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THE LEVERAGE CYCLE IN LUXEMBOURG'S BANKING SECTOR

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THE LEVERAGE CYCLE IN LUXEMBOURG'S BANKING SECTOR[1]

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Abstract

In this article we investigate the leverage cycle in Luxembourg's banking sector using individual bank-level data for the period 2003 Q1 to 2010 Q1. We discuss the mechanics behind the leverage cycle in Luxembourg's banks and show that these banks predominantly adjust leverage by changing both loans and deposits. One of our findings is that Luxembourg's banks have a procyclical leverage. This procyclicality is not due to marking-to-market but because Luxembourg's banks are liquidity providers to the EU banking sector. This also explains the different evolution of leverage compared to the US commercial banks (Adrian and Shin [1]) that, even though their balance sheet structure is similar to that of the Luxembourgish banks, target a constant leverage.

To further understand what drives leverage in Luxembourg's banks we empirically investigate the role of bank characteristics as well as real, financial and expectation variables that proxy for macroeconomic conditions in the pre-crisis and crisis period. We find that off-balance sheet exposures have different effects in the pre-crisis and crisis period, and that the share of liquid assets in the portfolio only affects the amount of security holdings.

In terms of macroeconomic variables, we find that the Euribor-OIS spread is a significant driver of the build-up in leverage in the pre-crisis period. The reason is that most banks in Luxembourg are either branches or subsidiaries. This, firstly, makes leverage a less relevant indicator of riskiness for investors. Secondly, it implies that in times of liquidity shortages, mother companies or groups demand further liquidity from their branch or subsidiary. The downturn in leverage during the crisis can be accredited to reductions in expectations, which we proxy by an economic sentiment indicator. It can also be explained by increasing bond prices which induce depositors to shift their funds from bank deposits into bonds. We find no important role for GDP growth.

Contents

Résumé non-technique

Les institutions bancaires à fort levier financier se sont trouvées à l'épicentre des turbulences qui ont conduit à la récente crise financière. En conséquence, une attention croissante est portée par les investisseurs et les régulateurs sur le ratio d'endettement des banques.

Le levier d'endettement est un indicateur du niveau de dépendance d'une banque du financement externe. Il mesure la part des actifs qui est financée par des fonds autres que les fonds propres. Plus le levier financier est élevé, plus la banque sera démunie face à l'émergence de chocs inattendus au niveau des passifs ou des actifs risqués, et plus important sera alors le risque de défaut. L'objectif de cette étude est de déterminer les facteurs sous-jacents à la dynamique du levier financier afin de comprendre ce qui conduit les banques à accepter les risques associés à un ratio d'endettement élevé. Cette étude est menée en deux étapes en se servant des données individuelles des banques d'un échantillon représentatif du secteur bancaire luxembourgeois au cours de la période 2003 Q1 - 2010 Q1.

Dans le cadre de la première étape, nous analysons la dynamique du ratio d'endettement des banques au Luxembourg, ainsi que le mécanisme de base qui serait à l'origine de ses ajustements. Plus précisément, nous cherchons à identifier les composantes du bilan susceptibles d'expliquer les changements du levier financier.

Il ressort de cette première analyse que le levier des banques est pro-cyclique. Il est plus ou moins synchrone avec l'évolution récente du cycle économique et des marchés financiers avec, notamment, une période de croissance suivie par un processus de désendettement à partir du troisième trimestre 2008. Ceci est essentiellement dû à l'évolution des crédits, qui représentent en moyenne pas moins de 75% des actifs, et s'explique du côté des passifs par l'évolution des dépôts, lesquelles représentent près de 85% des passifs. Ainsi, les ajustements du levier financier des banques luxembourgeoises sont largement influencés par les variations de ces deux composantes. Des analyses sur la base d'une ventilation plus poussée nous permettent de conclure que ce sont les dépôts à vue et ceux à terme qui sont les plus fortement corrélés à l'évolution des actifs, tandis que, en moyenne, les dépôts à préavis et ceux liés à des opérations de mise en pension pourraient être associés à l'objectif de maintenir un niveau d'actifs constant.

La comparaison des résultats de la première étape de notre article avec l'étude d'Adrian and Shin [1] sur le cas américain soulève une différence qualitative frappante. Les banques luxembourgeoises, bien qu'elles aient une structure bilantaire similaire aux banques commerciales aux Etats-Unis, sont caractérisées par un levier financier pro-cyclique ; similaire aux banques d'investissement américaines. Afin de creuser d'avantage la question et sachant qu'une telle classification n'existe pas au Luxembourg, nous définissons deux sous-échantillons selon le levier financier des banques ait un comportement pro-cyclique ou acyclique. Nous comparons ensuite la structure bilantaire des deux types de banques. Nos résultats indiquent que les banques pro-cycliques ont un ratio de crédits-actifs totaux significativement supérieur et qu'elles concèdent une part conséquente de ces crédits à des institutions financières et monétaires. En plus, les dépôts représentent une plus grande partie des dettes

pour ce type de banques, dépôts à vue pour la plupart. Par contre, les banques acycliques ont relativement plus des dépôts à terme, lesquels sont moins affectés par les fluctuations du cycle économique. Finalement, les banques classifiées en tant qu'acycliques investissent plus en bons souverains, considérés comme des investissements de long-terme.

En plus des aspects bilantaires, la différence dans le comportement du ratio d'endettement entre les banques luxembourgeoises et les banques commerciales américaines peut s'expliquer également par le fait que les banques au Luxembourg sont essentiellement des filiales ou des branches de grands groups bancaires européens et jouent un rôle important en tant que fournisseurs de liquidité. Donc, si les besoins de liquidité du group sont pro-cycliques alors les banques luxembourgeoises feront face à une demande pour prêts aussi pro-cyclique. Un argument additionnel réside sur le fait que les banques au Luxembourg pourraient bénéficier du soutien du group en cas de besoin, ceci limiterait l'utilité de cibler un levier financier constant. Toutefois, dans la deuxième étape des analyses menées dans cette étude, nous explorons des explications supplémentaires.

Dans la deuxième étape, nous analysons donc économétriquement les variables macroéconomiques qui pourraient se révéler être des facteurs importants de l'évolution de l'endettement. En outre, nous étudions comment certaines caractéristiques du bilan s'associent aux mouvements du levier financier. L'hypothèse sous-jacente aux analyses menées dans cette étape est que les banques ciblent un certain niveau d'endettement qui n'est pas nécessairement constant. Au contraire, le niveau ciblé peut être fonction, d'une part, de la volonté d'assumer plus ou moins des risques ou, d'autre part, de la situation économique générale ou sectorielle ainsi que des prévisions à cet égard. Finalement, nous cherchons à déterminer si pendant la récente crise financière les banques ont modifié la façon dont elles prennent les décisions en matière de levier financier.

Les principaux résultats des analyses économétriques nous amènent vers les conclusions suivantes. Premièrement, les banques chercheraient à élargir leur bilan si les attentes économiques sont bonnes, alors qu'elles chercheraient à le réduire si, au contraire, les anticipations sont sombres (cet effet est statistiquement significatif dans le période de crise). Deuxièmement, l'écart entre les taux d'intérêt Euribor 3 mois et l'OIS s'est révélé statistiquement significatif pour expliquer les mouvements du levier d'endettement. Ceci s'explique par le fait que lorsque des tensions sur la liquidité se manifestent et les conditions du marché interbancaire se détériorent, les maisons-mères demanderont plus de fonds à leurs filiales établies au Luxembourg. Il y a lieu de souligner que les banques luxembourgeoises répondent à ce gonflement des actifs essentiellement par des augmentations de dépôts mais aussi par le biais de réductions du stock de titres. Finalement, nous avons constaté que les positions hors-bilan jouent un rôle important dans la dynamique du levier financier. Les activités hors-bilan (qu'incluent les crédits engagés, les émissions de garanties et des facilités de trésorerie) ralentissent la croissance du levier dans la période de pré-crise, tandis que, lors de la crise, elles l'amplifient. Par conséquent, le hors-bilan a un rôle contre-cyclique dans la dynamique du levier financier.

