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THE DETERMINANTS OF SHORT TERM FUNDING IN LUXEMBOURGISH BANKS

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The Determinants of Short Term Funding in Luxembourgish Banks

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Abstract

This paper 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 leverage procyclicality in the banking sector. The results also imply that currently discussed regulatory standards on the funding structure of banks could mitigate the build up of vulnerabilities.

Résumé non-technique

La forte dépendance au financement à court terme est apparue, au cours de la récente crise financière, comme étant un facteur explicatif majeur de la vulnérabilité des bilans bancaires. La question qui se pose est de savoir si les banques ont eu recours au financement à court terme de manière excessive dans les années précédant la crise. De plus, il y a lieu de s'interoger sur l'interaction entre les risques financiers au niveau aggrégé et ceux idiosyncratiques aux établissements individuels. La réponse à ces questions pourrait permettre de mieux appréhender les mécanismes sous jacents à l'accumulation des risques.

Le financement à court terme expose les établissements de crédit au risque qu'ils soient incapables de renouveler leur financement dans le cas de perturbations brusques sur les marchés. Lors de la récente crise financière plusieurs disfonctionnements du marché ont pu être observés lorsque la confiance a soudainement disparu. L' évaporation de la liquidité sur plusieurs marchés de financement à court terme a causé des difficultés aux institutions qui étaient structurellement exposées à ce type de financement. Ces difficultés initiales ont affecté la confiance dans les marchés, aboutissant à une diminution accrue de la disponibilité de financement à court terme.

La nécessité de réfinancements fréquents pose un problème majeur du financement à court terme parce qu'elle peut, en cas de panique sur les marchés, mener à un phénomène dit de "boucle de rétroaction". Ceci est vrai même si la source de la crise n'est pas liée à l'établissement financier en question. Un choc sur le niveau général de confiance exposera ce type de financement à des dysfonctionnements profonds. Dans un travail empirique, Vazquez and Federico (2012) constatent que la dépendance au financement à court terme augmente de manière significative la probabilité d'une faillite bancaire.

La dimension macroprudentielle de la surveillance des marchés financiers se concentre sur les risques endogènes au système financier dans son ensemble, sur leur développement cyclique, et sur leur relation avec le comportement des institutions individuelles. Dans ce contexte, le présent papier a pour but de lier la dimension macroéconomique, le comportement des institutions individuelles et l'accumulation de risques financiers au niveau systémique.

Selon Brunnermeier (2009), le financement à court terme des établissements de crédit américains a augmenté dans les années qui ont précédé la crise, car ils ont tenté de financer l'expansion de leurs bilans en puisant dans la demande des organismes de placement collectif monétaires. Les chiffres agrégés pour la zone euro semblent étayer cette observation, tandis que pour les banques luxembourgeoises un développement cyclique du financement à court terme est également visible. Au début de l'année 2005, la banque mediane luxembourgeoise finançait environ 65 % de ses actifs avec des financements d'une échéance maximale de 3 mois. A la fin de l'année 2007, au pic du cycle financier, le ratio affichait une valeur de 71 %.

Cette étude s'appuie base sur les travaux dédiés à l'analyse du comportement cyclique de l'endettement du secteur financier pour décrire les déterminantes du financement à court terme. Le comportement pro-cyclique du levier financier et ses implications pour la

stabilité du secteur financier dans son ensemble a acquis une importance croissante dans la recherche économique plus récemment. Ces travaux mettent l'accent sur la tendance des banques à accroître leurs bilans en période de hausse des prix des actifs. Adrian et Shin (2009), montrent que les banques à comportement pro-cyclique ont tendance à financer l'expansion de leurs bilans en s'endettant davantage, plutôt que par le renforcement de leurs fonds propres. Une hypothèse possible découlant de cette observation est que dans le cas d'une envolée des prix des actifs, les banques ont tendance à modifier leur structure de financement vers un financement à court terme plus flexible et que, par conséquent, les vulnérabilités véhiculées par les actifs bilantaires des institutions individuelles pourraient augmenter.

La présente étude tente a contribuer à la réflexion sur cette problématique en traçant les liens entre l'accumulation de risques globaux et les vulnérabilités dans les structures de financement des banques. Il s'agit d'identifier les déterminants du financement à court terme des banques et, d'identifier, s'il existe, le lien entre la structure de financement des banques et le cycle du crédit. Ainsi, l'analyse est conduite à travers un panel de banques luxembourgeoises et en liant l'évolution du financement à court terme à des indicateurs de risques au niveau agrégé et à des variables specifiques aux banques échantillonnées.

Le secteur financier luxembourgeois occupe une place importante dans l'économie du pays. La plupart des banques au Luxembourg appartiennent à des groupes étrangers. Le total des actifs du secteur bancaire au Luxembourg s'élevait à 796.6 milliards d'Euros en décembre 2011. L'étude de la structure du financement des banques luxembourgeoises a une importance particulière car les banques au Luxembourg agissent généralement en tant que fournisseurs de liquidité à leurs sociétés mères.

Les principaux résultats apportent la preuve d'un lien étroit entre l'évolution du crédit au niveau agrégé et le financement à court terme des banques. Ceci soutient l'hypothèse de l'existence d'un canal de transmission des vulnérabilités relatif à la structure de financement des banques au niveau agrégé pendant une phase de boom de crédit. Enfin, la crise financière a réduit de façon significative le financement à court terme des banques luxembourgeoises, ce qui peut s'expliquer par la réduction de l'accès au financement interbancaire après l'aggravation de la crise suite à la faillite de Lehman Brothers.

