimate borrower and the ultimate lender.[38]

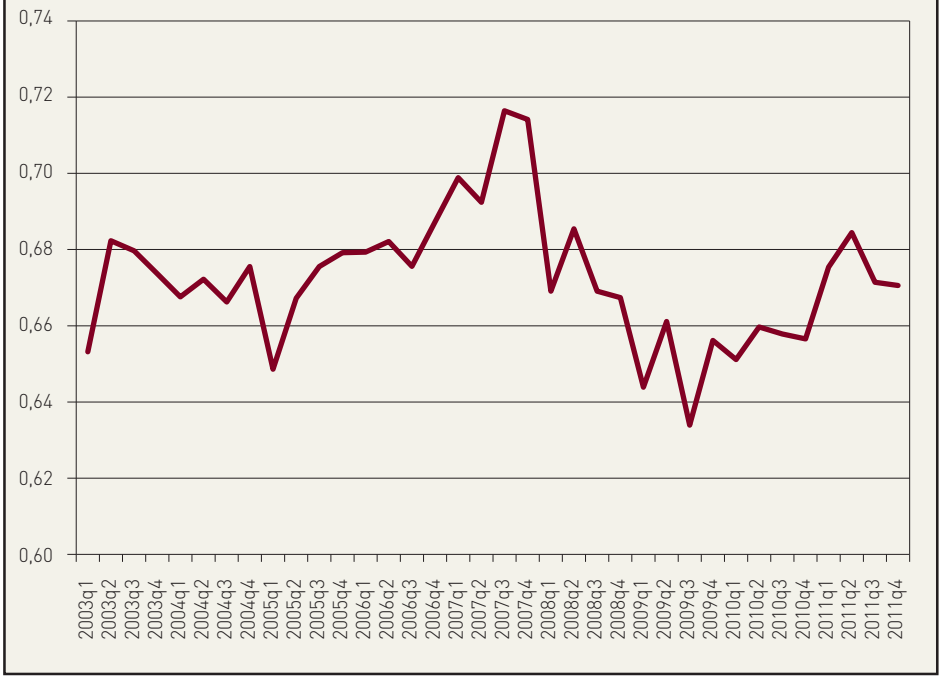
This mechanism is likely to lead to a shortening of funding maturities on average. Since at each stage of the chain under normal circumstances the funding interest rate is lower than the asset interest rate and short term funding tends to be cheapest, as the intermediation chain becomes longer, more short term funding must be used.

1.1 Short term funding in the Luxembourgish banking sector

The Luxembourgish banking sector consists mainly of subsidiaries and branches of foreign banks and a few Luxembourg based banks. In December 2011, 6 banks out of 142 were domestically owned and domestically owned banks held 6.9 % of total sector assets. Luxembourgish banks are very involved in private banking and wealth management and generally act as net liquidity providers to their foreign parents. In addition, very often they act as sponsoring banks to the local investment fund industry.

When separating small and big banks around the 75th percentile in total assets, one can see that size does have an influence on the decision of banks to use short term

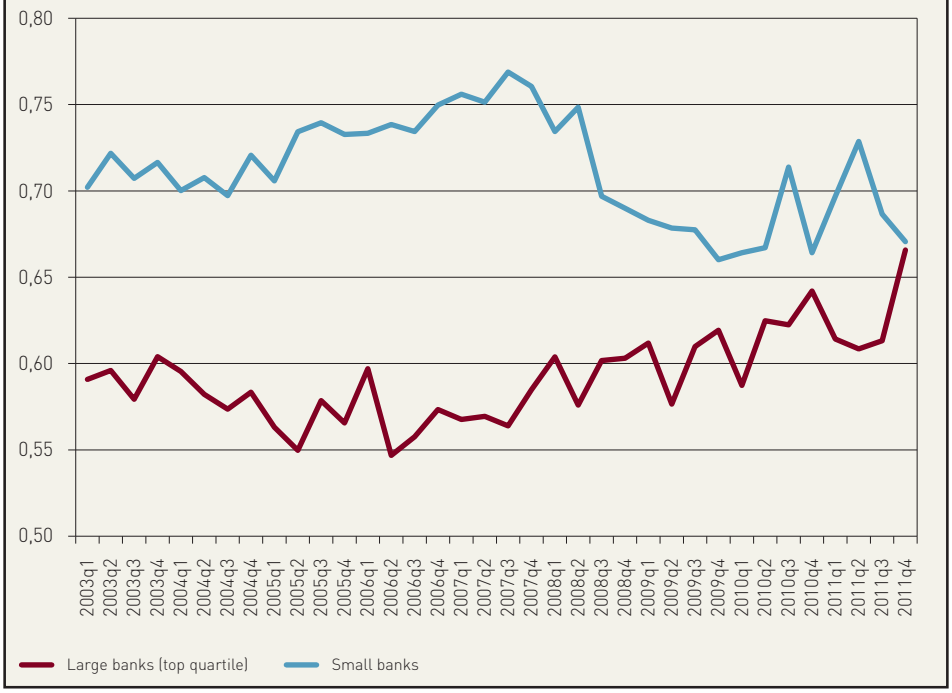
Figure 1
Evolution of short term funding of Luxembourgish banks as a share of total liabilities (Median)



Note: The ratio includes funding with maturities of up to 3 months as a share of total liabilities. The ratio of short term funding has been increasing significantly between early 2005 from around 65% of total funding to over 70% up until the end of 2007 when strains from the financial crisis started to shake up global financial markets. Short term funding extended in step with the expansion of the balance sheets. The fact that the ratio of short term funding to total liabilities increased shows that structurally, the median bank in Luxembourg relied more heavily on short term funding during the boom period.
Source: BCL, own calculations

38 Adrian and Shin (2011) provide an example for a complex financial system during a boom where "...mortgage assets are held in a mortgage pool, but mortgage-backed securities are owned by an asset-backed security (ABS) issuer who pools and tranches MBSs into another layer of claims, such as collateralized debt obligations (CDOs). Then, a securities firm might hold CDOs and finances them by pledging them as collateral to a commercial bank through repurchase agreements (repo). The commercial bank in turn funds its lending to the securities firm by issuing short term liabilities such as financial commercial paper. Money market mutual funds complete the circle, and household savers own the shares of these funds."

Figure 2
Median short term funding ratio for banks above and below the 75th percentile of total asset holdings



Source: BCL, own calculations

funding. Figure 1 shows that in particular smaller banks exhibited a cyclical pattern in their use of short term funding. Larger banks use less short term funding over the period under consideration. For smaller banks, an increase in short term funding is visible starting in early 2005 and peaking at end 2007. For larger banks the increase is less pronounced, starts later and continues up to the end of the sample period.

1.2 Identifying increasing aggregate risk

In order to identify excessive developments in lending, the present contribution relies on recent literature emphasizing the role of developments in credit to GDP and asset prices. Borio and Drehman (2009) find an important role for these indicators in predicting financial crisis. Similarly, IMF 2011 finds a strong leading indicator role in predicting crisis through the use of a combination of the credit to GDP-ratio, stock prices and real estate prices. Lund-Jensen (2012) sets up a probit model to determine the ability of these indicators to predict a crisis over a 2-4 year horizon. He notes that through the use of such indicators financial crisis can even be predicted in real-time.

Given the difficulty to attribute cross-border lending to specific sectors, we will use the credit to GDP gap as the main indicator of excessive lending and also test for interactions with a general indicator of asset price changes.

III. MODEL SPECIFICATION AND DATA

Panel regressions are carried out using an unbalanced panel dataset of quarterly bank level data over the period 2003Q1 to 2011Q4. The baseline model is as follows:

$$STFR_{i,t} = \alpha + \beta_1 STFR_{i,t-1} + Y_t\beta_2 + X_{i,t}\beta_3 + \beta_4 CRISIS_t + \beta_5 BRANCH_i + \beta_6 SD_t + v_i + \varepsilon_{i,t}$$

with *i* indicating the individual bank and t the time dimension. $STFR_{i,t}$ is the logit-transformed short term funding ratio. Y_t describes a vector of macro variables. $X_{i,t}$ is a vector of bank specific variables. $CRISIS_t$

and $BRANCH_t$ are the crisis and branch dummies, SD_t are seasonal dummies, v_i is a bank specific unobserved fixed effect and $\varepsilon_{i,t}$ is the error term.[39,40]

The main analysis builds on the System GMM estimator as proposed by Arrellano and Bover (1995) and Blundell and Bond (1998) to take account of the endogeneity bias.

The macro variables include the credit to GDP gap to account for lending booms, GDP growth, which covers the real economic developments, and the interest rate Euribor (3m) which is used as a general indicator for the cost of funding. A measure of euro area financial integration serves to control for improved market access through regulatory changes and financial innovation over the observation period.

To describe bank characteristics, the share of liquid assets held by the bank enters the equation. In addition, bank size and off-balance sheet commitments are controlled for.[41]

Furthermore, a dummy enters the equation denoting whether a bank is a branch or not. The difference between branches on the one hand and subsidiaries and independent banks on the other lies mainly in the fact that branches do not require their own capital and from a supervisory perspective they are consolidated on the balance sheet of their parent bank.

Macro data for the euro area comes from publicly available sources including the ECB statistical data warehouse (ECB SDW), Eurostat and the OECD. Balance sheet data stems from the balance sheet reporting of banks to the central bank of Luxembourg. Interest rate data were obtained from Bloomberg newswire services. All data are quarterly and cover the period from 2003q1 to 2011q4. On average the sample covers 150 banks per period.

IV. RESULTS

This section provides an overview of the main results. Detailed results can be found in the tables in the appendix to this contribution.

1.1 The baseline regression

The Credit to GDP gap variable exhibits a highly significant impact with a positive coefficient of 0.559 implying that credit-to-gdp growth beyond its trend increases the propensity of banks in Luxembourg to use short term funding. Taking account of the literature referred to above, this can be interpreted as evidence that banks resort to flexible short term funding in order to accommodate lending booms. Thus the funding structure of banks becomes more vulnerable when the economy experiences a lending boom. With respect to the evidence found by IMF 2011, Lund-Jensen (2012) and Borio and Drehman (2009), an increased use of short term funding is thus one of the channels through which the banking system as a whole builds up vulnerabilities during periods of excessive lending growth.