1 Introduction

Many economists shared the belief that the great moderation was due to a structural change in, and a better understanding of, the processes that underlie financial markets. This belief induced easy credit to flood the markets, leading to a higher demand than supply for assets which induced asset prices to diverge from their fundamentals (Allen and Gale [2]). Banks expanded their balance sheets through increasing their leverage (Adrian and Shin [1]), thereby making themselves prone to risks of liquidity shocks or maturity mismatch. At one point, however, highly leveraged financial players suddenly noticed that their previous expectations were not met anymore and they started to unwind various financial positions which quickly led to tumbling asset prices and further worsening of balance sheets (Shleifer and Vishny [11]). Once this mechanism had achieved a certain momentum it led to the course of events that is now called the financial crisis of 2007-2009, the general causes of which are well-described in e.g. Reinhart and Rogoff [10], Brunnermeier [6] and Cecchetti [7].

One of the variables that currently receives a particular attention from both regulators and investors is the leverage ratio. This ratio measures how much of a bank's own fund cover its assets, which is indicative for the level of indebtedness of a bank. The more a bank wishes to increase its profits by relying on outside funding the more susceptible it will be to bank runs or sudden shifts in liabilities or risky assets. Thus, a higher leverage may be associated with a higher level of bank default and an amplification of the effect of liability withdrawals.

It is, therefore, important to determine the causes underlying any change in leverage in order to understand why banks choose to accept the risks associated with higher leverage. This is the main objective of this study. To do this, we utilize individual banks' balance sheet data from the Luxembourgish banking sector, covering at maximum 153 banks and ranging from 2003 Q1 - 2010 Q1. We proceed in two steps. In the first step we study the basic mechanism behind leverage adjustments in Luxembourg. Our focus is on determining those balance sheet components that tend to explain most of the adjustments in Luxembourgish banks' leverage decisions.

In the second step we econometrically investigate which macroeconomic variables are significant drivers of changes in leverage as well as of its main components, namely credits and securities on the asset side and deposits on the liability side. Additionally, we also study if changes in leverage are associated with bank-specific characteristics. This we do in order to control for the possibility that banks with different business models or balance sheet structures have different leverage cycles or potentially also react differently to macroeconomic developments.

The main hypothesis is that banks target a certain level of indebtedness, or leverage, which certainly does not need to be constant but depends on their individual willingness to take risks, assessment of the economic situation and general level of demand in the economy. For this reason the macroeconomic variables should be good indicators for capturing those bank assessments and attitudes, while the bank-specific variables reflect a bank's current structure and, therefore, its ability to react to un-

foreseen events.

With this in mind we also investigate whether the crisis led to fundamental changes in the way banks rely on market indicators and in the way their current balance sheet structures constrain them in future choices. For example, intuition would suggest that banks with many off-balance sheet activities would have a smaller expansion of leverage than those with few off-balance sheet activities. In contrast, during a crisis when commitments or guarantees get exercised, then banks with a large amount of off-balance sheet commitments might need to expand their balance sheets by more than other banks. One would also expect that GDP growth or security prices might be guiding banks' decisions by more in a stable pre-crisis period, while during a crisis the role of expectations would predominate.

As bank-specific variables we include the loans-to-deposits ratio, which is a simple way to measure a bank's maturity mismatch; the liquid-assets-to-assets ratio (with liquid assets including cash, securities and quoted shares), which measures the percent of assets that can easily be converted into cash and thus reflects the ease with which a bank can respond to unforeseen events; the off-balance-to-assets ratio (where off-balance items include committed credits, guarantees and liquidity facilities), which allows us to assess a bank's contingent commitment to future credits. The list of macroeconomic variables includes the Euribor-OIS spread, which reflects the risk-adjusted price of lending funds on the interbank market; an economic sentiment indicator, which provides us with an assessment of the forward-looking expectations; a bond index, a proxy for changing bond prices; and European GDP growth, which is an indicator for the activity in the real sector that the internationally-oriented Luxembourgish banking sector is most active in. With these variables we, therefore, cover bank-specific conditions, the real sector, the financial sector as well as forward-looking expectations.

Our findings are as follows. Though Luxembourg's banks have balance sheets that are mainly composed of loans and deposits and are, thus, in their fundamental balance sheet structure similar to US commercial banks, their leverage dynamics are more in line with US investment banks. Indeed, in contrast to US commercial banks that are known to target a constant leverage ratio (Adrian and Shin [1]), we show that leverage in Luxembourg is inherently procyclical. Our explanation for this rest on the fact that most banks in Luxembourg are either branches or subsidiaries. In line with this argument, one of the macroeconomic variables that shows up as a highly significant driver of balance sheet expansions is the Euribor-OIS spread. We find that Luxembourg's banks strongly expand their balance sheets when the spread increases, which confirms to us that Luxembourg's banks are liquidity providers to the European banking sector. The main reason for this effect is that when market conditions worsen and it becomes more expensive for banks to borrow on the interbank market, then they increase their demand for funds from their subsidiaries or branches in Luxembourg. The econometric analysis shows that Luxembourg's banks fund these balance sheet expansions mostly by increasing deposits, but also by selling securities.

Additionally, since most banks in Luxembourg are branches or subsidiaries they can, in distressed

times, rely on help from their mother company or group. As a consequence, the Luxembourgish banking sector has one of the highest levels of leverage in Europe. We observe little leverage targeting and banks freely choose their level of indebtedness according to the market fundamentals or expectations. This observation is confirmed by the econometric results which show that Luxembourg's banks expand their balance sheets if expectations are good, while they shrink their balance sheets if times turn bad.

In addition, we find that the off-balance sheet exposures and the amount of liquid assets both play a crucial role for the evolution of leverage. In particular, the larger is the share of liquid assets on a bank's balance sheet the smaller is the growth of securities with a more pronounced effect during the crisis. The reason for this result can be found within the bank model that Luxembourg's banks utilize, as a large part of securities tends to be held for being able to obtain liquidity in uncertain times. The off-balance sheet activities constrain the growth of leverage in the build-up to the crisis, while they increase leverage growth during the crisis. The intuition for this draws, on the one hand, on the fact that banks with large committed credits or guarantees are constrained in the possibility to further expand their loan portfolio. On the other hand, large off-balance sheet exposures imply that during a crisis the committed credits or guarantees are exercised, which implies that these banks will have a larger growth in leverage than those with few commitments. This result links directly to the new Basel III regulations. Since these introduce an off-balance sheet augmented leverage ratio we can, firstly, expect a lower absolute exposure to off-balance sheets simply due to the regulation but, secondly, also a lower counter-cyclical effect on leverage from the off-balance exposure. This last point depends on how banks pay for their off-balance sheet commitments after the Basel III regulations have been imposed.[2]

The article is structured as follows. Section 2 develops upon the processes that are behind the leverage cycle. We look specifically into the adjustments of balance sheets of banks in Luxembourg, covering the period 2003 Q1 - 2010 Q1. In section 3 we present the econometric methodology followed by a discussion of the results. Finally, section 4 concludes.

2   The mechanics of the leverage cycle

2.1   The data

To analyze the determinants of the movements in leverage empirically we collect bank level data for the whole banking population in Luxembourg from the statistical reporting to the Banque centrale du Luxembourg. We built an unbalanced panel dataset consisting of at maximum 153 banks for the period 2003 Q1 - 2010 Q1. We use this data in this section and the next one to study the evolution of leverage for banks in Luxembourg. We define leverage as total assets divided by own funds. Own

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[2]Since raising equity takes time, it is likely that banks will fund their guarantees or commitments via deposits.

funds include basic capital, assimilated capital and reserves (Tier 1 capital).

