2 THE IMPACT OF THE BASEL III LIQUIDITY REGULATIONS ON THE BANK LENDING CHANNEL IN LUXEMBOURG [1]

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1 INTRODUCTION

The recent financial crisis uncovered the importance of liquidity positions and maturity mismatches in banks' portfolios. This led to a widespread agreement that there is a need for closer monitoring of the financial sector and for an improvement in the standards and regulatory practices. The Basel Committee on Banking Supervision (BCBS) recognizes the need for further regulatory action and suggests the introduction of the Liquidity Coverage Ratio (LCR) and the Net Stable Funding ratio (NSFR) (Basel Committee BIS (2010)). These ratios address the resilience of the liquidity risk profile of banks by building upon the main lessons of the financial crisis 2007-2010.

As the liquidity risk regulations are likely to induce behavioral changes that will be reflected in the composition of banks' balance sheets, one can expect an effect on monetary policy transmission. Thus, in this article we study how the new Basel III liquidity regulations are likely to alter the bank lending channel of monetary policy transmission [2] in Luxembourg.

The innovations presented in this paper are as follows. Firstly, this study is the first that assesses the bank lending channel using Luxembourg bank level data. Secondly, we estimate and analyze the LCR and NSFR using individual bank data for a representative sample of the Luxembourgish banking sector. Thirdly, this study is the first one, to the authors' knowledge, that quantitatively analyzes the impact of the new liquidity standards on the monetary policy transmission mechanism.

We start off by estimating the effect of the Basel III liquidity regulations on monetary policy transmission using historical individual bank data for a sample of banks covering between 82% and 100% of total assets of the banking sector in Luxembourg from 2003q1 to 2010q4. Under the assumption of imperfect information the bank lending channel operates when, after a policy-driven increase in short-term interest rates, banks are not able to compensate the reduction of core deposits with alternative sources of funding inducing then a reduction in the assets. This is likely to be the case for banks that hold neither sufficient liquidity nor capital buffers, or for small banks with a worse prospect to access wholesale funding markets [3]. Therefore, we study the role of the bank characteristics that have been identified in the literature as being important for monetary policy transmission and add new ones which we derive based on the LCR and NSFR.

Our analysis based on the historical data remains valid in the case that the introduction of the regulations does not induce significant changes to the balance sheet of banks. However, the objective of the regulations is exactly the opposite. The historical balance sheets might, thus, only provide limited information on the way that the LCR and NSFR would change monetary policy transmission, and the information is bound to be less correct the larger the impact of the regulations on banks' balance sheets. In order to get an idea of how large the impact of the regulations on banks is likely to be, we simulate banks' balance sheets by maximizing banks' profits subject to the balance sheet constraints and the requirements of the new regulations. We then use this simulated data to study how the monetary policy transmission would have

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1 This contribution is a non-technical summary of a forthcoming BCL working paper.

2 The economic literature provides an extensive analysis of the mechanism underlying the transmission of monetary policy to the real economy. Surveys are available in Bernanke and Getler (1995), Ceccheti (1995).

3 See, among others, Angeloni et al. (2003), Kashyap and Stein (1995), Ehrmann et al. (2002), Kishan and Opiela (2000) and Chatelain et al. (2003), Peek and Rosengren (1995).

been if the regulations had already been put in place prior to the crisis. This exercise is different from the regressions and predictions based on the historical data since we take into account the optimal balance sheet adjustments induced by the regulations.

Our results are as follows. We find a significant role for the bank lending channel in Luxembourg, which mainly works through small banks with a large shortfall in the NSFR. Thus, small banks that are suffering from relatively large maturity mismatches and that are relatively under-capitalized, as measured by the NSFR shortfall, are those that are most affected by a contractionary monetary policy shocks. We also show that big banks are able to increase their lending following a policy-driven increase in the short-term interest rate. This result confirms that Luxembourgish banks are liquidity providers to the market[4]. Additionally, we provide a more detailed description of the underlying mechanism of the bank lending channel in Luxembourg by disaggregating the shortfalls into their components (i.e. the stock of high quality liquid assets, the net outflows, the required stable funding and the available stable funding). The results suggest that indicators of the width of the funding bases (i.e. net outflows, available stable funding) are more relevant bank characteristics for the identification of the bank lending channel in Luxembourg than qualifiers on the assets (e.g. liquidity).