Changes in the 3 month interest rate have a small negative but significant impact representing the general effect of changes to the cost of funds. An increase in the 3 months Euribor rate leads to substitution effects as funding at this maturity becomes more expensive relative to other maturities. The

39 Given that the short term funding ratio STFR is bounded between 0 and 1, a monotonic logit transformation had to be carried out in order to translate the values for STFR from the 0, 1 space to the $-\infty,+\infty$ space.
40 A detailed description of all the variables can be found in the appendix to this contribution.
41 Giordana and Schumacher (2011b) find the off-balance sheet ratio to be a significant determinant of leverage in the Luxembourgish banking system.

GDP growth rate has a coefficient that is very close to zero and insignificant. The crisis dummy exhibits a significant and negative impact which relates to the post-Lehman breakdown of interbank markets. The macro variable controlling for financial integration and regulatory developments in the euro area financial sector does not show up significantly.

Regarding bank specific control variables, size has a significant, positive and fairly large impact (0.246). This result indicates that in addition to the aggregate effect of credit developments, banks tend to fund an extension of their balance sheet through increased use of short term funding which is further evidence of pro-cyclicality in short term funding. However, this result will be nuanced below as cross sectional effects of size are analyzed.

The off-balance sheet ratio is significant and positive (0.0532) implying that banks holding large contingent commitments tend to use more short term funding. One can expect that off-balance sheet commitments require additional flexibility to finance these commitments short term.

The coefficient on liquid assets is negative and significant at the 10 % level (-0.64). Increased holdings of liquid assets add to the flexibility of a bank. If additional liquidity is needed, a bank with a large amount of liquid assets can quickly sell these assets and does not need to resort to other (flexible) sources of funding.

The branch dummy is negative and insignificant. Hence, the institutional form does not seem to have a significant immediate impact on the tendency of a bank to fund its portfolio short term.

1.2 Interacting Credit-to-GDP with asset prices.

Lund-Jensen (2012) finds evidence that combining credit-to-GDP with asset price changes provides a good predictor of banking crisis. Also, IMF (2011) notes that while credit-to-GDP increases strongly before excessive lending booms, it also increases before 'healthy' booms in which future productivity gains are expected and such expectations drive credit growth. Hence they suggest to use a combination of changes to credit-to-GDP (or the credit-to-GDP gap) and asset prices. This procedure helps to predict 'bad' booms which lead to asset bubbles and subsequent banking crisis.

By consequence, this section will test a modified specification in which the credit-to-GDP gap indicator is combined with an indicator for changes in asset prices. The indicator is based on average quarterly levels of the ESTOXX 50 asset price index for European stocks. The modified specification hence features the credit-to-GDP gap, the changes to *ESTOXX* and an interacting term.

The results do, however, not confirm that the interaction between these two indicators materializes in additional short term funding on Luxembourgish banks' balance sheets. In the modified specification, the coefficient on the credit-to-gdp gap remains very similar to its value in the baseline specification and again is very significant (0.501). The coefficients on *ESTOXX* and the interacting term are insignificant and very small.

1.3 Cross-sectional effects

As was shown in Figure 2, the median short term funding ratio for banks in the highest quartile of the size distribution is lower throughout the observed time period. However, the previous section shows that the coefficient on bank size is positive and highly significant. In addition, the cyclical pattern for banks in this quartile is much more muted than for banks in the lower three quartiles. Furthermore, the short term funding ratio does not decline as abruptly for larger banks as it does for smaller banks.

Larger banks in Luxembourg differ in some essential ways from other credit institutions. For example the (unweighted) average leverage ratio of large banks is 25.1 whereas it is only 11.88 on average in the other quartiles. Larger banks also hold considerably more liquid assets than smaller banks. Furthermore, the largest quartile of banks features an off-balance ratio of 23.4 % on average over the observation period versus an average value of 12.9 % for the smaller banks.

Furthermore, in the literature there is some evidence that attaches behavioral aspects of banks to their size, e.g. with regard to monetary policy transmission (Kashyap and Stein (1995)) or lending (Giordana and Schumacher (2011a)).

In order to assess whether there is a differing impact of size for larger banks in the cycle, the specification was modified so as to take account of whether banks are part of the 4th quartile in terms of asset size by using a dummy variable. This dummy was interacted with the size variable. The marginal effect at the mean for a bank of being in the top size quartile is -0.836 and is highly significant (the p-value at the mean equals 0.0006). This implies that large banks on average rely less on short term funding and that for them the impact of size is less relevant. The result also leads to different coefficients on the size variable depending on whether a bank is located in the first three quartiles or in the top quartile of banks.

The coefficient on the (non-interacted) size variable increased in the new specification to 0.33 which implies that for banks in the lower three quartiles of the size distribution an increase in size by 1 percent induces a change in the transformed short term funding variable by 0.33 percent.

For the larger banks the coefficient on size becomes negative and significant at the 5 % level. Furthermore, in this specification the share of liquid assets held looses significance (-0.462). As noted above the most significant holdings of liquid assets coincide with the largest banks (4th quartile in the size distribution). Hence, it can be concluded that a significant share of the negative coefficient on size for the largest banks stems from the fact that they are less liquidity constrained and do not need to revert to short term funding to the same degree as smaller banks in order to accommodate their asset growth.

Over the observation period smaller banks were less liquid than larger banks with an average loan-to-deposit ratio of 1.04 over the observation period versus 0.94 for larger banks. This is mostly due to the fact that smaller banks hold more loans (93 % of total assets on average over the observation period as opposed to 71 %) in their portfolios than larger banks and less securities (12 % of total assets on average over the observation period as opposed to 30 %). As a result, in order to extend their balance sheet in the upswing, smaller banks had to revert more to flexible short term funding.

This result shows that pro-cyclical behavior is particularly relevant for smaller banks (i.e. the lower three quartiles in the size distribution) and that they tend to drive the build up of funding liquidity related vulnerabilities in the Luxembourgish banking sector. Smaller banks fund the extension of their balance sheet to a significant degree with short term funding.

Defining pro-cyclical behavior of banks as the co-movement of leverage growth and asset growth, and subsequently comparing the average values of this indicator across the large and small groups shows that there is a significant difference between the groups.[42] Smaller banks have an average value of the

42 Pro-cyclicality is measured as suggested by Adrian Shin (2009) through the indicator $gLEV/gASS$ with gLEV representing growth in leverage and gASS being growth of total assets. The closer this ratio is to one the more banks fund additional asset growth through an expansion of leverage (rather than equity issuance).

pro-cyclicality indicator of 0.775 while this value is 0.721 for larger banks. The difference is statistically significant (p-value: 0.045).

V. CONCLUSION

This contribution set out to study the determinants of short term funding in Luxembourgish banks' balance sheets. In particular, as short term funding exposes banks to funding liquidity risk, the question was whether cyclical movements in aggregate leverage affect the funding structure of banks and thereby raise the vulnerabilities on their balance sheets. The period under study covers the years 2003 to 2011 and thus includes a lending boom and a subsequent decline in the leverage cycle.

While some recent literature has made the link between periods of excessive lending and banking crisis, the picture on the mechanics of this link between aggregate lending and individual institutions' vulnerabilities remains to be completed. Empirical studies have shown the value of slow moving indicators like the credit to GDP gap and asset prices for predicting banking crisis. However, the mechanics underlying the build up of aggregate risks at the level of the individual institution remains obscure. Hence, the procedure of this contribution is to relate aggregate credit developments, GDP growth, the cost of funding and bank specific variables to the share of short term funding employed by banks. In order to do so, quarterly regressions on a panel of 150 banks over a period of 9 years were carried out.

The results of this study show that a case can indeed be made for a channel of risk transmission from the aggregate to institutions through increased use of short term funding. The main results indicate that aggregate credit developments in the euro area have a significant influence on the funding structure of Luxembourgish banks as they accommodate stark increases in credit growth through additional flexible short term funding. Thus, not only do banks increase leverage during an asset price boom but in addition, in order to finance the extension of their balance sheet, they need to resort to additional short term funding. This then causes the double vulnerability of being strongly leveraged and having to refinance very frequently. The findings also support the theories of pro-cyclical leverage cycles as the balance sheet size positively impacts short term funding. The findings depend, however, on the amount of liquid assets that banks hold. In Luxembourg larger banks hold considerably more liquid assets and on average they use less short term funding than smaller, more cyclical banks. Liquid assets are shown to have a negative and significant impact on short term funding.

Obviously, the findings of this contribution will be subject to the ongoing regulatory developments as the funding structure of banks currently receives additional scrutiny. In this context, the importance of a sound funding structure is undebated and this insight has even led to a new standard on bank funding, the Net Stable Funding Ratio (NSFR).[43] Based on the evidence provided in this paper, one can infer that the restrictions put on banks through the implementation of the NSFR could lead to a reduction in leverage cycles as it restricts the possibilities of banks from using additional short term funding to accommodate the expansion of their balance sheets during a boom phase.

Furthermore, the results imply as well, that the envisaged regulatory requirements on liquidity coverage of banks portfolios could have implications for banks' funding structure and render them less subject to the cyclical accumulation of aggregate risk. The interpretation from this contribution would be that more liquid banks are less prone to fund themselves at shorter maturities. Hence a more liquid portfolio would contribute to overall stability.

43 See BCBS (2010).

APPENDIX: TABLES

Table 1:

Variables

STFR	Short term Funding Ratio; Liabilities with maturities of up to 3 months over total liabilities; logit-transformed
LAR	Liquid assets over total assets
SIZE	Log of total assets
DSIZEQ4	Dummy indicating those banks that are in the top quartile with regard to the size variable
SIZEQ4	Interacted variable multiplying *SIZE* and *DSIZEQ4*
OFFB	Off-balance sheet commitments
BRANCH	Branch dummy
CtGap	Credit to GDP-gap
FININT	Indicator of financial integration; volume of cross-border credit
EURIB	Change in 3 month Euribor rate
EAGDP	Euro area GDP growth rate
CRISIS	Crisis dummy
ESTOXX	Quarterly changes to the Eurostoxx 50 stock index of European stocks.
GAPESTOX	Interacted variable of the credit to GDP gap and the change in the Eurostoxx value.

In the baseline regression the estimated coefficient on the lagged dependent variable is 0.727 in the system-GMM regression, in between the coefficient in the fixed effects regression (0.63) and the OLS regression (0.904) which indicates that the endogeneity bias has been addressed. The p-values on the AR(2) test-statistic and the Hansen test of over-identifying restrictions indicate that the model is well specified.