2.2 The procyclicality of leverage

One should find a negative relationship between total assets and leverage if banks were not to adjust their balance sheets. We denote leverage by L, A is total assets and D denotes debt, which is total liabilities excluding own funds E, implying $E = A - D$. The leverage ratio is given by

$$L = \frac{A}{A - D}. \tag{1}$$

Assume that banks are passive. If asset values increase due to, for example, a stock market boom and marking-to-market of securities then leverage decreases. Therefore, an increase in asset prices implies that

$$\frac{dL}{dA} = -\frac{D}{(A - D)^2} < 0. \tag{2}$$

Figure 1 – *Leverage growth versus asset growth, 2003 Q2-2010 Q1*
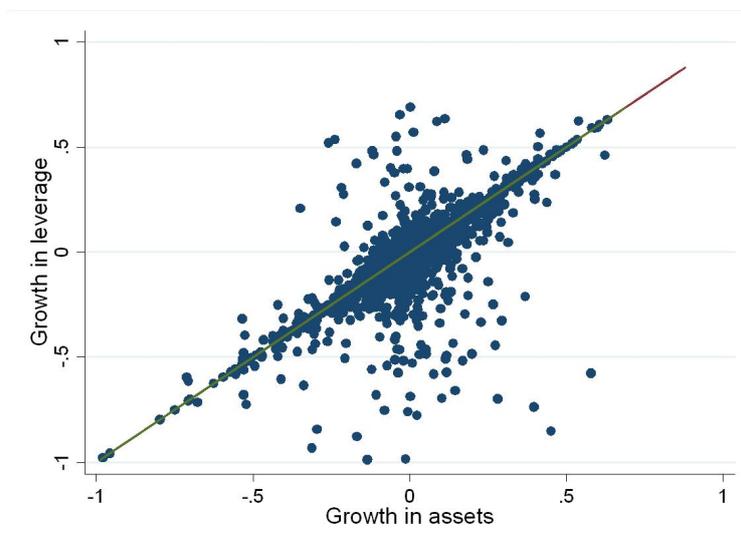
However, this relationship is not found when studying the data. Instead, as Figure 1 shows for the Luxembourgish banking sector from 2003 Q1 to 2010 Q1, increasing asset values are highly correlated with increasing leverage. As a consequence, leverage is procyclical.

We now compare this result to the findings in Adrian and Shin [1]. These authors find that US commercial banks target a constant leverage, while US investment banks seem to have a procyclical relationship between asset growth and leverage growth. Overall we observe that banks in Luxembourg, in common with US investment banks, have a procyclical leverage. In contrast, the balance sheet structure of Luxembourg's banks is more in line with that of US commercial banks, since Luxembourg's banks hold on average 75% of their assets in form of credits and 85% of their liabilities in

form of deposits. However, it would be surprising if different banking models do not induce asymmetric leverage behavior in Luxembourg, as it is the case in the US. Unfortunately, the distinction

Figure 2 – *Example of a procyclical and an acyclical bank in Luxembourg*

(a) Acyclical bank   (b) Procyclical bank
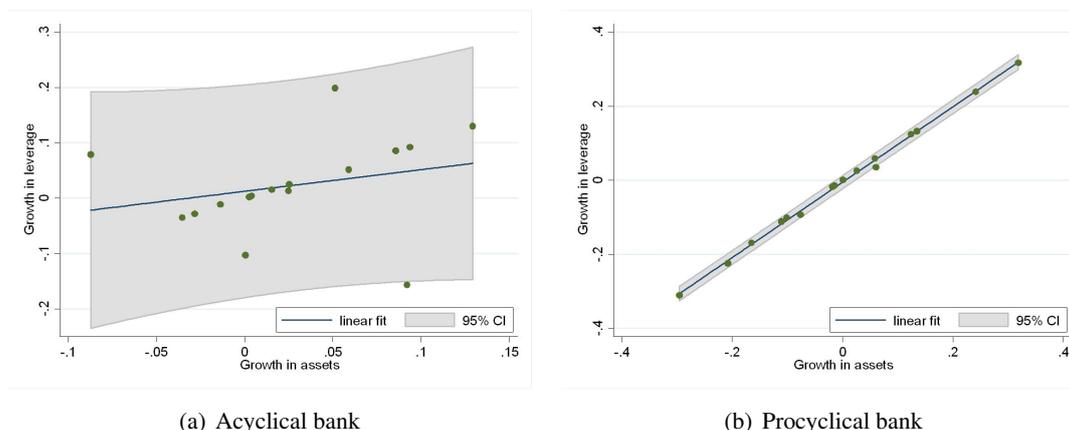
Explanation: The confidence interval is for an individual forecast, which includes both the uncertainty of the mean prediction and the residual.

between commercial banks and investment banks does not exist in Luxembourg. Our approach for comparison is as follows. We split our sample of banks into procyclical and acyclical banks. Procyclical are those that have a significant correlation between the growth in leverage and the growth in assets, where we define a correlation to be significant if the correlation coefficient is higher than .65 with a p-value below 0.05. Acyclical banks are all others. Figure 2 provides an example of a procyclical and an acyclical bank. As one can see, the acyclical bank has no significant relationship between leverage growth and asset growth, while the procyclical bank has a highly significant and positive relationship between both variables. We then compare the balance sheet structures of both samples, as shown in Table 1. Our main finding is that procyclical banks have a higher share of credits on their balance sheet, and they give a larger share of their credits to MFIs. Since credits to MFIs tend to be short-term credits, this is a likely explanation for those banks having a more procyclical balance sheet. In addition, procyclical banks have a larger share of their liabilities in the form of deposits, where furthermore they also have a larger share in overnight deposits. Acyclical banks, in comparison, have more deposits with maturity, which tend to be less affected by short-term business cycle fluctuations. Finally, acyclical banks are those that invest more in securities, with the bulk of the securities coming from government debt or debt from MFIs. These securities tend to be held for long-term investments or to safe-guard against liquidity shocks, which also makes our sample of acyclical banks less prone to unforeseen events.

A further explanation to substantiate the qualitative difference between US banks and Luxembourgish banks is that most banks in Luxembourg are either branches or subsidiaries and tend to function as liquidity providers to their mother company or group. Thus, if the liquidity needs of their mother

Table 1 – *Balance sheet structures of procyclical and acyclical banks*

Bank type	N	Sample medians (variables are shares of total assets)							
		Equity	Credits	Securities	Dep.	Dep. (MFI)	Credits (MFI)	Dep. (overn.)	Dep. (mat.)
Procyclical	114	24.86	0.89	0.07	0.89	0.25	0.63	0.20	0.49
Acyclical	20	21.31	0.85	0.11	0.84	0.36	0.44	0.13	0.55
KS test (p-val.)		0.000	0.018	0.003	0.000	0.000	0.000	0.000	0.000

Explanation: The KS test is the Kolmogorov-Smirnov test. It is a two-sample, non-parametric analysis comparing the distributions of both the procyclical and acyclical banks. H0 is that both distributions are equal.

companies or groups are procyclical, then the demand for credits from Luxembourg will be procyclical, too. Additionally, a reason why Luxembourg's banks may not target a constant leverage ratio could simply be that they do not need to. As they mostly belong to groups or have a mother company, then the market may not attach a risk premium to leverage in Luxembourg since default is unlikely for a bank that can easily be supplied with equity from its mother company. This, for example, is also supported by the fact that banks in Luxembourg tend to be among the most highly leveraged banks in Europe. In the econometric analysis we, however, show that there is a further explanation for the leverage decision of Luxembourg's banks.

2.3 The driving factors

As Figure 3 shows, leverage in Luxembourg was procyclical during the boom of 2003 Q1 to 2008 Q1, increased sharply at the beginning of the financial turbulences in 2007 Q3, and then decreased to an all time low with the materialization of the financial crisis in 2008 Q3. Therefore, leverage followed closely the recent evolution in the financial markets and economic boom-bust cycle. Figure 4 demonstrates that this evolution is clearly due to a reduction in total assets after the Lehman bankruptcy, while own funds continued to grow at approximately the same rate as before the crisis. Hence, leverage is procyclical since Luxembourg's banks increased their assets faster than their own funds, leading to an increase in leverage.