Par ailleurs, les résultats révèlent qu'il y a une différence significative dans le comportement des banques de différentes tailles au Luxembourg. Les banques de petite taille (les 3 premiers quartiles en termes de total des actifs) ont moins d'actifs liquides et se comportent de manière plus pro-cycliques que les plus grandes banques. Ceci se reflète aussi dans leur structure de financement : elles utilisent plus de financement à court terme. Ainsi, les petites banques accumulent plus de vulnérabilités en periode de hausse des prix des actifs financiers.

Les résultats permettent également de tirer des conclusions quant à l'impact de la réglementation sur la liquidité dans le cadre des règles de "Bâle III". Une réglementation plus stricte de la structure de financement mènerait à un comportement moins cyclique du levier. De plus, l'adoption de nouveaux standards en matière de liquidités, atténuerait le comportement pro-cyclique du financement à court terme.

1 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.[1] 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.[2] 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 as it bridges the underlying fundamental maturity mismatch in the economy by matching the short term liquidity preference of individuals and the fact that the projects that pay off the most only do so in the long term. Hence, the practice of engaging in short term funding is inherent in the system to a certain degree and possibly 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 behaviour 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 BCBS (2010) introduced

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[1] For a more elaborate description of the sequence of events see e.g. Brunnermeier (2009).

[2] See e.g. Brunnermeier and Pedersen (2009) for a more elaborate description of the concept of funding liquidity.

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 behaviour 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 econmomic research more recently.[3] 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. In this context, Shin (2010) builds a framework separating the sources of funding of banks between funding obtained from the real economy (which grows slowly in line with GDP growth) and intra-financial sector funding which is used by banks to flexibly and quickly adjust their balance sheets to take advantages in asset price movements. 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. European Central Bank (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. In particular, money market funding increased from 11.8 % to 16 % in the same period while net interbank market liabilities increased from 0.1 % in 2003 to 2.9 % in 2007. It is the aim of this contribution to shed more light on the mechanics of this process.

While the magnifying effects of leverage in a crisis have been investigated, this paper 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. Therefore, it embarks to identify the determinants of banks' short term funding and whether they are related to the credit cycle.

This paper 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

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[3]See for example Adrian and Shin (2009).

they typically act as liquidity providers to their foreign parent companies.[4] Hence, Luxembourgish banks play an important role in the funding of the European banking sector. In addition, as shown by Giordana and Schumacher (2011b) their leverage behaves very pro-cyclically.

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. Recent literature on identifying low frequency leading indicators to financial crisis have found a strong role in this respect for credit to gdp-based indicators, leverage and asset prices.[5] This 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.

Therefore, a number of panel regressions are carried out relating different measures of short term funding to variables describing the macroeconomic environment and to bank specific variables. This approach allows to dicriminate between effects relating to the macro-environment like e.g. the business cycle and the general cost of funds and to specific characteristics of banks including the size and institutional setup. The bank specific data that is being used stems from the balance sheet reporting of commercial banks to the central bank and covers approximately 150 banks over the period 2003q1 - 2011q4.

The main results provide evidence for a close link between excessive credit developments at the aggregate level (as indicated by a positive credit to GDP gap) and short term funding of banks which supports the view that one channel for increasing vulnerabilities during a lending boom may run through increased reliance of banks on short term funding. The interplay between the credit to GDP gap and asset prices, however, does not seem to add further information on the build up of vulnerabilities. GDP growth plays no significant role while the cost of funds has a small but significant effect. Financial integration has a positive yet insignificant effect. Lastly, the financial crisis has significantly reduced short term funding of Luxembourgish banks which can be explained by the reduced access to interbank funding after the events that involved the bankrupcy of Lehman Brothers.

When it comes to bank specific variables, size has an important effect on the tendency to contract short term funding. This result supports the view of pro-cyclical leverage and provides evidence that banks fund the extension of their balance sheet during boom periods through an increased use of short term funding. Nevertheless, there is an important distinction to make between the top quartile of banks in terms of size and smaller banks. While size plays an important role for the latter, in the top quartile there is no significant effect of size on short term funding. Larger banks hold considerably more liquid assets which leads to a negative and significant influence of liquid assets on short term funding.

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[4]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.

[5]See for example IMF (2011), Lund-Jensen (2012) and Borio and Drehman (2009).

It can also be shown more generally, that larger banks behave less pro-cyclically than smaller ones in Luxembourg. Off-balance sheet commitments play a small but significant role while the fact of whether a bank is a branch or not does not play a significant role.

Section 2 will present the stylized empirical facts underlying the regression analysis and theoretical considerations. Subsequently, section 3 will provide an overview of the data that is being used. The econometric strategy will be explained in section 4 and the full results will be reported in section 5. Section 6 concludes.

2 Background

2.1 Theoretical considerations

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 vulnerabilies can spread throughout the system due to close linkages with market liquidity and feedback effects within the smooth functioning of financial markets. Brunnermeier and Pedersen (2009) show in a theoretical model how the ability of traders to provide market liquidity depends on the ease with which they can acquire funding, i.e. the funding liquidity in the relevant markets. Shocks to specific funding markets can quickly spread - across 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.