Table 2:

Estimation results, Short term Funding Ratio, baseline regression

	OLS		FIXED EFFECTS		SYSTEM GMM	
$STFR_{t-1}$	0.904***	(0.0068)	0.630***	(0.0127)	0.727***	(0.0443)
LAR_t	-0.202***	(0.0436)	-0.244***	(0.0903)	-0.64*	(0.3566)
$SIZE_t$	0.00677	(0.0055)	0.125	(0.0193)	0.246***	(0.0731)
$OFFB_t$	0.0233	(0.0175)	0.0314	(0.0212)	0.0532**	(0.0256)
$BRANCH_t$	-0.0513**	(0.0236)	-0.0707	(0.296)	-0.482	(0.2941)
$CtGap_t$	0.0602	(0.1097)	0.285***	(0.1039)	0.559***	(0.1472)
$FININT_t$	0.00414	(0.0167)	0.00278	(0.0154)	0.000887	(0.0138)
$EURIB_t$	-0.0184	(0.0411)	-0.0635	(0.0386)	-0.0979*	(0.0509)
$EAGDP_t$	0.0334	(0.0255)	0.0013	(0.0237)	-0.00232	(0.0233)
$CRISIS_t$	0.0319	(0.0283)	-0.079***	(0.0273)	-0.0713*	(0.0385)
N	4326		4326		4326	
Groups			182		182	
					Seasonal Dummies	Yes
					Hansen p-value	0.263
					Ar(1) p-value	0.000
					Ar(2) p-value	0.187
					N. of instruments	146
					χ^2 p-value	0.000

Standard errors in parentheses, seasonal dummies and the constant were dropped from the table. * *p<0.1*, ** *p<0.05*, *** *p<0.01*

Table 3:

Estimation results, STFR, interaction specification

	OLS		FIXED EFFECTS		SYSTEM GMM	
$STFR_{t-1}$	0.903***	(0.0068)	0.629***	(0.0127)	0.749***	(0.0526)
LAR_t	-0.203***	(0.0436)	-0.249***	(0.0903)	-0.578*	(0.3483)
$SIZE_t$	0.00662	(0.0055)	0.124***	(0.0194)	0.25***	(0.0819)
$OFFB_t$	0.0227	(0.0175)	0.0302	(0.0213)	0.0531**	(0.0255)
$BRANCH_t$	-0.0510**	(0.0236)	-0.0478	(0.2961)	-0.486	(0.2971)
$CtGap_t$	0.052	(0.1103)	0.273***	(0.1043)	0.501***	(0.1532)
$ESTOX_t$	0.00004	(0.0001)	0.000046	(0.0000)	0.0000519	(0.0001)
$GAPSTOXX_t$	0.000142	(0.0001)	0.00018*	(0.0001)	0.000135	(0.0001)
$FININT_t$	0.000475	(0.0177)	-0.00189	(0.0163)	-0.00484	(0.0146)
$EURIB_t$	-0.0166	(0.047)	-0.018	(0.0445)	-0.0537	(0.0584)
$EAGDP_t$	0.0362	(0.0305)	0.00446	(0.0282)	-0.00471	(0.0297)
$CRISIS_t$	0.0241	(0.0289)	-0.0898***	(0.0279)	-0.0852**	(0.0414)
N	4326		4326		4326	
Groups			182		182	
					Seasonal Dummies	Yes
					Hansen p-value	0.241
					Ar(1) p-value	0.000
					Ar(2) p-value	0.181
					N. of instruments	150
					χ^2 p-value	0.000

Standard errors in parentheses, seasonal dummies and the constant were dropped from the table. * p<0.1, ** p<0.05, *** p<0.01

Table 4:

Estimation results, cross-sectional effects of size

	OLS		FIXED EFFECTS		SYSTEM GMM	
$STFR_{t-1}$	0.900***	(0.0068)	0.626***	(0.0127)	0.698***	(0.0525)
LAR_t	-0.168***	(0.0444)	-0.186**	(0.0910)	-0.462	(0.2852)
$SIZE_t$	0.0316***	(0.0087)	0.185***	(0.0231)	0.330***	(0.0886)
$DSIZEQ4_t$	-0.349	(0.6260)	3.627***	(1.3658)	7.542**	(3.1999)
$SIZEQ4_t$	0.00907	(0.0271)	-0.17***	(0.0604)	-0.359**	(0.1439)
$OFFB_t$	0.0296*	(0.0176)	0.0307	(0.0212)	0.0484*	(0.0254)
$BRANCH_t$	-0.0501**	(0.0235)	-0.16	(0.2960)	-0.225	(0.3581)
$CtGap_t$	0.0957	(0.1099)	0.327***	(0.1043)	0.539***	(0.1392)
$FININT_t$	0.00408	(0.0167)	0.00269	(0.0154)	-0.00135	(0.0137)
$EURIB_t$	-0.0299	(0.0411)	-0.0707*	(0.0388)	-0.107**	(0.0494)
$EAGDP_t$	0.0341	(0.0254)	-0.00186	(0.0236)	-0.0131	(0.0227)
$CRISIS_t$	0.0261	(0.0282)	-0.0901***	(0.0273)	-0.117***	(0.0348)
N	4326		4326		4326	
Groups			182		182	
					Seasonal Dummies	Yes
					Hansen p-value	0.565
					Ar(1) p-value	0.000
					Ar(2) p-value	0.245
					N. of instruments	149
					χ^2 p-value	0.000

Standard errors in parentheses, seasonal dummies and the constant were dropped from the table. * p<0.1, ** p<0.05, *** p<0.01

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3. IDENTIFICATION OF DOMESTIC SYSTEMICALLY IMPORTANT BANKS IN LUXEMBOURG: THE ROLE OF BANKS' BUSINESS MODELS

By Gaston GIORDANA[44]

ABSTRACT

This study proposes, following the BCBS's principles, an indicator-based methodology for the assessment of the systemic importance of banks in Luxembourg and a bucketing approach for assigning each bank into a bucket of systemic importance. The main contribution of the paper is the method proposed for calculating the relative weights. We argue that the relative weights should be determined through data-driven methods, rather than based on normative precepts, and account for the characteristics of the banking business model most widely present in the domestic sector. On the basis of a classification of banks by their business model resulting from a statistical cluster analysis, the proposed methodology is applied using data for the population of Luxembourg's active banks in 2012q1.

I. INTRODUCTION

The Basel Committee on Banking Supervision (BCBS) has recently issued a document proposing a framework for dealing with domestic systemically important banks (D-SIBs) (BCBS 2012). Taking the global systemically important banks (G-SIBs) policy as a starting point, the D-SIB framework complements it by focusing on the consequences on the domestic economy of the failure of those systemically important banks (SIBs) which are not global.

The rationale for implementing policy measures to cope with SIBs is similar whether these are considered global or domestic. The failure of banks that are important at the domestic level is expected to generate similar externalities as the global ones but locally. Indeed, distress or failures of D-SIBs would certainly have a sizable impact on the local financial sector and the real economy. Moreover, they can generate cross-border externalities, even if the effects are not global in nature (see paragraph 3 in BCBS, 2012). Finally, moral hazard related externalities can be considerable domestically.

Despite sharing the same motivation, the frameworks differ fundamentally in their approach. While the BCBS put forward a prescriptive approach for G-SIBs, the D-SIBs framework is characterized by an ample degree of national discretion. This would allow national authorities to accommodate the structural characteristics of their financial sector. However, the BCBS is of the view that the D-SIB framework should contribute to the reduction of cross-border externalities induced by spillovers at the bilateral or regional levels (see paragraph 5 in BCBS, 2012). Consequently, the D-SIBs framework *"should establish a minimum set of principles, which ensures that it is complementary with the G-SIB framework, addresses adequately cross-border externalities and promotes a level-playing field"* (see paragraph 5 in BCBS, 2012).

The BCBS has developed 12 principles that can be classified into two groups. The first group addresses the assessment methodology for D-SIBs while the second group deals with Higher Loss Absorbency (HLA) requirements. In this paper we focus on the assessment methodology. The objective of the present study is to propose, following the BCBS's principles, an indicator-based methodology for the assessment of the systemic importance of banks in Luxembourg and a bucketing approach for assigning each bank into a bucket of systemic importance.

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The assessment methodology consists of an index resulting from the aggregation of a set of bank-level indicators reflecting the several dimensions of systemic importance. The authorities determine the set of indicators and the relative weights required for aggregating them into one index. Theoretical and normative concepts would guide the selection of indicators which should provide an approximative measure of the systemic-importance-related externalities that a bank potentially generates. Given that the theoretical foundations are well established, the set of indicators are expected to be similar across different jurisdictions even if their banking sectors fundamentally differ. The contribution of this paper is to propose a method for calculating the relative weights. We argue that the relative weights should be determined through data-driven methods and account for the characteristics of the banking business model most widely present in the domestic sector rather than being based on normative precepts.

The necessity of accounting for the diversity of business models has been raised in several studies on the European banking sector. For instance, Altunbas, Manganelli and Marques-Ibanez (2011) analyze potential differences in banks' risk across business models, Giordana and Schumacher (2012) study the role of banks' specialization in leverage dynamics, while Ayadi, Arbak and De Groen (2011) evaluate changes in the business lines induced by the 2007-2008 financial crisis, Ayadi, Arbak and De Groen (2012) propose a deeper analysis of the different business models and suggest regulatory changes. The empirical literature on the transmission of monetary policy in the Euro area, namely on the *bank lending channel*, also relies on banks' characteristics for identifying such a channel (e.g. Ehrmann, Gambacorta, Martínez-Pagés, Sevestre and Worms, 2002; Altunbas, Gambacorta and Marques-Ibanez, 2009; Altunbas, Gambacorta and Marques-Ibanez, 2010; Giordana and Schumacher, 2013). Among the statistical techniques applied, some studies made use of cluster analysis tools for the identification of different banks' business models (e.g. Ayadi et al., 2011; Ayadi et al., 2012; Ferstl and Seres, 2012).

We start off presenting the different components of the methodology in Section II. In particular, we introduce the dimensions of systemic importance and the corresponding indicators in Sub-section II-1.1. While the dimensions of systemic importance that should be considered are clearly suggested in the BCBS principles, the indicators to be included within each dimension as well as the relative weights assigned to them are to be determined by the local authorities. We provide a detailed description of the method employed for the calculation of the relative weights attached to each indicator in Sub-section II-1.2.