Taking a closer look at the main components of assets, Figure 5 shows that the major driver of the reduction in total assets was total credits. A somewhat more disaggregated look at credits allows us to conclude that credits to 'monetary financial institutions' (MFIs) were the main source underlying the decline in total credits. The fact that mainly credits drive assets is supported through the observation that banks' portfolios in Luxembourg are, on average, to 75% composed of credits and to 15% of securities. Thus, changes in assets are likely to be mainly driven by changes in credits. However, the Pearson correlation between the growth of securities and the growth of assets is 12% (p<0.01), suggesting that both are at least not moving independently. The securities portfolio of banks

Figure 3 – *Evolution of leverage in Luxembourg, 2003 Q2-2010 Q1*
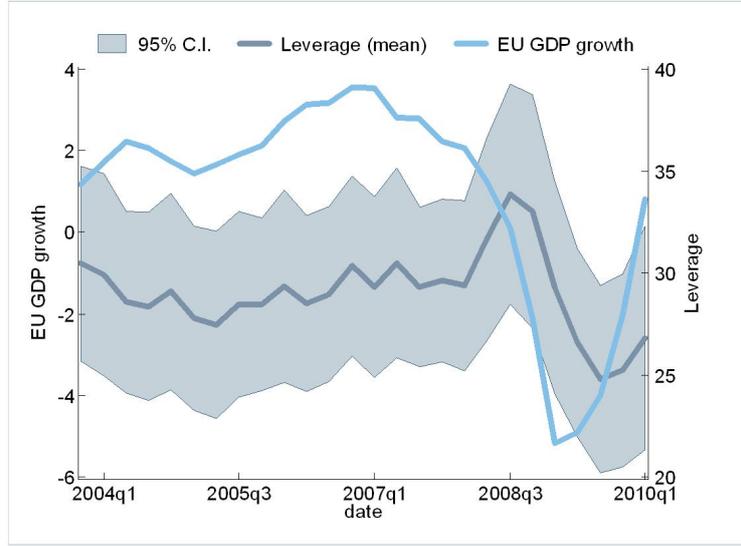
in Luxembourg consists, on average, to 90% of bonds and to 10% of shares, with 45% of all securities coming from credit institutions and 26% are government securities.

As Figure 4 shows, the increase in own funds in the pre-crisis period cannot solely account for the growth in assets. Thus, the increase in assets must have come through attracting other liabilities. Similarly, since banks in Luxembourg reduced their assets from 2008 Q3 onwards while they continued to increase their own funds, then this implies that they adjusted their balance sheets by changing other liabilities. Banks in Luxembourg did this especially through shedding deposits. Figure 6 confirms this. Indeed, we observe a highly significant (p<0.01) and positive correlation (82%) between asset growth and deposit growth. Thus, deposits are the main variable of adjustment to match the asset and liability sides of banks' balance sheets in Luxembourg.

The effect of this on leverage is easily determined. Assume that deposits increase by $d > 0$, leading to an equal expansion of the loan portfolio. Then the new level of leverage changes to

$$L = \frac{A + d}{A + d - D - d} = \frac{A + d}{A - D}. \tag{3}$$

Deposits make up on average 85% of liabilities (excluding own funds) for banks in Luxembourg. Hence, adjustments in leverage for Luxembourg's banks are largely driven by changes in deposits. For banks in Luxembourg, overnight deposits and deposits with maturity make up, respectively, approximately 35% and 57% of total deposits[3]. In addition, deposits with maturity from monetary and financial institutions (MFIs) make up 20% of total deposits.

A further disaggregation allows us to conclude that changes in overnight deposits and deposits with maturity are those that are strongly linked to changes in assets, while, on average, redeemable

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[3]Other deposit types are those that are redeemable at notice and repo deposits.

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Figure 4 – *Evolution of assets and own funds*
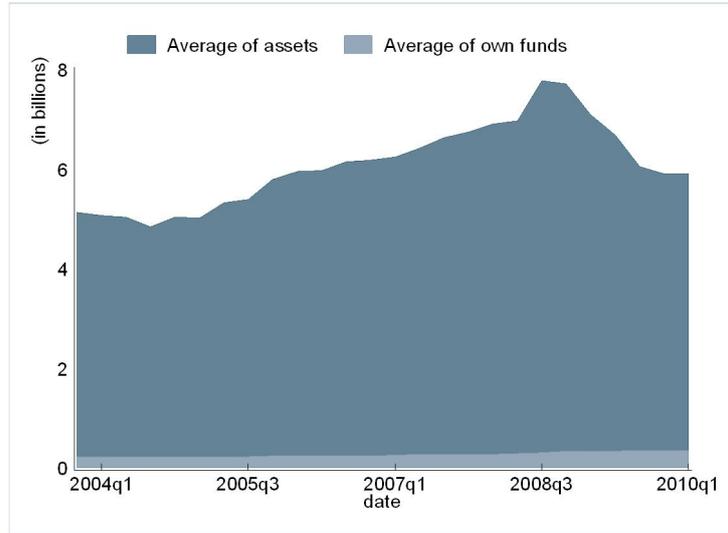
deposits and repo deposits may be associated with constant assets. This last result (with respect to repo deposits) confirms Adrian and Shin [1]'s view that repo deposits tend to be used to keep the asset side of the balance sheet constant.

3 Econometric analysis

3.1 An overview of the data

The previous section provided the foundation for our empirical study. We now present some further information on the data and the empirical approach.

The bank-specific variables As bank-specific variables we include the loans-to-deposits ratio, the liquid-assets-to-assets ratio and the off-balance-to-assets ratio. The loans-to-deposits ratio is a simple proxy to measure a bank's maturity mismatch. Loans tend to have a longer maturity than deposits and increases in this ratio would indicate that a bank funds itself by issuing either more equity or debt. We expect a higher ratio to lead to stronger adjustments in leverage since most banks in Luxembourg are debt financed. The liquid-assets-to-assets ratio (with liquid assets including cash, securities and quoted shares) measures the percent of assets that can easily be converted into cash and thus reflects the ease with which a bank can respond to unforeseen events. Banks with a low liquid assets ratio should be less able to constrain their leverage changes during a crisis than those that hold significant liquid assets. This can be shown as follows. Assume that there is a run-off of deposits of amount $x > 0$. A bank with a large number of liquid assets can compensate this run-off by selling high quality securities at a marginal haircut. Thus, their leverage changes according to $dL/dx = -1/(A - D)$. Assume now the case of a bank with few liquid assets that, when faced with a deposit run-off, needs

Figure 5 – *Evolution of credits and securities*
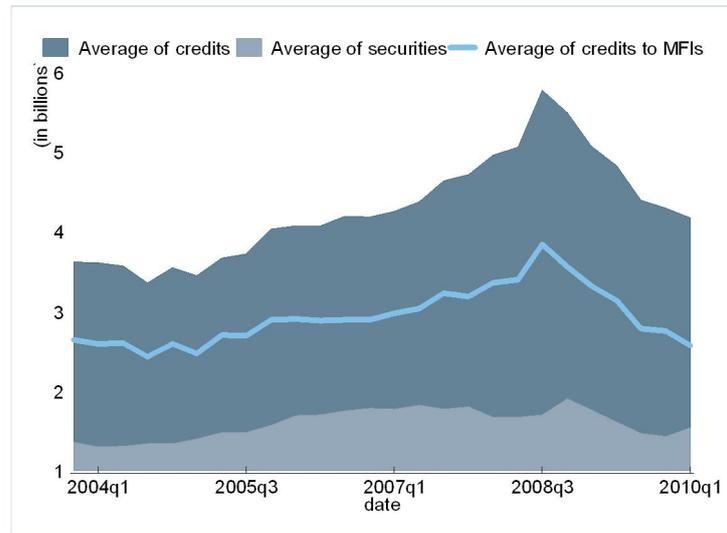
to sell assets. This bank will only be able to sell assets at a non-negligible haircut, which we denote by a multiplicative factor $\beta > 1$. In this case the bank will face a larger change in leverage, which will be given by $dL/dx = -\beta/(A - D)$.

Finally, the off-balance-to-assets ratio (where off-balance items include committed credits, guarantees and liquidity facilities) allows us to assess a bank's commitment to contingent credits. The higher this commitment the more liquidity banks would need in case that these committed credits or guarantees get exercised. This would, for example, be more likely in a crisis. The way banks fund these commitments then depends on the costs of raising funds relative to having to sell assets.

The macroeconomic indicators The list of macroeconomic variables includes a European bond index, the Euribor-OIS spread, an economic sentiment indicator and European GDP growth.

The bond index is the Bank of America Merrill Lynch 10+ Year Euro Financial Index. It consists of EURO denominated investment grade debt from financial institutions in the Eurobond or Euro member domestic markets. The index is based on the clean prices of the financial institutions' debt and, thus, changes in the index tend to be mostly due to changes in economic fundamentals, for example if there is a change in interest rates or if the credit quality of the bond's issuer changes. Hence, this index represents fundamentals more than expectations. In Luxembourg, a bond index is a potentially useful proxy of the relative return of securities on a bank's balance sheet since approximately 90% of the securities are held in form of bonds, and around 50% of these are bonds from credit institutions. The bond index is, therefore, a proxy for the return on the banks' securities portfolios.