The most obvious argument for a maturity mismatch in the financial sector as a whole stems from a general underlying maturity mismatch in the economy. A general short term liquidity preference has to be matched with investment projects that pay off in the long term only. On the one hand, most investors prefer assets with short maturities to stay liquid and be able to withdraw funds when needed. On the other hand, Investment projects in general require time to pay off a given yield.[6] The financial sector bridges this gap by engaging in maturity transformation. Furthermore, in order to generate returns banks borrow short and lend long term taking advantage of the differential along the yield curve. Nevertheless, there are also other factors affecting the preference of financial intermediaries to borrow short term.

Other theoretical explanations have been forwarded building on information asymetries between borrowers and lenders and the resulting incentives for signalling and commitment between borrowers and lenders. For example Flannery (1986) and Diamond (1991) show that for borrowers with positive prospects it is optimal to choose short term funding to reduce the cost of funding. Borrowers with negative prospects, however, have no choice but to follow those with positive prospects in order to maintain their sources of funding and not reveal negative information to lenders. Similarly Stein (2005) emphasizes that a borrower can signal his confidence in his own investment projects by choosing shorter maturity funding.

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[6]See e.g. Allen and Gale (2007).

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While these approaches rely on the optimization problem of borrowers and lenders, there has been recent evidence concerning the influence of factors stemming from the macro-environment on the maturity structure of bank funding. The micro-oriented approaches cited above, do not address this issue of cyclicality. However, a certain degree of pro-cyclicality can be observed in the data on the short term funding of financial institutions. A glance at short term funding in Luxembourgish banks (figure 1) shows a clearly cyclical pattern.

The cyclical behaviour 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 as a whole gives rise to concerns about increasing aggregate risk and vulnerabilities that may affect the financial sector as a whole.[7]

The literature on leverage cycles is based among others on contributions by Kiyotaki and Moore (1997) and Bernanke et al. (1998) which introduced financial accelerator mechanisms into business cycle models. These models emphasize that changes in asset prices imply changes in the value of collateral available to borrow and hence lead to cyclical lending. Similarly, Geanakoplos (2010, 2009) equally emphasizes the importance of changes in margins and haircuts in secured lending for the leverage cycle and the sudden dry-up of bank funding in the recent financial crisis. These contributions emphasize the role of haircuts during the cycle as changes in risk aversion influence haircuts and hence the amount of leverage that can be obtained with a given stock of assets. Gorton and Metrick (2010) describe the feedback effects between haircuts and asset prices in repo funding markets which contribute to reinforce leverage cycles.

Brunnermeier (2009) notes that such mechanisms worked to shorten the maturity of bank funding in the period leading up to the crisis which 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. In this model, equity is sticky and the forcing variable in the sense that receding risk aversion during an upswing allows banks to take on more leverage with a given amount of equity. This leads to pro-cyclical behaviour of leverage in

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[7]See for example BOE (2009).

the aggregate. The mechanism boils down to a positive feedback loop between receding risk aversion, increasing asset prices and lower collateral requirements.

However, 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 in addition to the increase in leverage. Shin (2010) distinguishes explicitly between core and non-core liabilities of banks.

$$Total\ Liabilities = Equity + core\ liabilities + non\ core\ liabilities \qquad (1)$$

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 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.[8]

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.

The contribution of the present paper lies in analyzing balance sheet dynamics and in particular short term funding during an upswing and test whether short term funding of Luxembourgish banks increases during a stark increase in lending as experienced over the period 2004-2007. Such a mechanism could be one channel for vulnerabilities to emerge during times when they are least expected - i.e. in a fast growing economic environment.

2.2 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

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[8]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.".*

142 were domestically owned and domestically owned banks held 6.9 % of total 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.

Figure 1 shows the evolution of median short term funding with maturities of up to 3 months for Luxembourgish banks as a share of total liabilities.[9] 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.

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 funding. Figure 2 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.

2.3   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, 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.

3   Data

The following analysis will attempt to relate determinants of the macro-environment and the rate at which banks use short term funding. In addition, bank specific characteristics are controlled for by introducing a number of indicators computed from the bank balance sheets.

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[9]Short term funding is defined as deposits, debt securities and repurchase agreements with maturities of up to 3 months. The data stems from the statistical balance sheet reporting of banks to the central bank.