These results, firstly, qualify further on previous findings in studies for other European countries that do not find that the size of a bank is a relevant characteristic for explaining distributional effects of monetary policy shocks[5]. We show that a bank's size is a significant driver of monetary policy distributional effects but only if one also takes into account the current liquidity and maturity mismatch structure of a bank itself.

Our findings regarding the impact of the new liquidity regulations lead us to the conclusion that the relevance of the bank lending channel is likely to be abridged as banks make their way to compliance. Adhering to the NSFR may reduce the reaction of the loan supply to monetary policy shocks more strongly than complying with the LCR. This was to be expected as any reduction in the maturity mismatch of banks strengthens the bank's position to cope with funding run-offs. In any case we find that, once banks adhere to both ratios, the bank lending channel will no longer be effective in Luxembourg.

The article is organized as follows. In section 2 we discuss the LCR and NSFR more deeply in order to understand how they relate to monetary policy transmission. Section 3 describes the data and the empirical specification of the econometric model. The estimation results are presented in Section 4, while Section 5 concludes.

2 BASEL III LIQUIDITY REGULATION AND MONETARY POLICY TRANSMISSION MECHANISM

Here we discuss the potential roles that the LCR and NSFR would have in altering the impact of monetary policy on bank lending.

The LCR requires that banks hold high quality liquid assets to meet liquidity needs over a 30-day time horizon under an acute liquidity stress scenario (BIS (2010), p.1). The Basel committee's regulation then demands that banks have an LCR that exceeds one, suggesting that the stock of high-quality liquid assets

4 In case of Luxembourg, interbank lending mainly refers to intra-group lending activities as Luxembourg's banks are not strongly active in the international interbank market. All along the paper we will interchangeably use interbank and intra-group activities.

5 A series of studies has been devoted to measuring the relevance of the bank lending channel in the Euro Area (Angeloni, Kashyap and Mojon, 2003). Although a common finding to each country-level study is that a bank's size is not a relevant characteristic for identifying the bank lending channel, there are also country-wide differences underlying this result (see Ehrmann et al.; Worms; Hernando and Martinez-Pagés; Loupins, Sauvignac and Sevestre; Gambacorta in Angeloni, Kashyap and Mojon, 2003). More recent studies have analyzed the implications of new practices, namely securitisation, market funding and financial innovation, on the bank lending channel (Altunbas et al. (2009), Loutskina and Strahan (2009), Hirtle (2008)). Their findings show that these practices have helped banks to isolate their asset portfolio from monetary policy shocks.

(HQLA) covers the net outflows (NO). Thus, the LCR shortfall is given by: LCR $shortfall_{it} = NO_{it} - HQLA_{it}$. The HQLA encompasses cash, high-quality securities and government debt. One would expect that banks with more HQLA are, *ceteris paribus*, more liquid banks and, therefore, be able to more easily offset monetary policy shocks through selling their liquid assets. The NO encompasses the entire expected outflow minus the expected inflow of money during one month. The main focus of the Basel Committee's definition of Outflows is on stable versus unstable deposit financing and off-balance sheet activities. Funding from unstable sources receives a higher run-off factor in the definition of NO than stable funding. Similarly, the Inflows compound different sources of revenues within the 30-day horizon. In order to encourage banks to hold higher HQLA, the Inflows are bounded at 75% of the Outflows. On the one hand, one would expect that a bank with higher NO faces a higher external finance premium because of the presumed lower resiliency of the bank's short-term liquidity risk profile. On the other hand, since bigger Outflows imply a bigger funding base due to a wider access to wholesale funding, one would expect that, during non stress periods, NO might be positively related to the ability of the bank to compensate for a reduction of core deposits[6].