The Euribor-OIS spread is derived as the difference between the 3-month Euro interbank offered rate (Euribor 3mth) and the OverNight Index Average (Eonia) rate. The Euribor 3mth rate is an average interest rate at which a selected sample of banks obtains three month unsecured funds in the European interbank market, while the Eonia rate is an average interest rate at which the same sample of

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Figure 6 – *Deposits growth versus assets growth*
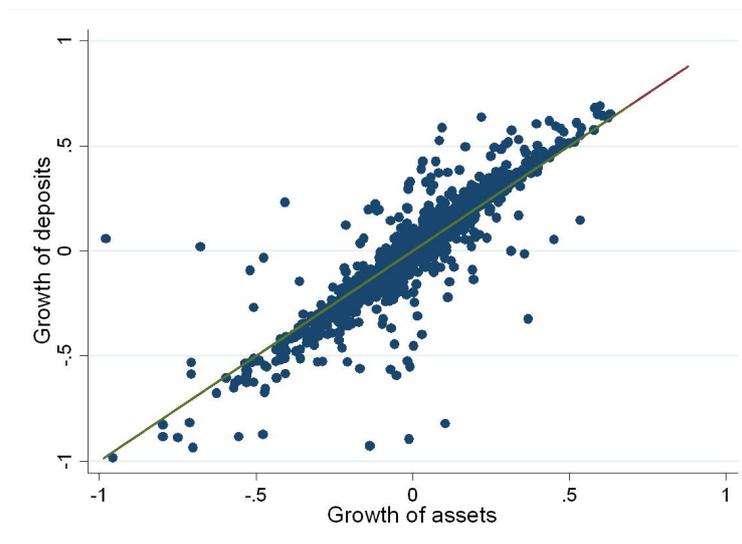
banks obtains overnight unsecured funding on the European interbank market. The difference in these two rates then reflects various risks that may arise during a three month period, which may prevent a bank from obtaining the funding that it needs to keep the current portfolio. Those risks should mainly reflect the market's assessment as well as the banks' subjective evaluations of others' default risk and it's own liquidity risk. During the financial crisis of 2007-2009 the spread should have mainly captured liquidity risk. Liquidity risk is the risk of losing one's liabilities and thereby not being able to sustain the same amount of assets on the balance sheet. It thus affects more strongly those banks that are leveraged and have a large maturity mismatch. The higher the market's expectation that banks run into liquidity problems the higher will be the risk premium that lenders on the interbank market will demand from borrowers. Also, as liquidity providers became unsure about their own liquidity needs during the crisis, they stopped lending out of a pure precautionary motive. Hence, demand for liquidity exceeded supply and this increased the Euribor-OIS spread. In this case, the Euribor-OIS spread should affect leverage for banks in Luxembourg positively since they often function as liquidity providers for their head institutions.

The economic sentiment indicator provides us with an assessment of the forward-looking expectations. We calculate this as the average of the Economic Sentiment Indicators from Belgium, Germany, France and Luxembourg. In terms of economic activity, these are the important trading partners for Luxembourg's banks. As suggested in the theoretical literature, higher expectations should induce increases in leverage through lower risk aversion and increases in expected collateral values (Bernanke and Gertler [4], Kiyotaki and Moore [8]).

The European GDP growth allows us to control for the activity in the real sector. It is well-known that the banking sector in Luxembourg has a strong international orientation with a main emphasis on intra-group activities. Deposits from MFIs make up on average 42% of all deposits, while credits

to MFIs average 72% of all credits. One would then expect credit demand and deposit supply to be strongly related to the general economic situation of those countries with which Luxembourg's banks hold strong economic ties. Since banks in Luxembourg are mainly active in Europe, we use European GDP growth to capture changes in deposit supply and credit demand in Luxembourg's banks.

The crisis period One of our objectives is to understand whether there is a differentiated impact of our variables of interest on leverage before and during the crisis. For this we study two sub-periods defined by the pre-crisis period, ranging from 2003 Q1 to 2007 Q3, and the crisis period, ranging from 2007 Q4 to 2010 Q1. Thus, we define a dummy variable called *C*, which is equal to one for the period 2007 Q4 - 2010 Q1 and zero otherwise, which should be able to capture crisis-specific behaviors. We note that the date 2007 Q4 coincides with the beginning of the turbulences in the real sector, where confidence, industrial production, GDP and the stock index started to decline.

An additional point is that we control for whether a bank is a branch or not. An important number of banks in Luxembourg are branches and they have a mother institution that mostly comes from the European banking sector. We control for this by introducing a dummy that we label B_i and which takes the value of one if the bank is a branch and zero otherwise.

The tables with the empirical results are relegated to the Appendix. Table 2 presents the description of the variables used in the empirical part and Table 3 the summary statistics.

The basic econometric model is as follows.

$$
\begin{aligned}
g(LEV_{it}) &= \alpha_1 + \alpha_2 g(LEV_{it-1}) + X_{it-1} \times \beta_1 + Y_t \times \beta_2 + C_t \\
&\quad + Y_t \times C_t \times \beta_3 + X_{it-1} \times C_t \times \beta_4 + B_i + v_i + d_t + \epsilon_{it},
\end{aligned}
\tag{4}
$$

where we explain the growth in leverage $g(LEV_{it})$ by the lagged growth in leverage (to account for a possible convergence in leverage), by a vector of variables X_{it} that we use to model bank-specific behavior, by a vector of variables Y_{it} that describes the macroeconomic condition, and by unobserved fixed effects v_i as well as seasonal dummies d_t. With these variables we, therefore, cover bank-specific conditions, the real sector, the financial sector, forward-looking expectations and also control for the crisis period.

We expect the lagged dependent variable to be correlated with the fixed effects and thus resort to the system GMM estimator (sysGMM) proposed in Arellano and Bover [3] and Blundell and Bond [5]. This estimator is particularly well-suited to cope with a dataset that consists of a large panel but has a small time dimension, where unobservable fixed effects might correlate with endogenous regressors and finally this estimator also controls for heteroscedasticity and autocorrelation within the panels. Not controlling for these factors would lead to a bias in our estimations as there is reason to believe that each of these criteria shows up in our regressions. Theory predicts (Nickell [9]) that a significant correlation between unobservable fixed effects and a lagged dependent variable induces an upward bias in the coefficient of the lagged dependent variable if one estimates based on an OLS

regression, while it leads to a downwards bias if one resorts to the within estimator (FE). An estimator that reduces this so-called Nickell bias should have a coefficient on the lagged dependent variable that is between that obtained for the OLS and the FE regression. We, therefore, present our results based on the sysGMM estimator in comparison to the OLS and the FE results. Finally, as the cross-correlations of the variables in Tables 4 and 5 show, some of these variables have a non-negligible correlation. The sysGMM estimator is suited for this case as well, since it can take care of correlated independent variables.

In addition, we provide several specification tests that need to hold if one uses the sysGMM estimator. These tests require that there is no first-order autocorrelation in the errors but we should find a significant second-order autocorrelation. We present the p-values of these tests as *AR(1) p-val.* and *AR(2) p-val.* respectively. Convergence of the estimator requires that the absolute value of the coefficient on the lagged dependent variable is less than one. Finally, we have to analyze whether our instruments are valid. We resort to the Hansen test to assess the over-identification restriction. The p-value of the Hansen test should reject the endogeneity of instruments at a sufficiently high level.

3.2   The results

We now present the results from our econometric estimation based on models including the bank-specific variables and the macroeconomic conditions. We give the OLS and the FE results followed by the sysGMM estimator, on which we base our analysis. We provide the results for the sysGMM estimator for the growth in leverage and then compare these results to those for the growth in loans, deposits and securities, as we observed that these three variables are those that determine most of the changes in leverage in Luxembourg. We present the actual values of the marginal effects in brackets with the stars representing the significance levels.

For the case of leverage, loans and deposits, our interpretation of the results relies on our preferred estimator, the sysGMM. However, we show in Table 6 that we do not need to run the sysGMM estimator for the case of securities, since the lagged dependent variable shows up insignificantly. Thus, in that case we use the Hausman and Taylor estimator, which allows us to capture the role of branches. Finally, for all regressions the marginal effects during the crisis are presented in Table 8.