In particular, we resort to cluster analysis techniques to identify the alternative business models in Luxembourg's banking sector. The clustering algorithm used (i.e. *k-means*) as well as the procedures implemented for validating the result are presented in sub-section II-1.2.1. On the basis of the outcome of the cluster analysis we propose an estimation of the relative weights of indicators that would be representative of the predominant business model in the banking sector. Finally, in sub-section II-1.3 the method for distributing banks in groups of systemic importance (the bucketing approach) is outlined.

The remainder of the paper is organized as follows. In Section III we apply the suggested methodology to identify a list of D-SIBs in Luxembourg and analyze the drivers by using data for first quarter 2012. The results are compared with the outcome of alternative measures of systemic importance. We conclude that, given the set of indicators used for the assessment of systemic importance, the relative weights accounting for the predominant business line tend to convey limited additional information. Finally, section IV discusses the way forward.

II. THE ASSESSMENT METHODOLOGY

Given that models for the measurement of banks' systemic importance are at an early stage of development, the indicator-based measurement approach is seen to be more robust than model-based ones

(par. 12 in BCBS, 2011).[45] In addition, the complexity of model-based methodologies and the level of information that their implementation requires impedes individual institutions to assess their systemic importance and thus constraint the incentives introduced by policies (Drehmann and Tarashev, 2011b).

The BCBS's method for the identification of G-SIBs consists in the aggregation of a selection of indicators which *"are chosen to reflect the different aspects of what generates negative externalities and makes a bank critical for the stability of the financial system"* (par. 12 in BCBS, 2011). The principles proposed by the BCBS for guiding the D-SIB framework suggest the use of a similar methodology. More specifically, the D-SIB framework principles call for an assessment of the systemic importance of domestic banks (Principle 1) based on bank-specific indicators (Principle 5) which reflect the potential impact of a bank's failure (Principle 2) on the domestic economy (Principle 3). The bank-specific indicators are aggregated into an index of systemic importance which allows ordering domestic banks and then determining the systemically important ones from a domestic perspective. The HLA requirement imposed on D-SIBs will also be partially determined by the degree of systemic importance of such banks (Principle 9).

In general, we adopt a similar methodology as the one prescribed by the BCBS for the identification of G-SIBs (see paragraphs 15 to 17 in BCBS, 2011). However, we make use of a different scheme for setting the relative weights of indicators.

1.1 The dimensions and indicators of systemic importance

The systemic importance of a financial institution is a multidimensional notion. In particular, a bank can be designated as systemically important because of: (i) its relative size, (ii) its complexity -which makes resolvability a hardship-, (iii) its position as an important vector of contagion, and/or (iv) the difficulties to replace the services it provides which make it pivotal for the functioning of the financial system.

The size, interconnectedness and complexity of a bank contributes to a moral hazard problem. Indeed, institutions might be considered "too big to fail" or "too complex to fail" because their failure or resolvability could generate unpredictable negative consequences for the rest of the financial system and the broader economy of a country or region (i.e. negative externalities, for example through interconnectedness). Thereby, these institutions benefit from an implicit public guarantee which might encourage them to engage in more risky activities. Moreover, market participants discount this implicit guarantee and reduce the funding cost of systemic banks exacerbating the situation. The substitutability dimension of systemic importance addresses the significance of an institution as a provider of services. Indeed, the failure of such a bank can leave the financial system without supply of key services. This issue is close to the scope of competition policy.

The multidimensional nature of systemic importance should be reflected in the measurement methodology. Thus, several bank-level indicators related to the different dimensions of systemic importance must be aggregated into a single index. Hence, the BCBS principles recommend that the indicators must reflect the impact of banking distress on the domestic economy and that they should reflect the size, the level of connectivity, the potential substitutability and the degree of complexity (see Principle

45 Among them one can find the CoVaR (Adrian and Brunnermeier, 2011), the Marginal Expected Shortfall (e.g. Acharya, 2009; Acharya, Brownlees, Engle, Farazmand and Richardson, 2010), measures using the Shapley Value (e.g. Tarashev, Borio and Tsatsaronis, 2009; Drehmann and Tarashev, 2011a), methods based on network models (e.g. Chan-Lau, 2010) and others using conditional probabilities (e.g. Xisong and Nadal De Simone, 2012)

5). The dimensions are similar to the ones required in the G-SIB framework although the set of indicators retained here differs (for comparison see Table 1 in BCBS, 2011).[46]

Table 1 below summarizes the definitions of the selected indicators. While the indicators in the Size dimension are completely different from the ones used in the G-SIB methodology, those included in the other dimensions partially match them. In particular, the indicators from the cross-jurisdictional activities and complexity dimensions in the G-SIB method prescribed by the BCBS, have been merged and designated as the set of indicators for the *complexity* dimension in D-SIB methodology. While it might be striking that almost all the bank-level indicators considered in the G-SIB measurement are also included for the domestic assessment of systemic importance of banks, such a choice is fully justified by the particularities of the Luxembourg banking sector. On one hand, the financial sector represents a big share of the domestic GDP although these activities are mainly internationally oriented. This justifies the inclusion of indicators that signal global systemic importance. On the other hand, the part of the broad financial sector that serves the local real sector is relatively small and concentrated. Consequently, the identification of domestically systemic banks necessitates the inclusion of locally oriented indicators.

Table 1:

Individual indicators definitions

CATEGORY	INDICATOR	DEFINITION	WEIGHT
Size	Total exposure over GDP	It is intended to measure the relative size of the bank in terms of the domestic product. **Definition:** total assets plus given loan commitments, financial guarantees and other commitments divided by GDP (seasonally and working days adjusted).	0.0679
	Domestic total assets	It is intended to measure the footprint of the bank in the domestic economy independently of the specialization of the bank. **Definition:** Total assets with counterparts in Luxembourg.	0.0488
	Employment	It appraises the weight of the bank to the domestic financial-related services labor market. **Definition:** Total number of employees.	0.1332
Connectivity	Intra-financial system assets (IFSA)	Intra-financial activity indicators (assets and liabilities) measure the exposure to contagion of distress in the financial system without distinction between local shocks and those coming from abroad. **Definition:** Similar to the G-SIB framework, it is calculated as the sum of the lending to financial institutions (including un-drawn committed lines),the holdings of securities issued by other financial institutions, net mark to market reverse repurchase agreements, net mark to market securities lending to financial institutions, and net mark to market Over-the-Counter derivatives with financial institutions. **Assumptions:** it is assumed that all the derivatives related transactions are made with financial institutions.	0.0444
	Intra-financial system liabilities (IFSL)	**Definition:** Similar to the G-SIB framework, it is calculated as the sum of the deposits by financial institutions, securities issued by the bank that are owned by other financial institutions, net mark to market repurchase agreements, net mark to market securities borrowing from financial institutions, and net mark to market OTC derivatives with financial institutions. **Assumptions:** (i) it is assumed that all the derivatives related transactions are made with financial institutions and, (ii) that all issued debt securities are held by financial institutions.	0.0165
	Wholesale funding ratio	**Definition:** Similar to the G-SIB framework, it is calculated by dividing (total liabilities less retail funding) by total liabilities. Retail funding is defined as the sum of retail deposits.	0.1020
	Network centrality (Closeness)	It measures the importance of the bank within the domestic interbank network. **Definition:** The closeness of a node is defined as the inverse of the farawayness; the farawayness is the sum of the distances of a node to all other nodes. For details see Box 4.1 in BCL Financial Stability Review 2012 (Buisson 2012)	0.0871

46 An exception is the inter-jurisdictional activities dimension in the G-SIB methodology which is not explicitly included. However, it is suggested that the indicators therein might be included within the complexity dimension in the D-SIB framework.

CATEGORY	INDICATOR	DEFINITION	WEIGHT
Substitutability	Assets under custody	**Definition:** Similar to the G-SIB framework, it is defined as the value of assets that a bank holds as a custodian.	0.0653
	Loans to the domestic non-financial sector	It accounts for the role played by the institution in the provision of funding to the real economy. **Definition:** total loans granted to non-financial sector by counterpart (i.e NFC, retail, public sector). The set includes three indicators.	NFC: 0.0229; Retail: 0.0250; Public: 0.0059.
	Real estate loans	It approximates the market share regarding real-estate loans newly granted and thereby the part taken by the institution in feeding a potential price bubble in the real sector. **Definition:** amount of new loans for real-estate in Luxembourg divided by the sum, over the last 5 quarters, of new loans for real-estate in Luxembourg (by counterpart: Households, promoters, and local governments).	Hous.: 0.0051; Prom.: 0.0041; Loc.Gov.: 0.0020.
	Liabilities from domestic non-financial sector	It approximates the part of the financial services supplied to the non-financial sector. **Definition:** total liabilities from the non-financial sector by counterpart (i.e NFC, households, public sector). Then, the set includes three indicators.	NFC: 0.0347; Retail: 0.0472; Public: 0.0045.
	Spatial coverage	It is intended to estimate the geographical coverage of the institution in the Luxembourgish territory. **Definition:** Number of agencies.	0.0332
Complexity	Over-the-Counter (OTC) derivatives notional value	The focus is on the amount of OTC derivatives that are not cleared through a central counterpart. **Definition:** Similar to the G-SIB framework, it is calculated as the outstanding notional amount of OTC derivatives. **Assumption:** any derivative transaction is cleared through a central counterpart.	0.0496
	Level 3 assets	Assets whose fair value cannot be determined using observable measures, such as market prices or models (BCBS 2011). **Definition:** Similar to the G-SIB framework, it is calculated as the amount of total assets minus the total value of marketable securities (i.e. those with an ISIN code in the Security-by-Security reporting to the BCL). **Assumptions:** All assets but Level 1 and 2 as defined in the LCR rules.	0.0104
	Held for trading and available for sale value (TASV)	**Definition:** Similar to the G-SIB framework, it is calculated as the total value of the bank's holding of securities in the trading book and available for sale category.	0.0493
	Cross-jurisdictional claims	"Total *foreign claims in the terminology of the BIS statistics is the sum of two components (both measured on an ultimate risk basis): (i) international claims, which are either cross-border claims (from an office in one country on a borrower in another country) or local claims in foreign currency (from the local office of the bank on borrowers in that location in a currency other than the one of the location); and (ii) local claims in local currency (similar to the other local claims but in the currency of that location). Claims include deposits and balances placed with other banks, loans and advances to banks and non-banks, and holdings of securities and participations."* (BCBS 2011) **Definition:** total foreign assets plus total local assets denominated in foreign currency. **Assumption:** the statistical table s2.5 is not consolidated. Though, we have included data from foreign branches. The data includes intra-group claims.	0.0932
	Cross-jurisdictional liabilities	The indicator includes all liabilities to nonresidents of the home country and it ideally should net out intra-office liabilities (to match the treatment in the cross-jurisdictional asset indicator). **Definition:** total foreign liabilities plus total local liabilities denominated in foreign currency. **Assumption:** the statistical table S2.5 is not consolidated. Though, we have included data from foreign branches. The intra-group activities are not netted out.	0.0475

Each of the indicators described in the previous subsection are normalized by the total of the sample. This transformation allows aggregating the indicators by setting them on a common scale and limiting the influence of outliers by bounding them to the interval [0,1]. However, some of the indicators considered are already defined in this interval (e.g. wholesale ratio, real-estate loans). Nevertheless, the transformation is still applied because it brings the transformed indicator to signal the relative importance of each bank in the sample. The G-SIB methodology prescribed by the BCBS employs this transformation for all the indicators except for the wholesale ratio.[47]

Table 3 in the appendix provides descriptive statistics of the untransformed indicators in the first quarter 2012.