The NSFR requires a minimum of stable funding over a one-year horizon (BIS (2010), p.1). Thus, one could say that the NSFR focus is on a bank's maturity mismatch. As the NSFR ratio should exceed one, the shortfall is given by: $NSFR\ shortfall_{it} = Required\ Stable\ Funding_{it} - Available\ Stable\ Funding_{it}$. The Available Stable Funding (ASF) consists of capital, liabilities with maturity greater than a year or those that are expected to be stable during a crisis. The amount of Required Stable Funding (RSF) places more weight on those assets that are less liquid during stress periods and therefore require a more stable source of funding. One would expect that the loan supply of those banks with a higher NSFR will be less responsive to monetary policy. Firstly, given that a bank's capital is one of the components of the available stable funding, a higher NSFR might be associated with less reliance on outside funding and a lower external finance premium. Secondly, the bigger the ASF the larger a bank's stable funding base which increases the resiliency of a bank to liquidity shocks. Additionally, banks that have a higher amount of ASF are, *ceteris paribus*, less subject to maturity mismatch. Finally, the amount of RSF consists mainly of long-term assets (i.e. exceeding one year) and loans to retail clients or non-financial corporate clients of maturity less than one year. It also includes off-balance sheet exposures. A bank with assets that have a maturity structure that tends to be longer is more likely to face significant maturity mismatch risk and might face a higher external finance premium.

3 THE MODEL SPECIFICATION AND THE DATA

The empirical specification, based on the standard literature for identifying the bank lending channel, is designed to test whether banks that show different balance sheet structures react differently to monetary policy shocks. This approach is in line with the works conducted by the ECB on monetary policy transmission (see Angeloni et al. 2003). Our contribution is to use, as additional bank characteristics, the shortfalls in the LCR and NSFR.

$$\Delta \log(L_{it}) = \alpha_i + \beta_1 \Delta \log(L_{i,t-1}) + \beta_2 \Delta r_t + \beta_3 \Delta \log(GDP_{t-1}) + \sum_{h=1}^{z} \beta_{4h} x_{ih,t-1} + \sum_{h=1}^{z} \beta_{5h} x_{ih,t-1} \Delta r_t +$$

$$+ \beta_6 \prod_{h=1}^{z} x_{ih,t-1} \Delta r_t + c_t + \varepsilon_{it} \qquad (1)$$

where $i=1,...,N$ and $t=1,...,T$ and where N denote the number of banks and T the number of quarters in the sample. L_{it} are the total loans of bank i in quarter t. Δr_t is the first difference of a nominal short-term

