



## 2. THE DETERMINANTS OF SHORT TERM FUNDING IN LUXEMBOURGISH BANKS

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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.<sup>32</sup> 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 of 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.<sup>33</sup> 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

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<sup>32</sup> For a more elaborate description of the sequence of events see e.g. Brunnermeier (2009).

<sup>33</sup> 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<sup>34</sup> 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.<sup>35</sup>

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

<sup>34</sup> See BCBS (2010).

<sup>35</sup> 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.<sup>36</sup> 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.<sup>37</sup>

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.

$$\textit{Total Liabilities} = \textit{Equity} + \textit{core liabilities} + \textit{non-core liabilities}$$

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

<sup>36</sup> See for example IMF (2011), Lund-Jensen (2012) and Borio and Drehman (2009).

<sup>37</sup> 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.

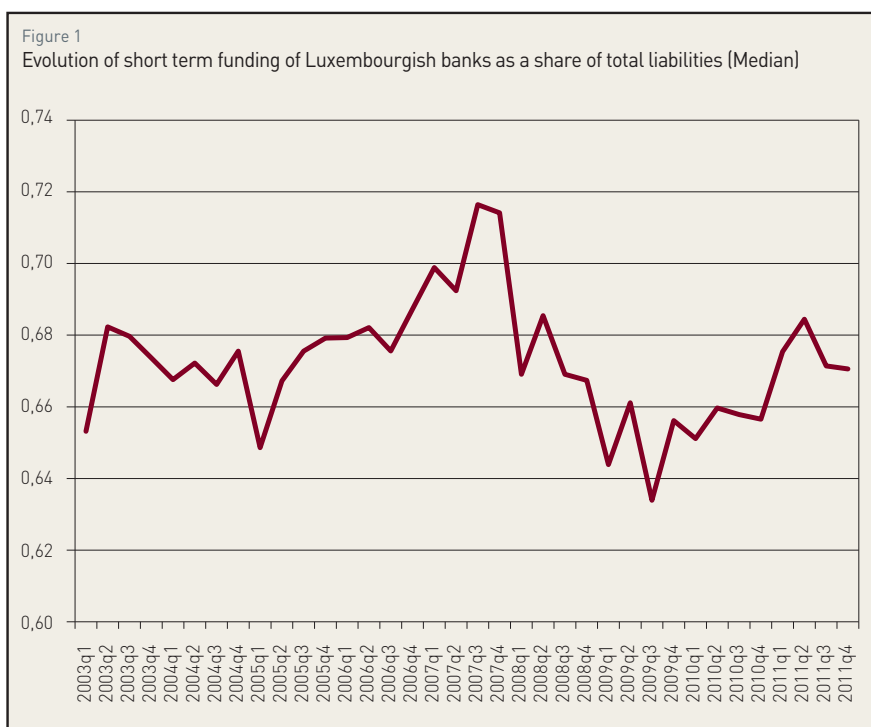
In this context, banks could adjust their balance sheet size by making increased use of flexible short term funding. Adrian and Shin (2011) argue that in the upswing of the asset-leverage cycle, intermediation chains - i.e. the number of financial intermediaries between the ultimate lender and the ultimate 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.<sup>38</sup>

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.