3.2.1   Bank-specific variables

Table 7 presents our empirical results and shows the relationship between leverage and bank-specific variables. We find that leverage in Luxembourg is mean reverting (-0.134***), with higher growth in leverage today leading to a lower growth in leverage tomorrow. This result is common to the literature (see e.g. Adrian and Shin [1]). A one percentage increase in the growth rate of leverage today reduces the growth of leverage tomorrow by approximately 0.134%. The coefficient of the lagged-dependent variable lies within the range of the OLS (-0.131***) and FE (-0.175***) coefficient, suggesting that

the sysGMM estimator improves upon the Nickell bias.

With respect to the bank-specific variables we find that the off-balance sheet exposure provides the most significant impacts on leverage and its components. It has statistically significantly (Prob > chi2 = 0.000) different effects in the pre-crisis and crisis period and also across the components of leverage. With respect to the pre-crisis period, we find the following. Leverage growth is significantly negatively affected by the off-balance sheet exposure (-0.0109***), with both the growth in credits (-0.0092*) and the growth in deposits (-0.0153**) affected in a similar way. Intuitively, banks that committed to a large number of credits or guarantees know that their future balance sheets will be constrained by their contingent commitments and, as a consequence, it will not be prudent to expand their balance sheets.

During a crisis, however, another argument applies. Banks with a large share of off-balance sheet commitments tend to have a larger growth of leverage during a crisis (.0935***), the coefficient being significantly different from the one in the pre-crisis period. The growth in credits and deposits is affected to a similar extent (.0983* and .08**, respectively). This is the case since banks with large amounts of committed credits need to stick to their commitments and can therefore not reduce their credits like banks with fewer committed credits. Therefore, they need to keep attracting more liabilities, have less flexibility in shrinking their balance sheets and consequently have a larger leverage growth compared to those banks that do not commit to so many credits or give many guarantees. The off-balance commitments also affect the growth of securities during a crisis (.084***). Since we included liquidity facilities as part of off-balance exposure, then this means that we also account for commitments in the form of negotiable debt securities, Note Issuance Facilities or Revolving Under-writing Facilities. For example, it is reasonable to assert that some borrowers are not able to sell their notes in crisis times. In that case the bank that committed to buying these securities needs to step in, which increases both its holdings of securities and its leverage in comparison to those banks that did not commit to those facilities.

The share of liquid assets to total assets seems to play only a role for the growth of securities (-.221***). Here, banks that have substantial amounts of liquid assets tend to have a lower growth of securities, an effect which is further enhanced through a crisis (-.348***). Intuitively, banks that already have a large share of liquid assets on their balance sheets do not need to increase their securities by as much as those banks that hold lower shares of liquid assets, since they are already well-structured to cope with uncertain events. Hence, they can have a lower growth rate of securities and expand their balance sheets along different lines. Furthermore, in a crisis period, with tumbling security prices, a larger share of the balance sheet of those banks will be subject to losses from marking-to-market. Also, these banks may want to minimize losses by decreasing their holdings of securities by more than banks with fewer liquid assets. On the liability side these banks match the decrease in securities by reducing their growth in deposits (-.183*). It is, thus, those banks with many liquid assets that are facing the largest costs from marking-to-market, and consequently those that are the driving forces

when it comes to inducing second-round fire sales and loss spiral effects.

Further findings indicate that the loans-to-deposits ratio tends to have an effect on leverage that is not significantly different from zero (0.0123). Thus, assuming that the loans-to-deposits ratio is a useful measure of a bank's maturity mismatch, we find that banks' leverage decisions do not seem to be influenced by this variable. We find a weak impact on the growth of securities (-0.0551*) in the pre-crisis period and an impact on the growth of deposits during a crisis (-.0839**), suggesting that banks with a maturity mismatch have a smaller growth in securities (as they tend to hold more credits) and reduce their deposit holdings by more during a crisis than other banks. Since we do not obtain a statistically significant impact on other balance sheet variables during the crisis, we expect that banks increase their equity when they reduce their deposits in case their maturity mismatch is large.

Our last findings on bank-specific variables indicate that branches do not have significantly different leverage dynamics from subsidiaries or other types of banks (.00352). This may reflect the fact that our bank-specific variables are able to sufficiently capture potential differences between branches and other bank types, or it could mean that branches simply do not act in a different way to other banks in Luxembourg.

3.2.2   Macroeconomic indicators

We now turn to the effects of the macroeconomic variables as shown in Table 7, with the marginal effects in the crisis period calculated in Table 8. In order to obtain an idea of the marginal effects of the macroeconomic variables, we study the combined impacts of the Economic Sentiment Indicator (ESI), European GDP growth (g(EU GDP)), a bond index (bond) and the Euribor-OIS spread (spread).[4]

The results of the full model reveal that the key variable explaining the build-up of leverage before the crisis is the Euribor-OIS spread (0.0849**), as well as the bond prices. A one percentage point increase in the Euribor-Eonia spread increases the growth of leverage by 0.085 percent. We find that both loans and deposits increase if the Euribor-Eonia spread increases (0.0648* and 0.0973** respectively). As suggested above, this reflects, to some extent, that a non-negligible amount of banks in Luxembourg are branches or subsidiaries and in times of liquidity needs may step in to provide the requested funds for their mother companies or groups. Figure 7 helps us to complete this picture. For the period of investigation we plot the evolution of average credits on a Luxembourgish bank's balance sheet and the Euribor-Eonia spread. As the spread is a measure of the risk premia that banks attach to providing funds on the interbank market, then during the financial crisis 2007-2009 it mainly reflects liquidity risk. As we can see, credits are strongly correlated with this spread, indicating that in times of liquidity constraints, mother companies or groups increase their credit demands to their branches or subsidiaries in Luxembourg. This may be the crucial explanation for the build-

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[4]We performed several robustness exercises. Firstly, we studied the bank-specific variables alone but found no significant difference to the full model. Secondly, we ran constrained models by dropping insignificant variables. Again, there were no qualitative and few small quantitative differences.

up of credits in the pre-crisis period. We also consistently find that branches do not act differently to subsidiaries or other bank types (0.00352). Conclusively, whether banks are branches or subject to another type of ownership should not drive our results. The view on the build-up of credits can

Figure 7 – *Credits and Euribor-Eonia spread*
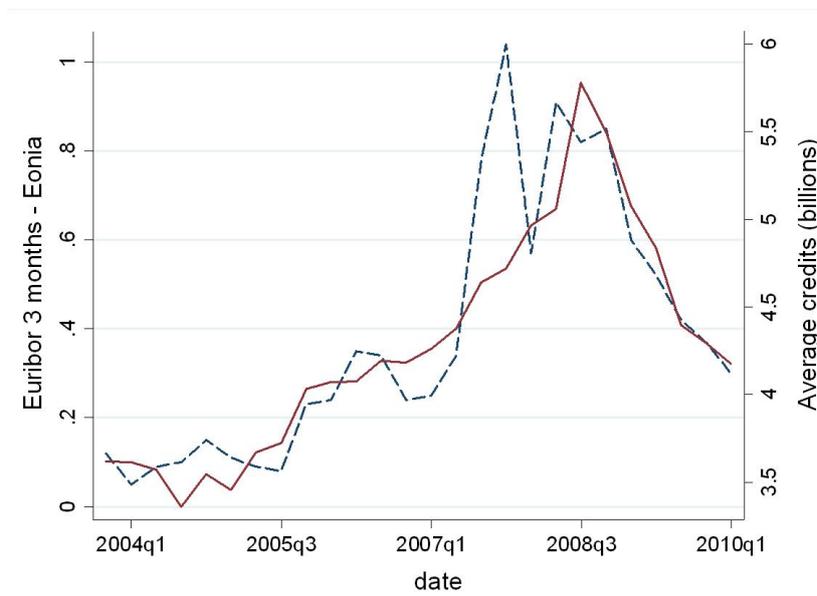
be further substantiated by the finding that both expectations (2.88e-06) as well as EU GDP growth (-0.0046) turn out to be insignificant drivers of the pre-crisis build-up in leverage. In contrast, we find that the strongest relationship between sentiment and leverage can be found during the crisis (.00428*), where a decrease in sentiment is associated with a decrease in leverage. Thus, banks reduce debt (mostly in form of deposits) and shed assets when sentiment diminishes. We obtain the result that sentiment is a statistically significant driver of the deleveraging process in Luxembourg, while we do not find it to be a significant driver in the pre-crisis period. We, furthermore, obtain that the reduction in ESI during the crisis induced banks to reduce their deposits (.0039***) and their credits (.0053***). This also lowered their leverage (.0042***).