Figure 1: **Evolution of short term funding of Luxembourgish banks as a share of total liabilities (Median).** The ratio includes funding with maturities of up to 3 months as a share of total liabilities.
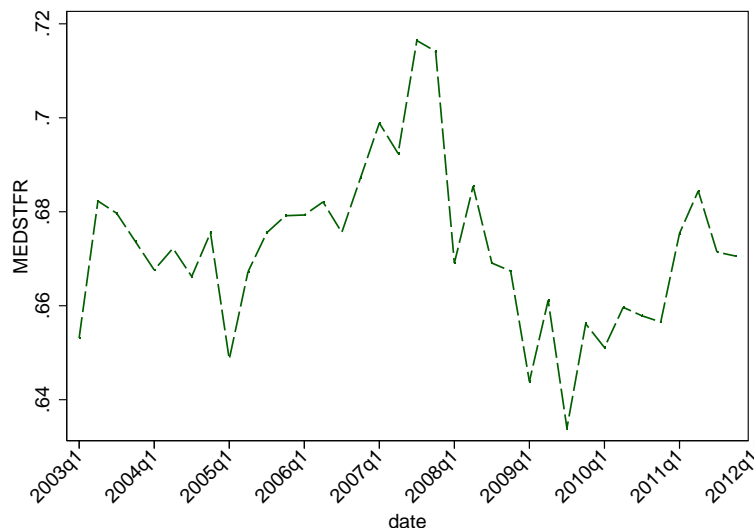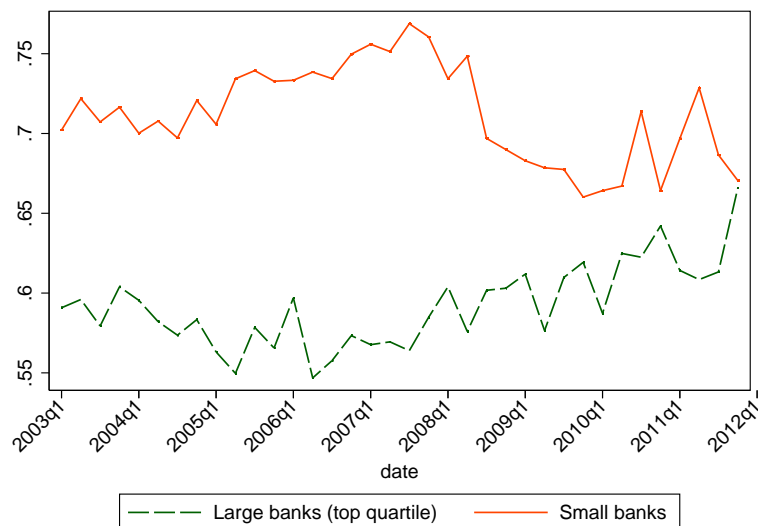

Source: BCL, own calculations.

The macro variables include the credit to GDP gap to account for lending booms, GDP, which covers the real economic developments, the interest rate Euribor 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. A crisis dummy is also introduced into the equation.

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.[10] Lastly, a dummy determining whether a bank is a branch or not enters the analysis. 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

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[10]Giordana and Schumacher (2011b) find the off-balance sheet ratio to be a significant determinant of leverage in the Luxembourgish banking system.

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

Source: BCL, own calculations.

per period.

The dependent variable

The dependent variable is the short term funding ratio which describes the share of short term funding in total liabilities. This indicator is computed in analogy to the procedure in Vazquez and Federico (2012). Funding sources that enter the ratios are overnight deposits, deposits with agreed maturity, deposits redeemable at notice, repurchase agreements and debt securities. By normalizing short term funding by total liabilities, this indicator allows to assess whether structural changes in the funding of banks have taken place. Based on the descriptive analysis in section 2 an increase in the short term funding ratio is viewed as a sign of heightened vulnerabilities on the balance sheet of financial institutions.

Since the short term funding ratio is bounded between 0 and 1, a logit transformation has to be applied to transfer the variable from the 0,1 to the $-\infty, +\infty$ space.[11]

Macro variables

To discern the potential impact from a generalized lending boom on short term funding in Luxembourgish banks, the main macro indicator in the baseline specification is the

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[11]For a thorough discussion of the logit transformation and its application to bounded economic variables see Wallis (1987). Further details on the transformation can be found in section 4.

credit to gdp-gap ($CtGgap$). Other macro variables that will enter the regression analysis to control for the general economic environment are changes in the Euribor 3 months interest rate ($\Delta EURIB$), a measure for financial integration ($FININT$), euro area GDP ($EAGDP$) and a crisis dummy ($CRISIS$).

The credit to gdp ratio is computed using euro area credit including loans and debt securities to non-government entities. The euro area was chosen as a reference area since more than 90 percent of Luxembourgish banks' assets lie outside Luxembourg, of which the large majority is located in the euro area. ($CtGgap$) series is obtained by substracting the trend component from the actual value. Statistical tests reject the null hypothesis of the series containing a unit root. The sign on $CtGgap$ is expected to be positive as this would give an indication that banks fund lending booms by increasing short term funding. As noted in section 2.1 elaborates, the theory on pro-cyclical leverage leaves a possibility that during a lending boom, banks have to resort to more flexible funding which in turn could lead to additional short term funding. Figure 3 shows the evolution of $CtGgap$ during the period 2003-2011. The figure shows that the actual value almost constantly exceeded the trend between early 2004 and mid 2008.

Figure 3: **Development of the euro area credit-to-GDP gap 2003-2011.** The credit-to-GDP gap is computed by substracting the current realization of the ratio from its HP-trend.
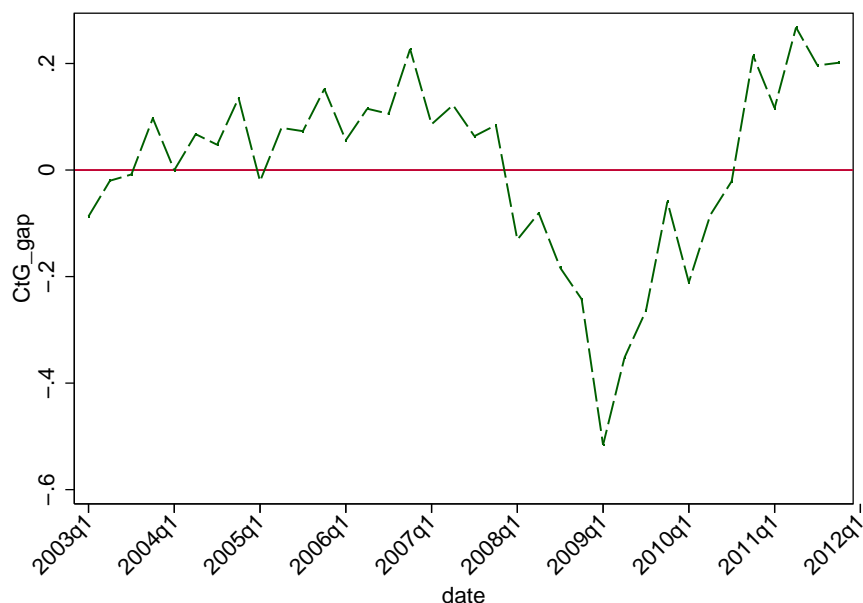
Source: ECB SDW, own calculations.