47 The wholesale ratio is normalized by the sample average in the BCBS methodology. While they acknowledge that such a transformation is arbitrary, they argue that it renders the score in units that are comparable to the other indicators (see paragraph 34 and footnote 12 in BCBS, 2011).

1.2 The relative weights of indicators

The choice of vector of weights which would permit the aggregation of several indicators into one multidimensional index is far from being obvious. In what follows we discuss alternative ways to set the vector of relative weights and we provide a detailed description of the weighting scheme that we found to be the most adapted to the case of Luxembourg.

On the one end, the relative weights can be set following normative precepts in a rather ad-hoc manner which reflect the preferences of the regulator regarding the relative importance of indicators. One possibility would be to assign the same weight to every indicator in the index (i.e. equal weighting scheme). The equal weighting scheme is appealing because of its simplicity. However, even if they are equally set, the weights are not neutral in terms of the incentives introduced by the regulation. On the other end, the vector of relative weights can be set using data driven weighting schemes, meaning that the weights would depend on the characteristics of the statistical distribution of the indicators (for the population or a sample of banks). The motivation for using data driven weighting schemes relates to the fact that such weights convey information about predominant banks' business models and the degree of specialization in the banking sector. It is valuable that the assessment methodology integrates this information given that the final objective of the D-SIB regulation is not to alter practices but to make banks internalize the externalities generated by their SIB condition.

In the assessment methodology proposed in this study we make use of a particular vector of relative weights which differs from those of an equal weighting scheme. The construction of our vector of relative weights minimizes the employment of normative precepts. Rather, it is based on information contained in the dataset. The aim of such a weighting scheme is to grant higher weights to indicators heavily present in bank business models that count significantly forward the domestic real sector while avoiding to disregard the importance of banks that are less domestically oriented. In addition to the arguments provided in the introduction to this paper, the empirical rationale for this approach lies on several features of Luxembourg's financial system. These features concern the diversity of financial services provided by banks, the degree of specialization of some banks and the importance of the financial services sector for the economy while the part of those services that serves the local real sector is relatively small and concentrated.

We advocate that relative weights should tend to reflect the banks' business line which is predominant. Thus, the calculation of relative weights is done in two steps. First, banks are classified into different business specializations using cluster analysis techniques. Second, a vector of weights is calculated for each dimension of systemic importance as the ratio between the indicator total, across the banks within the concerned bank type, and the sum of all indicators totals in the corresponding dimension. Note that we impose the same weight for each one of the four dimensions (i.e. 0.25). The following subsections describe in detail the classification methodology.

1.2.1 The classification methodology

In order to classify banks by their business model we perform a cluster analysis. Cluster analysis allows us to group banks based only on information found in the data. The goal is that the banks within a group are similar to one another and different from the banks in the other groups. There are several clustering techniques available in well known statistical programs like Stata. In our study we make use

of a "K-means" clustering which is a partitional[48] technique aimed at finding a user-specified number of clusters (K) represented by their centroids, i.e. their means.[49]

It is worth noting that cluster analysis is not an exact science and, thereby, the results tend to depend strongly on the analyst's choices. In order to obtain results as consistent as possible we implement an algorithm which includes internal and external validation procedures.[50] The internal validation tools we use are the "Calinski-Harabasz pseudo F-statistic" (F_{CH}) and the *"Silhouette"* indicator.

The F_{CH} is defined as follows:

$$F_{CH} = \frac{\left(\frac{R^2}{k-1}\right)}{\left(\frac{1-R^2}{N-k}\right)}$$

where N is the total number of data points, k is the number of clusters and R^2=(SST-SSE)/SST. SST is the total sum of squared distances to the overall mean and SSE is the sum of squared distances of the data points to their own class means. The higher the "Calinski-Harabasz pseudo F-statistic" the better, as it would mean that on average points are closer to their class mean than to the overall mean.

The silhouette method combines measures of cohesion and separation of points. The cohesion measures the proximity between points within the same class. Then, if we consider the squared distance as a proximity measure (which is in fact a dissimilarity measure), the SSE defined above would be the cohesion. In such a case, the lower the SSE the better in terms of cohesion. The separation refers to the proximity between points of different classes. For example, it can be calculated as the sum of the squared distances between a point and the mean of the other classes. The higher the separation of points the better, as this would mean that clusters are clearly distinguishable.

The silhouette coefficient is given by:

$$s_i = \frac{\left(b_i - a_i\right)}{\max(a_i, b_i)}$$

where a_i is the average distance of bank *i* to all other banks in its cluster, b_i is the minimum separation value with respect to all clusters. In order to obtain b_i, first, one has to calculate the average distance to all the banks in clusters to which bank *i* does not pertain. Then, one has to take the minimum value with respect to all clusters. The value of the silhouette coefficient can vary between -1 and 1. The higher the silhouette the better as it would mean that on average banks are closer to the banks in their class than to the banks in the other classes.

48 While a "partitional clustering is simply a division of the set of data objects into non-overlapping subsets (clusters) such that each data object is in exactly one subset", a hierarchical clustering "is a set of nested clusters that are organized as a tree" (page 492 in Tan, Steinbach and Kumar, 2006).

49 The centroids can be represented by other centrality indicators like the median.

50 The internal validation consists in evaluating the goodness of the clustering structure without using more information than the one contained in the dataset. By contrast, the external validation compares the outcome of the classification algorithm with some external structure.

The first step of the classification procedure consists of determining the set of variables on which the clustering algorithm would run. We focus on balance sheet characteristics rather than taking variables from the profit-and-loss account as a way to minimize the influence of market conditions and other factors which are out of banks' direct control (for a similar approach see Ayadi et al., 2012). The choice of variables is then made on the basis of the different streams of the literature which make use of balance sheet characteristics to approximate banks' business line (e.g. Altunbas et al., 2009; Athanasoglou, Brissimis and Delis, 2008; Giordana and Schumacher, 2013) as well as on the specific objective of our clustering exercise. In particular, the aim is to differentiate between the banks oriented toward the domestic real sector and banks with other business models. The vector of balance sheet ratios seeks to characterize the funding and investment behavior of banks. In particular, we consider the ratios of local assets, of loans to retail counterparts, of loans to non-financial counterparts, of cross-jurisdictional assets over total assets. On the liability side, we compare the ratios over total assets of deposits from non-financial corporates and of cross-jurisdictional liabilities.

Given a set of variables characterizing the banks, the clustering algorithm goes as follows. First, the number of clusters are determined. A common rule of thumb for setting the number of clusters indicates that the maximum number of groups should not exceed eight.[51] Accordingly, with the purpose of determining the number of clusters we first classify banks into three to eight groups using the K-means algorithm. As this classification algorithm is sensitive to the initial values of the clusters' centroids, we have iterated the algorithm, given the number of groups, one hundred times using a different random draw of initial values each time. This makes a total of 600 hundred classifications. Second, in order to sort the alternatives out we choose those outcomes that have the highest F_{CH} statistic. Then, we select the one that has the lowest number of negative Silhouette values among them. As external validation we check if clusters are also distinguishable by other bank level indicators[52] than those used in the classification algorithm. Then, we run multi-comparison tests with the aim of evaluating if the typology results in significant differences in the average of these indicators.[53] Finally, if the result of the external validation exercise is satisfactory and there are some banks left with negative silhouette values, we relocate them into alternative clusters depending on our separation measure.

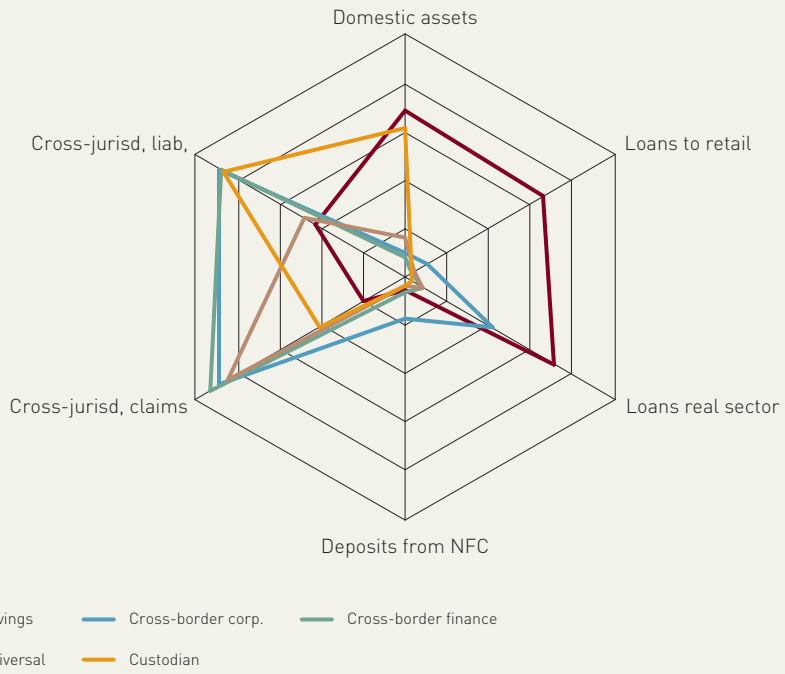
1.2.2 Characterizing the vector of relative weights

The cluster analysis results in a typology with five classes of banks: Savings, Cross-border corporate finance oriented, Cross-border banking oriented, Universal and Custodian. Figure 1 as well as Tables 4 and 5 show descriptive statistics by cluster of banks for several balance-sheet indicators including some of those considered for the assessment of domestic systemic importance.