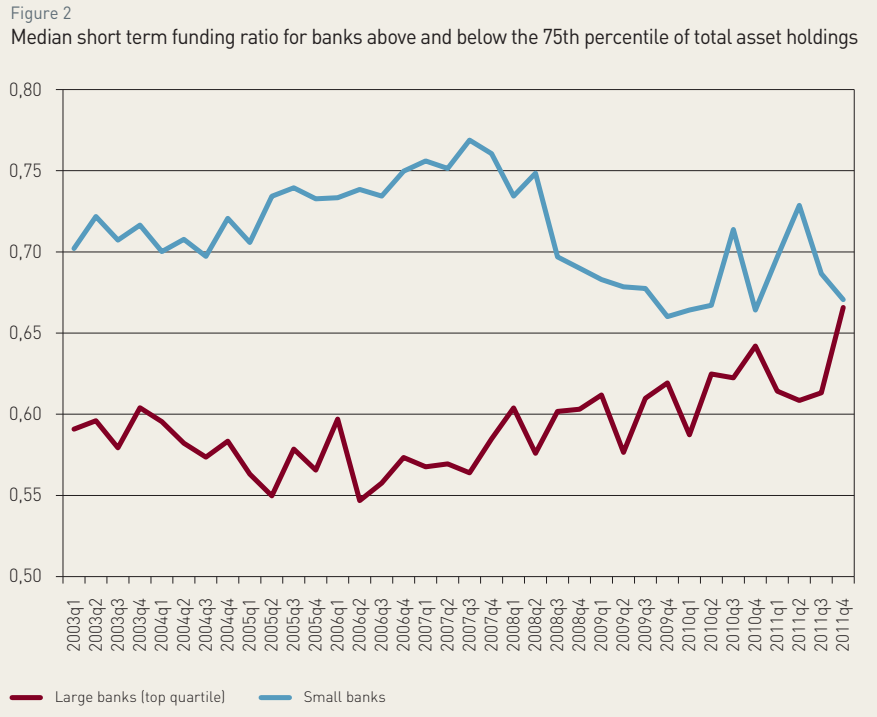
When separating small and big banks around the 75th percentile in total assets, one can see that size does have an influence on the decision of banks to use short term



*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."



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  $BRANCH_i$  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.<sup>39,40</sup>

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.<sup>41</sup>

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 loses 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.<sup>42</sup> Smaller banks have an average value of the

<sup>42</sup> 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).<sup>43</sup> 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.

<sup>43</sup> See BCBS (2010).

## APPENDIX: TABLES

Table 1:

## Variables

<i>STFR</i>	Short term Funding Ratio; Liabilities with maturities of up to 3 months over total liabilities; logit-transformed
<i>LAR</i>	Liquid assets over total assets
<i>SIZE</i>	Log of total assets
<i>DSIZEQ4</i>	Dummy indicating those banks that are in the top quartile with regard to the size variable
<i>SIZEQ4</i>	Interacted variable multiplying <i>SIZE</i> and <i>DSIZEQ4</i>
<i>OFFB</i>	Off-balance sheet commitments
<i>BRANCH</i>	Branch dummy
<i>CtGap</i>	Credit to GDP-gap
<i>FININT</i>	Indicator of financial integration; volume of cross-border credit
<i>EURIB</i>	Change in 3 month Euribor rate
<i>EAGDP</i>	Euro area GDP growth rate
<i>CRISIS</i>	Crisis dummy
<i>ESTOXX</i>	Quarterly changes to the Eurostoxx 50 stock index of European stocks.
<i>GAPESTOX</i>	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	
<i>STFR</i> <sub>t-1</sub>	0.904***	(0.0068)	0.630***	(0.0127)	0.727***	(0.0443)
<i>LAR</i> <sub>t</sub>	-0.202***	(0.0436)	-0.244***	(0.0903)	-0.64*	(0.3566)
<i>SIZE</i> <sub>t</sub>	0.00677	(0.0055)	0.125	(0.0193)	0.246***	(0.0731)
<i>OFFB</i> <sub>t</sub>	0.0233	(0.0175)	0.0314	(0.0212)	0.0532**	(0.0256)
<i>BRANCH</i> <sub>t</sub>	-0.0513**	(0.0236)	-0.0707	(0.296)	-0.482	(0.2941)
<i>CtGap</i> <sub>t</sub>	0.0602	(0.1097)	0.285***	(0.1039)	0.559***	(0.1472)
<i>FININT</i> <sub>t</sub>	0.00414	(0.0167)	0.00278	(0.0154)	0.000887	(0.0138)
<i>EURIB</i> <sub>t</sub>	-0.0184	(0.0411)	-0.0635	(0.0386)	-0.0979*	(0.0509)
<i>EAGDP</i> <sub>t</sub>	0.0334	(0.0255)	0.0013	(0.0237)	-0.00232	(0.0233)
<i>CRISIS</i> <sub>t</sub>	0.0319	(0.0283)	-0.079***	(0.0273)	-0.0713*	(0.0385)
<i>N</i>	4326		4326		4326	
<i>Groups</i>			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
					$\chi^2$ 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)
$GAPSTOX_t$	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)
<i>N</i>	4326		4326		4326	
<i>Groups</i>			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
					$\chi^2$ 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)
<i>N</i>	4326		4326		4326	
<i>Groups</i>			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
					$\chi^2$ 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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