An additional specification will test the effects of interacting $CtGgap$ with a measure of asset price developments. In this case changes to the quarterly average level of the

Estoxx 50 stock index were used to obtain $\Delta ESTOXX$

As an indicator for the cost of funds, the 3-month interbank interest rate Euribor is used. Given that a unit root cannot be excluded at statistically significant levels(using an augmented Dickey-Fuller test), a first differenced series $\Delta EURIB$ is used in the regression analysis. This implies for the interpretation of the results that the coefficient on this varible describes the impact of changes to the cost of funds which is expected to be negative. Quarterly figures for euro area GDP growth $EAGDP$ were used to controll for the impact of the real economy. As in previous studies on the Luxembourg banking sector and based on the evidence regarding the predominant orientation of Luxembourgish banks towards the European banking sector, euro area GDP is deemed to be the most relevant statistic in this regard. GDP growth is expected to have a positive sign given its impact on expectations of future productivity growth and the general economic environment.

A measure for financial integration is obtained from the ECB SDW.[12] In particular, a measure describing the evolution of cross-border MFI loans in the euro area was used. Driving factors for this variable include increased cross-border activities which could be based on changing business models in a common market but also regulatory developments that increase the ease of doing business cross-border. Due to the fact that the unit root could not be rejected, a first-difference transformation was applied. Hence, in the interpretation, the coefficient on $FININT$ has to be interpreted as the impact of changes in financial integration on short term funding. Financial integration is expected to have a positive sign as with closer integration access to short term interbank funding should be improved.

A crisis dummies was introduced to account for a dramatically changed environment and heightened risk aversion during the immediate post-Lehman liquidity crisis ($CRISIS$). The dummy turns to 1 during the period 2008q3-2009q2.

Bank specific variables

The bank specific variables that will be used are bank size ($SIZE$), the liquid assets ratio (LAR), and the off-balance sheet ratio ($OFFB$). Furthermore, a dummy $BRANCH$ will indicate whether the specific bank is a branch or other.[13] The data that is used is taken from the monthly and quarterly balance sheet reporting of commercial banks to the central bank of Luxembourg.

Total assets of an institution are used to control for the impact of bank size on its propensity to contract short term funding. The $SIZE$ series describes the log of total assets in a given period. While in general larger banks are more leveraged in Luxembourg, it remains to be seen whether this additional leverage is funded by increased short term funding. The evidence underlying figure 2 seems to point in another direction, however.

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[12]See Baele et al. (2004) for a comprehensive overview of the available indicators for measuring financial integration in the euro area financial sector.

[13]Depending on period, between 22 and 30 % of banks in Luxembourg take on the institutional form of a branch. Branches are not required to hold own capital and on average are leveraged more heavily than other banks.

The liquid assets ratio (LAR) is determined by the sum of liquid assets over total assets. The sum of liquid assets consists of cash, securities and quoted shares. A large share of liquid assets implies more flexibility on the asset side of the balance sheet. Intuitively this could imply that such institutions would also prefer additional flexibility on the liabilities side of their balance sheet.

The off-balance sheet ratio is computed by summing up off-balance credit lines, guarantees and other standing facilities that imply contingent liabilities to banks and by dividing these commitments by total assets. This indicator depends strongly on the specific business model of the bank in question and the dispersion of the resulting indicator is fairly large. The sign to be expected from the off-balance sheet ratio is positive as large potential commitments require increased flexibility in funding. However, it has been shown by Giordana and Schumacher (2011b) that larger off-balance sheet commitments render banks in Luxembourg more prudent in their decision on leverage. This effect could lower the positive impact brought about by the need for more flexible funding.

Before running the regressions, the outliers in the series were removed by cutting the 1% tails on each side of the distribution. This treatment led to the removal of bank-quarter observations covering in total 8% of total assets over all periods. In panel unit root tests, the null hypothesis of the existence of a unit root was rejected for all micro data series.[14]

4   Econometric Analysis

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:

$$STFR_{i,t} = \alpha + \beta_1 STFR_{i,t-1} + Y_t \beta_2 + X_{i,t} \beta_3 \tag{2}$$
$$+ \beta_4 CRISIS_t + \beta_5 BRANCH_i + \beta_6 sd_t + v_i + \epsilon_{i,t}$$

with i indicating the individual bank and t the time dimension. 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 $\epsilon_{i,t}$ is the error term.

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. If Z is a logistically distributed variable, its cdf is given by

$$Z = F(V) = \frac{e^V}{1 + e^V} \tag{3}$$

Solving for V gives the transformation that has been applied to $STFR$:

$$V = \ln \frac{Z}{1 - Z}. \tag{4}$$

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[14]See appendix A for a comprehensive overview of the variables used.