It can be seen from figure 1 and the tables that the cluster of savings banks shows the highest median ratio of local assets over total assets and a retail oriented business line. The group of banks oriented toward cross-border corporate finance essentially contains subsidiaries and branches of international banking groups specialized in non-financial corporates. The banks in this cluster show elevated median ratios of non-financial corporate assets and liabilities while they manifest the highest mean ratios of cross-jurisdictional activities. Likewise, the cluster of cross-border intra-financial oriented banks occupies the second position in terms of cross-jurisdictional activities but their assets and liabilities are composed of financial sector counterparts.

51 The rule of thumb is given by: $k \approx N/2$ where k is the number of clusters and N the number of observations in the sample.
52 We consider all the indicators listed in Table XX plus the leverage and the liquidity ratios.
53 Given that the number of clusters exceeds two several pairs need to be compared. A simple t-test in such a situation increases the probability of error of type 1. Multi-comparison tests provide an upper bound on the probability that any comparison will be incorrectly found significant.

Figure 1
Comparison of cluster means



Custodian banks group is characterized by high median ratios of local assets which are likely constituted by shares of collective undertakings. The assets are mainly intra-financial (Table 4) and they are very active in the OTC derivatives market (Table 5). While they have a high level of cross-jurisdictional liabilities their wholesale ratio is among the lowest (Table 5).

Even if the cluster of Luxembourg's universal banks does not show any statistically significant differences with the other classes of banks in most of the variables (means comparison), the inspection of figure 1 and the tables highlights some differences. These banks distinguish themselves by the size of their trade book of securities and the ratio of liquid assets. On the liability side their distinctive feature is rather the quite elevated ratio of wholesale funding (Table 5).

The cluster of the cross-border intra-financially oriented banks represents the most generalized business model with 55 banks over the 127 in the sample and total assets averaging up to 8775 million euros. It is followed by the group of universal banks which is composed by 31 banks and the total assets average equals 7283 million euros. In spite of not being the predominant business model we focus on the later group in order to calculate the relative weights for the assessment of the systemic importance because the ratio of domestic assets is higher in this group.[54]

The third column in Table 1, already discussed in the previous sub-section, contains the relative weights assigned to each indicator. As can be seen, the employment indicator receives the highest weight within the size dimension.[55] As regards the connectivity dimension, the indicator of centrality in the domestic interbank network and the wholesale funding ratio receive the highest weights. The indicators with the highest relative weights within the substitutability dimension are: assets-under-custody, loans to and liabilities from domestic retail counterparts, and the spatial coverage indicator (i.e. number of

54 Additionally, in order to provide quantitative evidence for further guiding the choice of the vector of relative weights, we evaluate alternative weighting schemes in terms of the quality of the bucketing approach. The procedure through which the banks are designated as systemically important and then placed into buckets is fundamental. This would allow requiring banks to have a higher loss absorbency capacity commensurate with their degree of systemic importance. The appraisal is based on a specific bucketing rule aimed at generating the limits of the buckets of systemic importance and which was explained in the main text. The results of this appraisal supports our choice of weights and are available under request.

55 Such a weight might raise some concerns from a political point of view. It would tend to discourage systemically relevant banks to increase the number of employees. It can even encourage a reduction in the employment of SIBs. In order to avoid this pervasive effect the indicator might be eliminated from the index. Alternatively, a modification of the parameter related to the elasticity of substitution between indicators can also cope with this drawback.

agencies). In the complexity dimension the highest weight is attached to the cross-jurisdictional claims indicator.

1.3 The bucketing approach

In order to require banks to have a HLA capacity which would be commensurate with their degree of systemic importance, the distribution of the Index of Systemic Importance (ISI) scores must be separated in buckets. The BCBS bucketing methodology for G-SIBs separates banks into equally sized groups. The banks in the first bucket, the widest one, are not required to hold additional loss absorbency capacity. The following, equally sized buckets require increasing levels of HLA. Finally, there is an empty bucket on top with an even higher capital requirement aiming at discouraging banks from further increasing their degree of systemic importance.

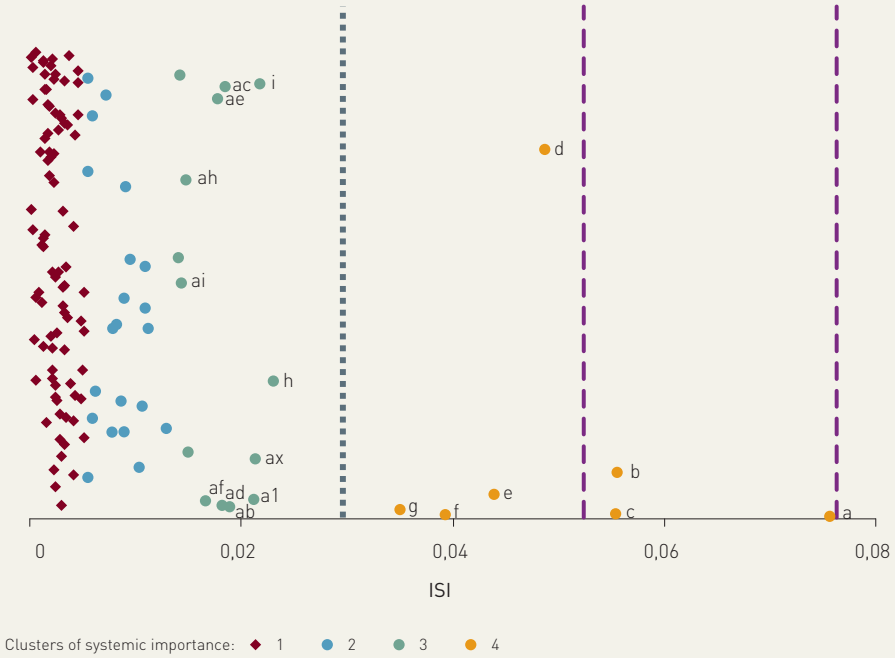
On the basis of the G-SIB methodology implemented by the BCBS, we propose the following rule to calculate the buckets' limits. First, we classify the banks into four categories of systemic importance. The category number one is composed by the banks with the lowest ISI and, conversely, the fourth category by banks with the highest scores. The cut-off level (i.e. the minimum ISI score that triggers HLA requirements) is fixed at the maximum score in the third category plus two standard deviations. The width of the buckets is set to three quarters of the cut-off level.

The main advantage of the proposed rule is its transparency. However, the proposed bucketing rule is just one among several alternatives. The limits of the buckets are to some extent determined on an ad-hoc basis and can be modified based on judgment without altering the nature of the methodology.

III. SYSTEMICALLY IMPORTANT BANKS IN LUXEMBOURG

Based on the indicators and relative weights depicted in Table 1, we calculate the index of systemic importance for each active bank in the first quarter of 2012.[56] The result is shown in Figure 2. The score ranges from 0 to 1. The implementation of the bucketing approach described above provides the buckets' limits and separates the banks in four groups. The first three groups, those on the left-hand side of cut-off level (i.e. the blue dashed line in Figure 2), are the non systemically important banks according to the adopted approach. To the contrary,

Figure 2
Index of systemic importance: distribution of banks' scores and their allocation to buckets

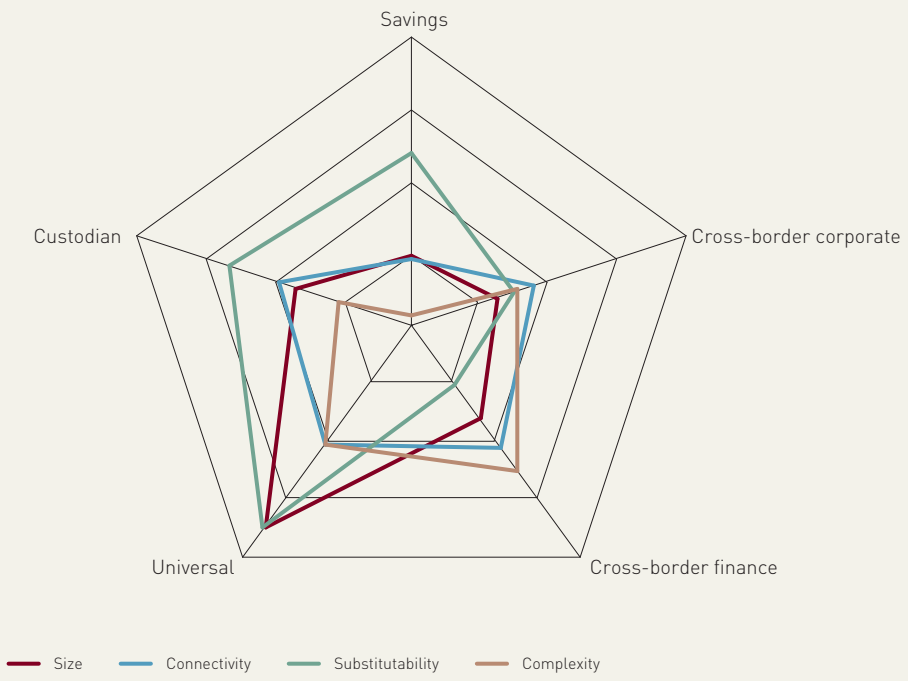


56 In order to perform the calculations we made use of the user-made Stata module MDEPRIV (Pi Alperin and Van Kerm, 2009).

the fourth group, those banks on the right-hand side of the cut-off level, are the systemically relevant ones and might be subject to HLA requirements. The SIBs are moreover separated in two additional buckets.