As bonds make up, on average, 90% of total securities on Luxembourgish banks' balance sheets, we expect that changes in bond prices induce banks to subsequently adjust their balance sheets, too. Our statistical results suggest that there are different incentives at work in the pre-crisis and crisis period. In the pre-crisis period, increasing bond prices induce banks to attract more deposits (.00289***) in order to obtain more securities (.00382***). However, during the crisis, we find that higher bond prices reduce deposits (-0.0035***), with subsequent adjustments to credits (-.005***) and a deleveraging (.004***). The intuition for this result rests on two observations. Firstly, depositors may want to shift their funds out of bank deposits and into bonds, whose relative price improved and that are po-

tentially safer. Secondly, it may be cheaper for banks not to roll over credits than to sell e.g. securities in order to meet the deposit run-off. Additionally, banks may want to hold on to securities, which are viewed as relatively safe investments, and shed credits, whose riskiness increased during the crisis.

Finally, we find that the marginal effect of the crisis variable at the sample mean shows up as statistically significant for the growth in leverage (-.0746***), credits (-.0527**) and deposits (-.0433*) but not securities (.0361), with the expected signs. Thus, ceteris paribus, during the crisis, banks entered a deleveraging process through shedding credits and deposits. Clearly, the reason for this is that during a crisis precautionary motives lead banks to keep holding larger amounts of securities since they represent relatively safe stores of value. A further explanation is that banks might have not been able to roll over the same amount of deposits due to liquidity problems of the lenders and default risks of borrowers.

4   Conclusion

In this article we studied the determinants of the leverage cycle for the Luxembourgish banking system. Our purpose in this article was to explore the role of bank-specific variables as well as real, financial and expectation variables for the leverage cycle in Luxembourg. Focusing on two sub-periods, the pre-crisis period 2003 Q1 - 2007 Q3 and the crisis period of 2007 Q4 - 2010 Q1, we find that banks react according to different incentives during economic expansions and contractions.

We have shown that leverage is inherently procyclical, which is a consequence of an active management of balance sheets, with banks borrowing more during boom times to increase their assets and reducing their assets while shedding liabilities during bust times. We, furthermore, found that banks mainly change their assets by adjusting their credits and predominantly adjust their liabilities by attracting deposits. This observation stands in contrast to US commercial banks that target a constant leverage, while US investment banks have a strongly procyclical one (Adrian and Shin [1]). Since the distinction between commercial and investment banks does not exist in Luxembourg, we classified banks according to whether their leverage behavior is procyclical or acyclical and studied their balance sheet structures. We found that procyclical banks tend to hold a higher share of credits on their balance sheet, and also attract more overnight deposits from MFIs. In constrast, acyclical banks hold a larger share of government or banking sector debt on their asset side, and finance themselves with a higher share of deposits with maturity. As a consequence, acyclical banks are less prone to sudden market shocks, face lower liquidity risks and follow the financial cycle to a lesser extend.

There are an additional three reasons for the procyclicality of Luxembourgish banks' balance sheets. One, most banks in Luxembourg are either branches or subsidiaries, thus they are expected to be protected by their mother companies, which is confirmed by the fact that the Luxembourgish banking sector has one of the highest levels of leverage in Europe. This leads to little leverage targeting and the standard arguments for constraining leverage, namely ratings and probability of default,

are reduced in importance. Two, the procyclicality of leverage comes about since increases in the Euribor-OIS spread makes funding on the European interbank market more costly, wherefore mother companies or groups turn to their Luxembourgish branches or subsidiaries for further credits. Finally, increasing securities prices make holding securities more attractive, and we find that banks increase their holdings of securities, financed via attracting more deposits, which induces an increase in leverage.

Further results are related to the balance sheet structure of banks. We find that the larger is the share of liquid assets on a bank's balance sheet the smaller is the growth of securities. Securities tend to be held for being able to obtain liquidity in uncertain times. Thus, banks that hold higher shares of liquid assets do not need to level up their balance sheet with securities since those banks are already well-adapted to cope with uncertain events. In a crisis period, when security prices decrease, those banks will minimize losses and sell securities, which affects their portfolio by more than those banks that hold securities solely for liquidity reasons.

Finally, we found that the off-balance sheet exposures play a crucial role for leverage. The off-balance sheet activities (they include committed credits, guarantees and liquidity facilities) constrain the growth of leverage in the pre-crisis period, while they increase leverage growth during the crisis. Banks with large committed credits or guarantees would tend to constrain the expansion of their loan portfolio since they already committed to a significant amount of credits. Furthermore, large off-balance sheet exposures imply that during a crisis the committed credits or guarantees are exercised, inducing a larger growth in leverage than if the banks had fewer commitments.

As an additional remark, this result links directly to the new Basel III capital regulations. Since these introduce an off-balance sheet augmented leverage ratio we can, on the one hand, expect a lower absolute exposure to off-balance sheets simply due to the regulation itself. On the other, we might also see a more important deleveraging process as the counter-cyclicality induced through the diminished off-balance exposure is reduced.

However, Basel III intends to reduce maturity mismatches and thereby limits the likelihood of forced deleveraging. For example, the increases in credit have, up to now, come through increasing short-term deposits. This increase in short-term deposits will be penalized through Basel III and banks will need to seek greater internal funding.

As a final point, the Luxembourgish banking sector may benefit from Basel III not only through increasing resilience but also through its functioning as a liquidity provider. For example, since the interbank market gets penalized by Basel III but these regulations are to be calculated at the consolidated level, then this could increase the demand for credits from branches in Luxembourg.

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5 APPENDIX

Table 2 – *Variable definitions*

Variable	Definition
$g(LEV_{it})$	Growth in leverage (leverage is assets/own funds) of bank i at time t (source: own calculations, statistical tables of BCL)
$g(L_{it})$	Growth in loans of bank i at time t (source: own calculations, statistical tables of BCL)
$g(D_{it})$	Growth in deposits of bank i at time t (source: own calculations, statistical tables of BCL)
$g(S_{it})$	Growth in securities (debt securities and shares) of bank i at time t (source: own calculations, statistical tables of BCL)
$spread_t$	spread between Euribor 3 month and Eonia (source: ECB statistical warehouse)
ESI_t	Economic Sentiment Indicator, calculated as average of Belgium, France, Germany and Luxembourg (source: European Commission, Business and Consumer Confidence Surveys)
$bond_t$	Bank of America Merrill Lynch 10+ Year Euro Financial Index (source: Bloomberg)
$g(EU\ GDP_t)$	Growth of EU GDP (source: ECB statistical warehouse, seasonally adjusted)
$\log(L_{it}/D_{it})$	logarithm of the loans-to-deposits ratio (source: own calculations, statistical tables of BCL)
Liq_{it}/A_{it}	ratio of liquid assets to assets. Liquid assets include cash, securities and quoted shares. (source: own calculations, statistical tables of BCL)
OB_{it}/A_{it}	ratio of off-balance sheet items to assets. The off-balance sheet items include committed credits, guarantees and liquidity facilities (like NIF's, RUF's) (source: own calculations, statistical tables of BCL)
C_t	crisis dummy = 1 for 2007 Q4 - 2010 Q1
B_i	dummy = 1 if the bank is a branch (source: own calculations)

Table 3 – *Summary statistics*

Variable	Obs.	Mean	Std. Dev.	Min.	Max.
g(LEV)	3152	-0.011	0.18	-0.988	0.689
g(L)	3152	0.004	0.189	-0.954	0.665
g(D)	3152	0.004	0.179	-0.986	0.689
g(S)	2586	-0.012	0.21	-1	0.994
$\log(L_{it}/D_{it})$	3152	-0.035	0.553	-2.719	5.67
Liq/A	3152	0.167	0.214	0	0.921
OB/A	3152	0.108	0.201	0	1.978
bond	3152	121.86	11.24	96.38	138.08
ESI	3152	98.5	11.1	69.1	115.7
g(EU GDP)	3152	1.139	2.381	-5.18	3.56
spread	3152	0.377	0.286	0.05	1.04
B	3152	0.193	0.394	0	1
C	3152	0.363	0.481	0	1