The inclusion of the lagged dependent variable and the use of balance sheet data will likely raise endogeneity concerns. This will lead to a dynamic panel bias[15] which will affect the estimators and render them invalid. Therefore, the main analysis builds on the System GMM estimator as proposed by Arellano and Bover (1995) and Blundell and Bond (1998).[16] The estimator reduces the dynamic panel bias which is due to unobservable fixed effects by instrumenting with past observations of the dependent and independent variables. It is also well-suited for panels with large N and small T. Whether the endogeneity bias has been taken care of can be controlled for by comparing the resulting coefficient on the lagged dependent variable with the OLS estimate (which tends to be upward biased and thus higher) and the fixed effect (FE) estimator (which tends to be downward biased and thus lower).

In tables 5-7 in appendix B all the results for all three estimators are provided. In addition, the results of the specification tests for the system GMM regression are provided. In particular, to control for autocorrelation in the error term the test statistics AR(1)p and AR(2)p are reported. Furthermore, the Hansen test statistic is reported which assesses the over-identification restriction by rejecting the endogeneity of instruments.

5   Results

This section will present the results from the estimations carried out on the short term funding variable. Section 5.1 will present the results from the baseline regressions while section 5.2 will pick up on some of the cross-sectional effects in the panel of banks. The full results can be found in appendix B.

5.1   General results

The baseline regression includes the credit to GDP gap as an indicator for excessive financial sector developments.[17] A second specification interacts the credit-to-GDP gap with asset prices.[18] As there is empirical evidence that the interaction of these indicators provides a good predictor of banking crisis (See Lund-Jensen (2012)).

The baseline regression

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.[19] The p-values on the AR(2) test-statistic and the

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[15]This so called Nickell-bias relates to the fact that in dynamic panels the dependent variable is correlated with past realizations of the error term. See Nickell (1981).

[16]For an elaborate description on the implementation of the system GMM estimator see Bond (2002) and Roodman (2006).

[17]See table 5 in appendix B.

[18]See table 6 in appendix B.

[19]Stars attached to coefficients indicate significance levels: * $p-value < 0.1$; ** $p-value < 0.05$; *** $p-value < 0.01$.

Hansen test of over-identifying restrictions indicate that the model is well specified.

The $CtGgap$ 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 in section 2, this can be interpreted as evidence that banks resort to flexible short term funding in order to accomodate 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 ($\Delta EURIB$) have a small negative but significant impact (-0.098*) representing the general effect of changes to the cost of funds. An increase in the 3 months Euribor rate will thus, ceteris paribus, lead to substitution effects as funding at this maturity becomes more expensive relative to other maturities. The gdp growth rate has a negative coefficient. However, the coefficient is very close to zero and insignificant (-0.002). The crisis dummy $CRISIS$ exhibits a significant and negative impact (-0.0713*). A candidate explanation for this finding relates to the post-Lehman breakdown of interbank markets which strongly reduced the availability of short term interbank funding.[20] The macro variable controlling for financial integration and regulatory developments in the euro area financial sector does not show up significantly but has a positive coefficient (0.0009).

Regarding bank specific control variables, size ($SIZE$) 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 procyclicality in short term funding. However, this result will be nuanced in section 5.2 as cross sectional effects of size are analyzed.

The off-balance sheet ratio ($OFFB$) is significant and positive (0.0532**) implying that banks holding large 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. This may explain why such commitments concur with an extended use of short term funding.

The coefficient on liquid assets (LAR) 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 ($BRANCH$) is negative and insignificant (-0.482). 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.

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[20]See for example Brunnermeier (2009).

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 which drives 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 provide the results of 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 series was first-differenced in order to get a stationary series. The modified specification hence features the credit-to-gdp gap $CtGgap$, the first-differenced series $\Delta ESTOXX$ and the interacting term $GAPSTOXX$. Since both individual series are centered around 0, their coefficients can be interpreted as the individual marginal effects while the coefficient on the interacting term provides the marginal combined effect.

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***). However, both the coefficients on $\Delta ESTOXX$ and $GAPSTOXX$ are insignificant and very small (0.0000519 and 0.000135 respectively). By consequence, the entire effect on short term funding stems from the change in the credit-to-gdp gap, while asset price developments are not relevant.[21]

5.2 Cross-sectional effects

As was shown in figure 2, the median short term funding ratio for banks in the highest quartile of the size distribtion 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. Figure 4 shows the median short term funding ratio by quartile of asset size. The three lower quartiles exhibit a much more cyclical pattern in their use of short term funding than the quartile of the largest banks. Also, the median short term funding ratio for the second and third quartiles is significantly higher than that for the smallest quartile which may explain the positive significant coefficient on size in specification 2. The main conclusion from figure 4 is, however, that the quartile of largest banks seems to be guided by different factors regarding the use of short term funding.

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[21]For the complete results of the modified specification see table 6 in appendix B.