1.1 Dimensions of systemic importance and bank types

Figure 3
Index of systemic importance: scores by dimension and bank



We analyze the score obtained in each dimension of systemic importance by the different bank types. Figure 3 shows a radar plot of the scores obtained in each of the four categories of indicators. Some features should be noted. The size dimension is fully dominated by the group of universal banks while the savings banks group has the lowest average score. Likewise, universal banks dominate the substitutability dimension. Custodian and savings banks also rank highly on this dimension while the cross-border banking oriented group shows the lowest score. Regarding the connectivity dimension, savings banks group represents a unique outlier with a rather low score on this dimension which is under the control of the cross-border corporate oriented group of banks. The cross-border banking oriented group clearly prevails in the complexity dimension while saving banks score zero in this dimension.

1.2 A comparison with other indicators

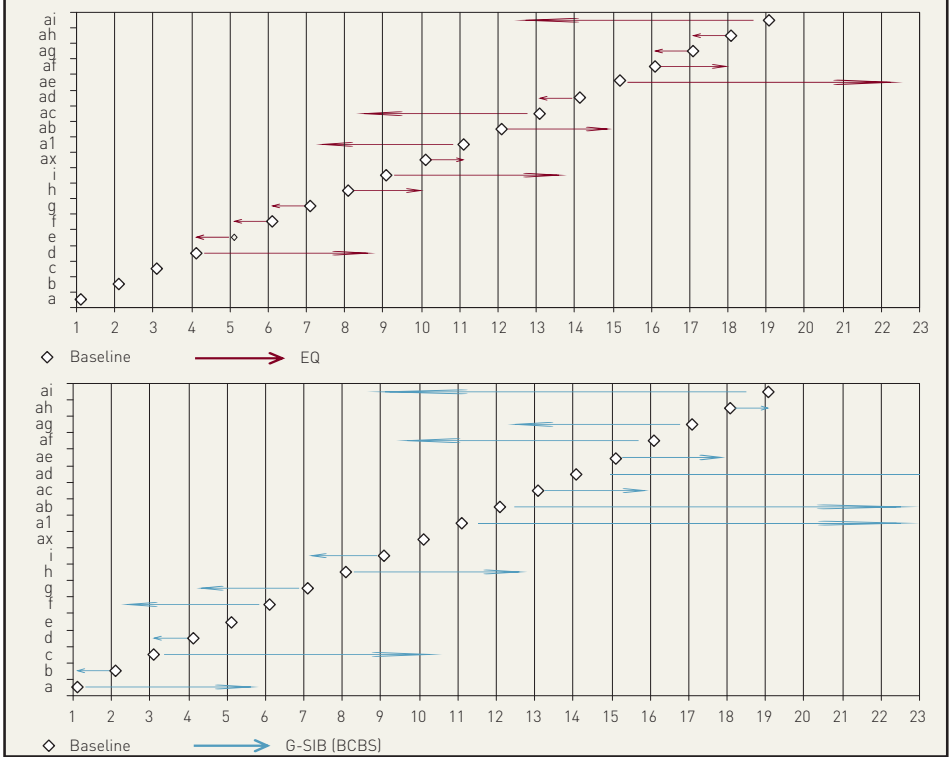
From a practical point of view, it is useful to check whether the ISI of banks are related to other indicators. In a first step, we compare the classification of banks obtained using the methodology presented above with those resulting from two alternative indicator-based methods: (i) against the results obtained using the same set of indicators but an equal weighting scheme, (ii) against the classification of banks resulting from the the G-SIBS methodology which is based on an equal weighting scheme and a set of indicators globally oriented (BCBS, 2011). The first comparison allows us to assess the importance of adjusting the vector of weights to reflect differences in the business line of banks. The second one provides an indication of the role played by the indicators introduced to measure the impact of banks activities on the domestic economy. Finally, in a second set of comparisons we contrast the proposed measure of domestic systemic importance against simple balance sheet indicators.

1.2.1 Alternative measures of systemic importance

In order to evaluate as how the ordering that results from the alternative measures changes, we make use of Figure 4. At the ordinate axis the figure lists the highest ranked banks resulting from the baseline method. The listed banks are those that have entered the top 10 ranking in at least one of the three measures that are considered. The horizontal axis gives the order. The arrows indicate the change in the order of each of these banks. The green arrows start at the order obtained by a bank in the baseline and indicate the change induced by assigning the same weight to every indicator. Then, the red arrows indicate the changes in order triggered by using the G-SIB methodology for the assessment of systemically important banks.

Two issues come out from Figure 4. First, accounting for business lines of banks in the relative weights of indicators does not introduce sensitive changes in the ordering of banks. Indeed, for those banks included among the top ten ranked ones the changes in the order are marginal. Exceptions are bank *a1* which was placed at the eleventh position in the baseline method and is promoted to the seventh place once weights are set equally, and bank *ac* which jumped from the thirteenth place to the eighth one. Second, modifying the considered indicators to include a more globally oriented set radically modifies the top ten ranking of banks.

Figure 4
Alternative measures of systemic importance: impact on the ordering



The analysis leads us to conclude that what matters most for identifying systemic banks whose business models are domestically oriented, is the choice of the set of indicators. A calibration of the weights aimed at reflecting those business lines that are relevant for the domestic economy does not seem to add information which was not already captured by the indicators. Moreover, an important potential drawback of business model based weights relies on the incentives that such a scheme introduces to those banks concerned by additional capital requirements. Indeed, it is likely that those banks would tend to adjust more strongly the most heavily weighted indicators.

1.2.2 Individual bank-level indicators

We analyse the correlation between our measure of the domestic systemic importance of banks and some balance sheet indicators, namely, total assets, and the ratios to total assets of deposits from domestic retail and non-financial corporate counterparts, of total deposits from domestic counterparts,

domestic and foreign interbank deposits, domestic and foreign interbank loans, the off-balance sheet activities ratio, the ratios of short and long-term funding and the leverage ratio[57]. From Table 6 one can see that there is a linear and positive relationship between ISI and total assets. Conversely, while there is no significant relationship between ISI and the deposits from domestic non-financial sector counterparts, a significant linear relationship between ISI and interbank domestic deposits appears. As regards the interbank loans, those with domestic counterparts do not seem to show any relationship but a negative one exist between foreign interbank loans and ISI although not significant statistically speaking. The table shows rather clear relationships between ISI, leverage and the short-term funding ratios.

In addition, we perform a multivariate regression analysis. We regress the ISI score against the balance sheet indicators discussed in the previous paragraph. As can be seen in Table 2 the coefficient of total assets is the highest and is highly significant; a one percent increase in total assets enhances the systemic importance by 0.6 percent. As expected from the correlation analysis the coefficients of deposits from non-financial counterparts are not significantly different from zero. Conversely, indicators of intra-financial activities have the expected sign and are statistically significant. In particular, domestic (respectively foreign) intra-financial loans and deposits are positively (respectively negatively) related to the index of systemic importance. The presumed relationships between ISI, leverage and long-term funding ratios are not supported by the regression analysis. Conversely, the coefficient of the short-term funding ratio is positive and statistically significant.

Table 2:

Index of Systemic Importance and simple indicators: OLS estimation result

VARIABLE	COEFF.	ST. ERRORS
log(Total Assets)	0.622***	(0.0318)
log(OBS)	-0.0203	(0.0113)
log(DepositsRET)	0.0490	(0.0245)
log(DepositsNFC)	0.00260	(0.0120)
log(IFLoansDOM)	0.0503***	(0.0109)
log(IFLoansFOR)	-0.0743***	(0.0166)
log(IFDepositsDOM)	0.0298**	(0.00847)
log(IFDepositsFOR)	0.0257*	(0.0108)
log(LEV)	0.0912	(0.0702)
log(STFund.)	0.0910*	(0.0440)
log(LTFund.)	0.00516	(0.0153)
Cons.	0.916*	(0.371)
N	82	
R-sq	0.902	
Adjusted R-sq	0.887	

*p < 0:1, **p < 0:05, *** p < 0:01

57 The leverage ratio is defined as total assets over equity.

IV. CONCLUSION AND WAY FORWARD

In this paper we propose, following the BCBS principles, an indicator-based methodology for the identification of D-SIBs in Luxembourg. This implies the selection of a set of bank-specific indicators and a vector of relative weights. Additionally, a procedure for separating banks into buckets of systemic importance - a bucketing approach - is also suggested. Finally, we bring up a tentative list of D-SIBs in Luxembourg and we analyze potential drivers of the degree of systemic importance.

The set of bank-level indicators that we consider target the footprint of the banking sector on the real economy and compounds those from the G-SIB methodology. The vector of relative weights, which is applied to the indicator set, tends to assign more importance to indicators that more closely characterize universal banks. The vector of weights is chosen on the basis of the results of an experiment aimed at assessing alternative weighting schemes in terms of two criteria. First, we evaluate the stability of the ordering of banks (in terms of their systemic relevance). Second, the ability of the bucketing rule to separate banks into the distinct buckets of systemic importance is also tested. The details of the experiment are not included in this note but are available upon request. We implemented the methodology using data for almost all active banks in Luxembourg in the first quarter 2012.

This paper is a first step toward the implementation of a D-SIB policy in Luxembourg. There are still several analytical and governance issues that should be treated. First, a deep understanding of the incentives that are introduced by this policy is necessary. For instance, while the geographical coverage is certainly a relevant indicator of the domestic importance of a bank, the regulator might not want that systemic banks give priority to a reduction in the number of agencies in order to manage their degree of systemic importance. Rather, the regulator might prefer that SIBs first tackle their level of complexity. One possibility is that the regulator assigns more weight to the indicators in the complexity dimension or eliminates controversial indicators from the index. However, in the case of Luxembourg, this might impede the assessment methodology to identify as systemically important those banks that are the most relevant for the domestic real sector.

Second, the higher loss absorbency requirements should be specified. This, as the BCBS requires, should be done on the basis of quantitative analyses. With this aim, a study of the cost and benefits of this policy must be developed. Such work requires, on the one hand, linking the level of capitalization of a SIB with its contribution to the probability of occurrence of a systemic event. On the other hand, the long-term economic cost of stronger capital requirements on D-SIBs needs to be estimated.

Finally, all the aspects related to the governance of this policy should be addressed. There are three which are particularly important and may need the development of an specific communication strategy. First, the policy should be transparent. All the details and parameters of the assessment methodology should be public in order to encourage banks to manage their degree of systemic importance. Second, the timing of reassessment and publication of the list of D-SIBs needs to be established. Finally, the timing for revising the assessment methodology and the bucketing approach also needs to be determined. Indeed, the methodology for the measurement of systemic importance should evolve while, a relatively long period during which the method remains immovable is required to ensure some stability and visibility of the incentives in the medium term.