Table 4 – *Cross-correlations of macroeconomic variables*

Variables	bond	ESI	g(EU GDP)	spread
bond	1.000			
ESI	0.635	1.000		
g(EU GDP)	0.665	0.920	1.000	
spread	-0.753	-0.276	-0.278	1.000

Table 5 – *Cross-correlations of bank-specific controls*

Variables	log(L(t-1)/D(t-1))	Liq(t-1)/A(t-1)	OB/A	branch	C
log(L(t-1)/D(t-1))	1.000				
Liq(t-1)/A(t-1)	-0.554	1.000			
OB/A	-0.047	-0.023	1.000		
B	-0.023	-0.058	0.027	1.000	
C	0.033	-0.050	0.012	-0.039	1.000

Table 6 – *Specification choice for securities*

VARIABLES	(1) g(S)	(2) g(S)	(3) g(S)	(4) g(S)	(5) g(S)
Model	OLS	FE	OLS	FE	HT
g(S(t-1))	-0.000177	-0.000147			
	(0.000216)	(0.000218)			
log(L(t-1)/D(t-1))	0.00127	-0.0433	-0.000492	-0.0502	-0.0495
	(0.0119)	(0.0315)	(0.0118)	(0.0311)	(0.0307)
Liq(t-1)/A(t-1)	0.0651**	-0.233***	0.0653**	-0.240***	-0.216***
	(0.0282)	(0.0703)	(0.0280)	(0.0700)	(0.0688)
OB(t-1)/A(t-1)	-0.0259*	-0.00639	-0.0240*	-0.00503	-0.00370
	(0.0138)	(0.0153)	(0.0137)	(0.0153)	(0.0152)
log(L(t-1)/D(t-1))*C	0.00168	0.0225	0.00435	0.0253	0.0260
	(0.0209)	(0.0232)	(0.0208)	(0.0231)	(0.0228)
Liq(t-1)/A(t-1)*C	-0.110**	-0.117**	-0.109**	-0.115**	-0.115**
	(0.0469)	(0.0503)	(0.0467)	(0.0501)	(0.0496)
OB/A *C	0.0948***	0.0865***	0.0932***	0.0843***	0.0872***
	(0.0287)	(0.0299)	(0.0286)	(0.0298)	(0.0295)
B	0.0195		0.0191		0.0144
	(0.0119)		(0.0118)		(0.0252)
C	0.00859	-0.00474	0.00812	-0.00517	-0.000902
	(0.0120)	(0.0123)	(0.0119)	(0.0123)	(0.0121)
Constant	-0.0423***	0.0206	-0.0432***	0.0210	0.00892
	(0.0107)	(0.0157)	(0.0106)	(0.0157)	(0.0179)
Seas. dummies	yes	yes	yes	yes	yes
Observations	2,575	2,575	2,586	2,586	2,586
R-squared	0.014	0.024	0.014	0.025	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 – *The full model*

VARIABLES	(6) g(LEV)	(7) g(LEV)	(8) g(LEV)	(9) g(L)	(10) g(D)	(11) g(S)
Model	OLS	FE	sysGMM	sysGMM	sysGMM	HT
g(LEV(t-1))	-0.131***	-0.175***	-0.134***			
	(0.0181)	(0.0248)	(0.0280)			
g(L(t-1))				-0.150***		
				(0.0351)		
g(D(t-1))					-0.122***	
					(0.0269)	
log(L(t-1)/D(t-1))	-0.0198**	-0.0247	0.0123	0.0309	-0.00955	-0.0551*
	(0.00951)	(0.0374)	(0.0466)	(0.0652)	(0.0443)	(0.0294)
Liq(t-1)/A(t-1)	-0.0374*	-0.0834	0.0843	-0.0331	0.136	-0.221***
	(0.0225)	(0.0780)	(0.122)	(0.203)	(0.118)	(0.0685)
OB(t-1)/A(t-1)	-0.00443	-0.000867	-0.0109***	-0.00922*	-0.0153**	-0.00143
	(0.0114)	(0.00979)	(0.00418)	(0.00477)	(0.00608)	(0.0151)
log(L(t-1)/D(t-1))*C	0.0340**	0.0385**	-0.0321	-0.0719	-0.0744	0.0237
	(0.0138)	(0.0169)	(0.0482)	(0.0720)	(0.0661)	(0.0228)
Liq(t-1)/A(t-1)*C	0.0735**	0.0753**	0.00114	-0.0538	-0.319**	-0.127**
	(0.0369)	(0.0379)	(0.109)	(0.203)	(0.146)	(0.0517)
OB(t-1)/A(t-1)*C	0.0499**	0.0547***	0.104***	0.108**	0.0952**	0.0855***
	(0.0218)	(0.0191)	(0.0207)	(0.0529)	(0.0376)	(0.0297)
B	-0.000221		0.00352	-0.000270	-0.0134	0.0153
	(0.00800)		(0.0107)	(0.0109)	(0.0136)	(0.0257)
C	0.0455	-0.0176	0.185	-0.0109	0.638**	0.944**
	(0.315)	(0.284)	(0.326)	(0.379)	(0.321)	(0.396)
ESI	-0.00110	-0.00119	2.88e-06	-0.00115	0.00228	0.00521**
	(0.00187)	(0.00168)	(0.00194)	(0.00202)	(0.00180)	(0.00232)
ESI*C	0.00501**	0.00505**	0.00428*	0.00651***	0.00167	-0.00758**
	(0.00235)	(0.00205)	(0.00228)	(0.00246)	(0.00216)	(0.00296)
g(EU GDP)	-6.67e-05	-0.000741	-0.00464	0.00331	-0.00854	-0.0218*
	(0.00915)	(0.00835)	(0.00936)	(0.00955)	(0.00893)	(0.0114)
g(EU GDP)*C	0.00120	0.00181	0.00588	0.000309	0.0106	0.0240*
	(0.0106)	(0.0103)	(0.0114)	(0.0114)	(0.00975)	(0.0134)
spread	0.0995***	0.0938***	0.0849**	0.0648*	0.0973***	-0.0252
	(0.0323)	(0.0317)	(0.0332)	(0.0386)	(0.0321)	(0.0406)
spread*C	-0.0541	-0.0372	-0.0378	-0.0816	-0.109**	0.00715
	(0.0480)	(0.0498)	(0.0569)	(0.0741)	(0.0550)	(0.0616)
bond	0.00147	0.00140*	0.00168*	0.000471	0.00289***	0.00382***
	(0.00107)	(0.000838)	(0.000936)	(0.00103)	(0.00108)	(0.00133)
bond*C	-0.00510***	-0.00475***	-0.00569***	-0.00548***	-0.00640***	-0.00137
	(0.00162)	(0.00163)	(0.00168)	(0.00181)	(0.00151)	(0.00206)
Constant	-0.0673	-0.0373	-0.216	0.0797	-0.621**	-0.972***
	(0.280)	(0.234)	(0.277)	(0.293)	(0.286)	(0.348)
Seas. dummies	yes	yes	yes	yes	yes	yes
Observations	3,152	3,152	3,152	3,152	3,152	2,586
R-squared	0.055	0.069				
Number of bank		153	153	153	153	136
No. instruments			48	31	100	
AR(1) p-val.			0	0	0	
AR(2) p-val			0.985	0.697	0.389	
Sargan p-val.			0.290	0.0120	3.14e-05	
Hansen p-val.			0.166	0.321	0.545	

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 8 – *Marginal effects in crisis period*

Model	Dep. var.	$\log(L/D)$	Liq/A	OB/A	bond	ESI	g(EU GDP)	spread
		Explanatory variables						
(8)	g(LEV)	-.0198	.085	.0935***	-.004***	.0042***	.0012	.047
		(.0215)	(.0786)	(.0188)	(.0013)	(.0016)	(.0073)	(.054)
(9)	g(L)	-.041	-.0869	.0983*	-.005***	.0053***	.0036	-.0168
		(.0295)	(.087)	(.051)	(.0013)	(.0016)	(.007)	(.062)
(10)	g(D)	-.0839**	-.183*	.08**	-.0035***	.0039***	.002	-.012
		(.0405)	(.1059)	(.035)	(.0011)	(.0014)	(.006)	(.0518)
(11)	g(S)	-.0313	-.348***	.084***	.0024	-.0023	.002	-.018
		(.0273)	(.068)	(.0279)	(.0015)	(.0019)	(.0076)	(.048)

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1