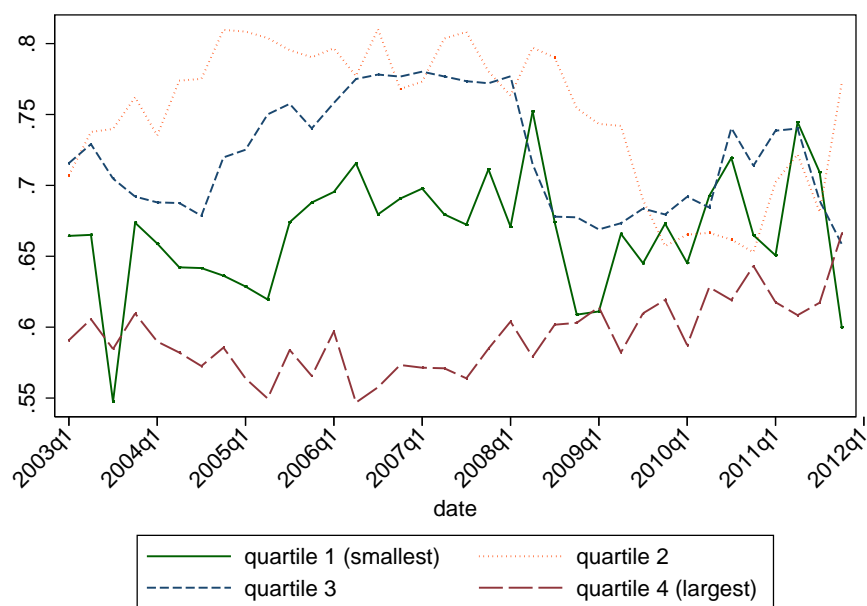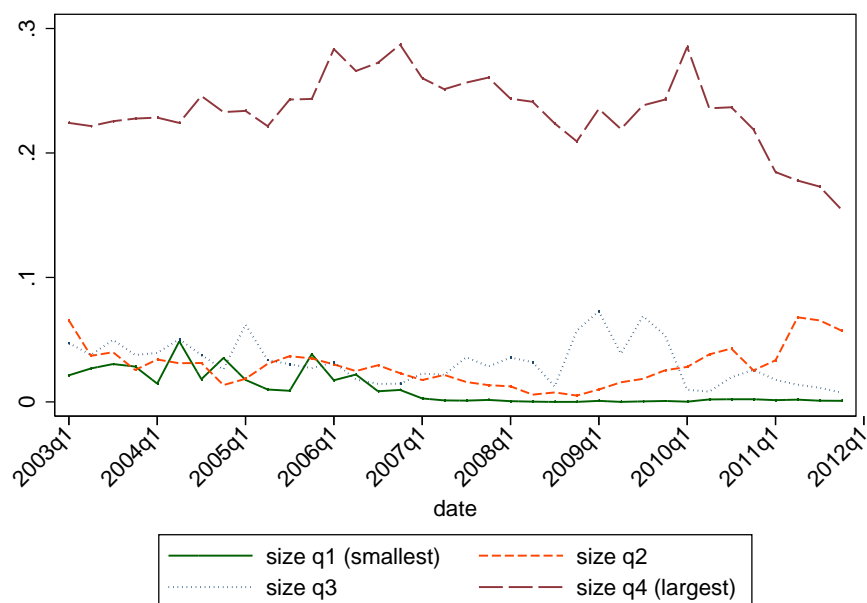Figure 4: **Median short term funding ratio by quartiles of asset size.**

Figure 5: **Median holdings of Liquid assets by quartiles of size.**

Source: BCL, own calculations.

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 as can be seen in figure 5. The largest quartile of banks also 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, specification 2 was modified so as to take account of whether banks are part of the 4th quartile in terms of asset size. A dummy variable $DSIZEQ4$ was introduced into the specification, turning 1 if a bank features in the largest quartile of banks in a given period. This dummy was interacted with the size variable $SIZE$ to get the interaction variable $SIZEQ4$.[22]

The results show that the marginal effect for a bank of being in the largest quartile is given by multiplying the coefficient of the interacted variable with the interacted variable and adding the coefficient on the dummy, i.e.:

$$\frac{\partial STFR}{\partial DSIZEQ4} = \beta_{3,DSIZEQ4} + \beta_{3,SIZEQ4}SIZEQ4 = 7.454 - 0.357SIZEQ4 \quad (5)$$

for $DPT75 = 1$. The resulting coefficient for the marginal effect at the mean 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 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 could be seen in figure 5 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 vs. 71%) in their portfolios than larger

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[22]The complete results from this specification can be found in table 7 in appendix B

banks and less securities (12 % of total assets on average over the observation period vs. 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 procyclical 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 behaviour 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.[23] Smaller banks have an average value of the pro-cyclicality indicator of 0.775 while this value is 0.721 for larger banks. The difference is statistically significant (p-value: 0.045). In addition, the null hypothesis of the former group behaving more pro-cyclically than the latter is accepted with a p-value of 0.023.

6 Conclusion

This paper 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 paper 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, regressions on a panel of 150 banks on average per period 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 accomodate stark increases in credit growth through additional flexible short term funding. Thus,

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[23]Pro-cyclicality is measured as suggested by Adrian and Shin (2009) through the indicator $\frac{gLEV}{gASS}$ 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).

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 paper 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).[24] 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 accomodate 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 paper 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.

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[24]See BCBS (2010).