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APPENDIX OF TABLES

Table 3:

The untransformed indicators

INDICATORS	MEAN	MIN	P10	P25	P50	P75	P90	MAX
Size								
Total exposure to GDP [a]	0.704	0.000	0.015	0.054	0.199	0.723	1.766	11.233
Domestic assets [b]	1.215e+09	29,317.8	5.054e+06	2.760e+07	1.517e+08	7.065e+08	2.671e+09	2.310e+10
Employment	198.712	0	5	15.5	44	187	567	2,784
Connectivity								
IFSA [b]	5.071e+09	965872	8.698e+07	2.907e+08	1.303e+09	5.570e+09	1.219e+10	8.876e+10
IFSL [b]	3.970e+08	0.000	0.000	0.000	4.577e+06	1.451e+08	9.676e+08	8.072e+09
Wholesale funding [c]	0.926	0.188	0.830	0.918	0.995	1.000	1.000	1.000
Closeness	0.252	0.000	0.000	0.000	0.344	0.382	0.421	0.577
Substitutability								
Assets under custody [b]	8.217e+10	0.000	0.000	3.655e+06	1.418e+09	1.910e+10	8.114e+10	6.250e+12
Loans to NF [b]								
to retail	3.041e+08	0.000	0.000	0.000	6.118e+06	1.230e+08	5.525e+08	9.493e+09
to NFC	5.396e+08	0.000	0.000	0.000	7.945e+06	1.763e+08	2.005e+09	1.367e+10
to public sector	7.227e+07	0.000	0.000	0.000	0.000	1.390	7.631e+07	4.542e+09
Total	9.147e+08	0.000	0.000	1.318e+06	5.955e+07	5.557e+08	2.503e+09	1.439e+10
New loans for real-state [c]								
Households	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.548
Promotors	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.402
Non residential	0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.492
Local government	0.008	0.000	0.000	0.000	0.000	0.000	0.000	1.000
Liabilities [b]								
Retail	4.20e+08	0	0	0	0	3.82e+07	2.13e+08	7.34e+08
NFC	2.762e+08	0.000	0.000	269.269	1.250e+07	2.459e+08	7.577e+08	6.583e+09
Public sector	4.723e+07	0.000	0.000	0.000	0.000	2,235.735	2.972e+07	3.354e+09
Nr. of agencies	1.894	0.000	0.000	0.000	0.000	0.000	1.000	74.000
Complexity								
Complex OTC [b]	6.177e+09	0.000	0.000	0.000	3.772e+08	4.886e+09	2.380e+10	1.057e+11
Level 3 assets [b]	1.421e+07	0.000	0.000	0.000	0.000	0.000	785023.64	3.851e+08
Held for trading & available for sale assets [b]	6.876e+08	0.000	0.000	120.665	2.727e+07	4.177e+08	1.523e+09	1.881e+10
Cross-jurisdictional claims [b]	4.834e+09	119478	6.588e+07	2.318e+08	1.323e+09	5.065e+09	1.289e+10	8.886e+10
Cross-jurisdictional liabilities [b]	4.684e+09	1.041e+06	6.942e+07	2.618e+08	1.151e+09	5.079e+09	1.251e+10	8.874e+10

[a] *Takes values in [0, +∞).*
[b] *In euros.*
[c] *Takes values in [0,1]*

Table 4:

Balance-sheet indicators by bank type

CLUSTERS		TOTAL ASSETS	LIQ. ASS.	LOCAL ASS.	IFSA	CUSTODIAN	LOANS TO NF COUNTERPARTS				LEVEL 3	TBAS	CROSS-JUR.
							TOTAL	RETAIL	NFC	PUBLIC	ASSETS	VALUE	CLAIMS
Saving banks	N	7	7	7	7	7	7	7	7	7	7	7	7
	Mean	1624.811	0.045	0.681	0.294	0.057	0.706	0.660	0.042	0.004	0.000	0.041	0.202
	Median	593.773	0.000	0.805	0.315	0.005	0.678	0.638	0.017	0.000	0.000	0.000	0.195
	St.D.	2491.351	0.061	0.249	0.092	0.090	0.089	0.123	0.063	0.010	0.000	0.052	0.086
Cross-border corporate	N	18	18	18	18	18	18	18	18	18	18	18	18
	Mean	6485.508	0.066	0.103	0.563	1.202	0.423	0.096	0.323	0.007	0.001	0.051	0.942
	Median	1888.191	0.002	0.071	0.577	0.608	0.394	0.037	0.331	0.000	0.000	0.006	0.939
	St.D.	1.0e+04	0.112	0.078	0.117	1.352	0.142	0.137	0.212	0.021	0.003	0.078	0.073
Cross-border finance	N	55	55	55	55	55	55	55	55	55	55	55	55
	Mean	8774.726	0.162	0.084	0.910	14.825	0.076	0.029	0.040	0.008	0.001	0.089	0.928
	Median	3233.907	0.059	0.050	0.929	0.531	0.059	0.002	0.005	0.000	0.000	0.024	0.969
	St.D.	2.1e+04	0.224	0.089	0.106	42.313	0.083	0.054	0.065	0.031	0.007	0.138	0.096
Universal banks	N	31	31	31	31	31	31	31	31	31	31	31	31
	Mean	7282.772	0.162	0.159	0.900	107.113	0.079	0.046	0.029	0.003	0.001	0.126	0.851
	Median	1840.548	0.028	0.148	0.933	3.642	0.042	0.012	0.004	0.000	0.000	0.047	0.898
	St.D.	1.2e+04	0.215	0.120	0.145	529.014	0.102	0.072	0.042	0.009	0.006	0.168	0.143
Custodian banks	N	16	16	16	16	16	16	16	16	16	16	16	16
	Mean	4141.019	0.039	0.610	0.969	61.961	0.035	0.024	0.010	0.001	0.003	0.057	0.405
	Median	1160.498	0.001	0.631	0.982	5.851	0.006	0.000	0.001	0.000	0.000	0.016	0.418
	St.D.	7105.142	0.065	0.246	0.100	144.712	0.065	0.050	0.022	0.003	0.011	0.088	0.203

Table 5:

Balance-sheet indicators by bank type (continuation from Table 4)

CLUSTER		LEVERAGE	SH.T. FUNDING	WHOLESALE	IFL	LIABILITIES BY NF COUNTERPARTS			CROSS-JUR. LIAB.	COMPLEX OTC
						RETAIL	NFC	PUBLIC		
Savings banks	N	7	7	7	7	7	7	7	7	7
	Mean	0.036	0.289	0.430	0.000	0.002	0.053	0.016	0.423	0.012
	Median	0.039	0.170	0.338	0.000	0.000	0.050	0.000	0.197	0.000
	St.D.	0.025	0.334	0.345	0.001	0.006	0.057	0.031	0.385	0.033
Cross-border banks	N	18	18	18	18	18	18	18	18	18
	Mean	0.166	0.339	0.782	0.019	0.003	0.174	0.001	0.941	0.449
	Median	0.085	0.331	0.929	0.002	0.000	0.134	0.000	0.954	0.500
	St.D.	0.196	0.207	0.319	0.036	0.007	0.162	0.003	0.085	0.442
Cross-border finance	N	55	55	55	55	55	55	55	55	55
	Mean	0.101	0.390	0.611	0.050	0.002	0.063	0.002	0.876	1.143
	Median	0.047	0.312	0.855	0.003	0.000	0.005	0.000	0.909	0.135
	St.D.	0.181	0.289	0.430	0.119	0.007	0.121	0.006	0.102	3.468
Universal banks	N	31	31	31	31	31	31	31	31	31
	Mean	0.071	0.262	0.632	0.044	0.005	0.033	0.004	0.475	1.080
	Median	0.063	0.237	0.778	0.012	0.000	0.014	0.000	0.494	0.269
	St.D.	0.059	0.222	0.405	0.079	0.013	0.040	0.015	0.163	1.446
Custodian banks	N	16	16	16	16	16	16	16	16	16
	Mean	0.142	0.188	0.445	0.020	0.002	0.038	0.002	0.869	1.089
	Median	0.066	0.065	0.375	0.001	0.000	0.001	0.000	0.934	0.039
	St.D.	0.243	0.318	0.464	0.050	0.005	0.098	0.006	0.155	2.355

Table 6:

Index of Systemic Importance and simple indicators: correlation coefficients

	ISI	TOTAL ASSETS[A]	OBS	RETAIL DEPOSITS	NFC DEPOSITS	DOMESTIC DEPOSITS	IB DOM. DEPOSITS	IB FOR. DEPOSITS	IB DOM. LOANS	IB FOR. LOANS	LEVERAGE	SH.TERM FUNDING
ISI	×											
Total assets	0.8870*	×										
OBS	0.2410*	0.3006*	×									
Retail deposits	-0.0885	-0.1801	0.1290	×								
NFC deposits	-0.0415	-0.0969	-0.0958	0.2969*	×							
Domestic deposits	0.0434	-0.0612	0.0700	0.4679*	0.5916*	×						
IB dom. deposits	0.2230*	0.2592*	0.1205	-0.1896	-0.0555	-0.1242	×					
IB for. deposits	0.1896	0.2484*	0.1932	0.1346	-0.0305	-0.2076	0.1552	×				
IB dom. loans	-0.0013	-0.1344	0.0103	0.1662	0.0081	0.0174	0.1712	0.0064	×			
IB for. loans	-0.1519	-0.1284	-0.1296	-0.1580	-0.0890	-0.0985	-0.0505	0.0664	0.0120	×		
Leverage	0.3476*	0.4600*	0.1695	-0.1332	-0.0400	0.0237	0.1189	0.1570	-0.1881*	-0.0291	×	
Sh.term funding	0.2823*	0.2750*	0.2379*	0.1955	0.4469*	0.0857	0.1030	0.3682*	-0.0955	-0.0140	0.2079*	×
L.term funding	0.1821	0.2122*	0.2108	-0.1817	0.0973	0.0890	0.2049	0.2274	0.0285	-0.2272*	0.0218	0.1000

* The stars indicates that the p-values of the t-test (H0: no correlation) are lower than 0.05 which implies a correlation significantly different from zero