A Data

Table 1: **Variable description**

Variable	Description
$STFR$	Sum of funding (overnight deposits, deposits with agreed maturity, deposits redeemable at notice, debt securities and repo) with maturities of less than 3 months divided by total assets. (*Source: Statistical tables of the BCL, own calculations*)
$CtGgap$	Difference between the current value of the credit to gdp ratio and its trend. The trend is obtained by applying a hodrick-prescott filter to the series.(*Source: ECB SDW, own calculations*)
$\Delta ESTOXX$	Change in average quarterly level of the Eurostoxx 50 stock index. The index covers 50 stocks from 12 Eurozone countries.(*Source: bloomberg*)
$FININT$	Measure of financial integration: First differenced series of the volume of cross-border MFI loans in the euro area. (*Source: ECB SDW, own calculations*)
$\Delta EURIB$	Changes to the euro area 3-month interbank interest rate Euribor 3m. (*Source: Bloomberg*)
$EAGDP$	euro area quarterly GDP growth. (*Source: OECD.*)
$CRISIS$	Crisis dummy turning 1 from 2008q3 to 2009q2.
$SIZE$	Natural log of total assets. (*Source: Statistical tables of the BCL, own calculations*)
LAR	Sum of liquid assets (cash, debt securities and quoted shares) divided by total assets. (*Source: Statistical tables of the BCL, own calculations*)
$OFFB$	Sum of off-balance guarantees, credit lines and other commitments divided by total assets. (*Source: Statistical and prudential tables of the BCL and CSSF, own calculations*)
$BRANCH$	Dummy indicating whether an institution is a branch.

Table 2: **Summary statistics**

variable	mean	sd	min	max
$STFR$	0.5189	1.3948	-11.3996	4.7058
LAR	0.1798	0.2230	0.0000	0.9887
$SIZE$	21.1200	1.7781	15.6625	25.2362
$OFFB$	0.1366	0.5262	0.0000	12.6358
$CtGgap$	0.0024	0.1635	-0.5161	0.2678
$FININT$	0.0498	0.6822	-2.6447	1.1513
$\Delta EURIB$	-0.0308	0.4612	-2.2356	0.4259
$EAGDP$	0.3173	0.7208	-2.7476	1.0883

Table 3: **Correlation Matrix of bank specific variables**

	LAR	$SIZE$	$OFFB$	$BRANCH$
LAR	1.0000			
$SIZE$	0.2912	1.0000		
$OFFB$	-0.0328	0.0979	1.0000	
$BRANCH$	0.0195	-0.1115	0.0063	1.0000

Table 4: **Correlation Matrix of macro variables**

	$CtGgap$	$FININT$	$\Delta EURIB$	$EAGDP$	$CRISIS$
$CtGgap$	1.0000				
$FININT$	0.1764	1.0000			
$\Delta EURIB$	0.7913	0.1197	1.0000		
$EAGDP$	0.6961	0.2760	0.7912	1.0000	
$CRISIS$	-0.3027	-0.2913	-0.3702	-0.5721	1.0000

B   Estimation results

Table 5: **Estimation results, *Short Term Funding Ratio*, baseline regression**

	(1) OLS		(2) FE		(3) SYS-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)	-0.640*	(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	(0.2960)	-0.482	(0.2941)
$CtGgap_t$	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)
$\Delta EURIB_t$	-0.0184	(0.0411)	-0.0635	(0.0386)	-0.0979*	(0.0509)
$EAGDP_t$	0.0334	(0.0255)	0.00130	(0.0237)	-0.00232	(0.0233)
$CRISIS_t$	0.0319	(0.0283)	-0.0791***	(0.0273)	-0.0713*	(0.0385)
N	4326		4326		4326	
Groups			182		182	
Seas. dumm.					yes	
Hansen p-val.					0.263	
ar(1) p-val.					0.000	
ar(2) p-val.					0.187	
N. of instr.					146	
χ^2 p-val.					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 6: **Estimation results, *STFR*, interaction specification**

	(1) OLS		(2) FE		(3) SYS-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)	0.250***	(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)
$CtGgap_t$	0.0520	(0.1103)	0.273***	(0.1043)	0.501***	(0.1532)
$\Delta ESTOXX_t$	0.0000370	(0.0001)	0.0000464	(0.0000)	0.0000519	(0.0001)
$GAPSTOXX_t$	0.000142	(0.0001)	0.000180*	(0.0001)	0.000135	(0.0001)
$FININT_t$	0.000475	(0.0177)	-0.00189	(0.0163)	-0.00484	(0.0146)
$\Delta EURIB_t$	0.0166	(0.0470)	-0.0180	(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	
					Seas. dumm.	yes
					Hansen p-val.	0.241
					ar(1) p-val.	0.000
					ar(2) p-val.	0.181
					N. of instr.	150
					χ^2 p-val.	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 7: **Estimation results, cross-sectional effects of size.**

	(1) OLS		(2) FE		(3) SYS-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)	-0.170***	(0.0604)	-0.359**	(0.1439)
$OFFB_t$	0.0296*	(0.0176)	0.0307	(0.0212)	0.0484*	(0.0254)
$BRANCH$	-0.0501**	(0.0235)	-0.160	(0.2960)	-0.225	(0.3581)
$CtGgap$	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)
$\Delta EURIB_t$	-0.0299	(0.0411)	-0.0707*	(0.0388)	-0.107**	(0.0494)
$EAGDP$	0.0341	(0.0254)	-0.00186	(0.0236)	-0.0131	(0.0227)
$CRISIS$	0.0261	(0.0282)	-0.0901***	(0.0273)	-0.117***	(0.0348)
N	4326		4326		4326	
Groups			182		182	

Seas. dumm.	yes
Hansen p-val.	0.565
ar(1) p-val.	0.000
ar(2) p-val.	0.245
N. of instr.	149
χ^2 p-val.	0.000

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

24

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