6 Given the cap on inflows, the relationship between the Outflows and the NO is expected to be monotonic.

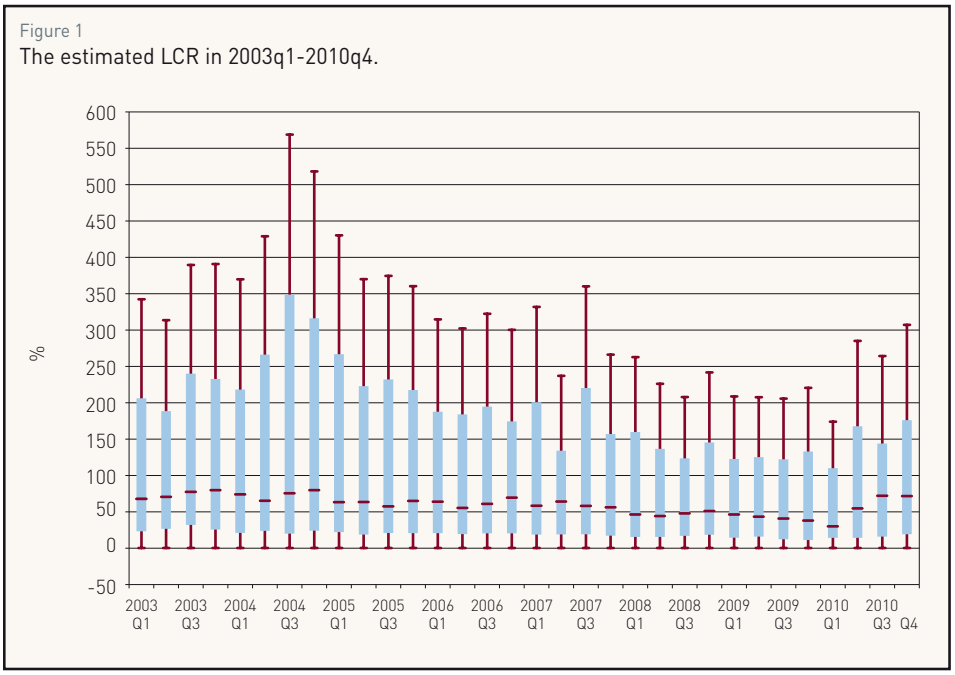
interest rate, and represents a proxy for the change in monetary policy. $\Delta\log(GDP_{t-1})$ is the growth rate of the Luxembourgish real GDP, which allows us to control for the evolution of loan demand. The dummy variable c_t equals one for those quarter within the last liquidity crisis period[7] and zero otherwise. The lagged bank-specific characteristic h are given by $x_{ih,\ t-1}$. We include an interaction term between bank characteristics and the change in the level of monetary policy indicator aiming at testing for non-linear reactions of banks to monetary policy shocks. All bank characteristics are calculated as shares of total assets. Finally, the model allows for individual fixed effects in the error term ε_{it}.

We consider as bank characteristics the ratios of the LCR and NSFR estimated shortfalls over total assets and their components (i.e. the stock of HQLA, NO, ASF and RSF). Additionally, we follow the literature by considering indicators of size (i.e. the logarithm of total assets), capitalization (i.e. the ratio of capital over total assets) and liquidity (i.e. the ratio of HQLA over total assets[8]).

In this study we make use of data from the statistical reporting of banks to the Banque Centrale du Luxembourg. We build an unbalanced panel for the period spanning 2003q1 to 2010q4 and have quarterly observations on balance sheet characteristics for a maximum of 157 banks per quarter (and a minimum of 68 banks)[9]. Our monetary policy indicator comes from the ECB Statistical Warehouse and is the Euribor 3 month interest rate.

In order to identify the bank lending channel of monetary policy transmission, standard practice considers the loans to non-financial corporates and retail customers in the econometric analysis. We deviate from that by using total loans. Since NFC and retail loans of Luxembourgish banks only add-up to less than 14% of total assets and less than 18% of total loans, the standard practice would give a constrained picture of the ECB monetary policy transmission through Luxembourg's banking sector. In the case of Luxembourg, combining loans granted to different sectors is likely to be neutral for the analysis of monetary policy transmission as they tend to react similarly to a monetary policy shock.

Figure 1
The estimated LCR in 2003q1-2010q4.



Source: BCL, authors' calculations

In the following paragraphs we take a closer look at the evolution of the Luxembourgish banks' positions regarding the LCR and NSFR in the period spanning 2003q1 to 2010q4. Figures 1 and 2 show, respectively, the evolution of the quartiles of LCR and NSFR. A distinction should be made for the last three periods of the series because of the changes in the sample that followed the modifications in the reporting rules (see footnote 9). The median of the LCR declined from a maximum

7 We consider 2007q3 as the starting quarter which corresponds to the beginning of the financial turbulence (ECB Monthly Bulletin, 2010).

8 We consider a more restrictive definition of liquid assets than in the mainstream literature in other to fit to the definition of liquid assets required in the LCR. It is worth to note that underlying the LCR components there is the BCBS's acute stress scenario.

9 In the last three quarters we make use of a sample of banks representing between 82% and 95% of the sector's total assets. This is due to a change in the reporting rules of the Eurosystem of Central Banks which made the statistical reporting non-mandatory for small banks.

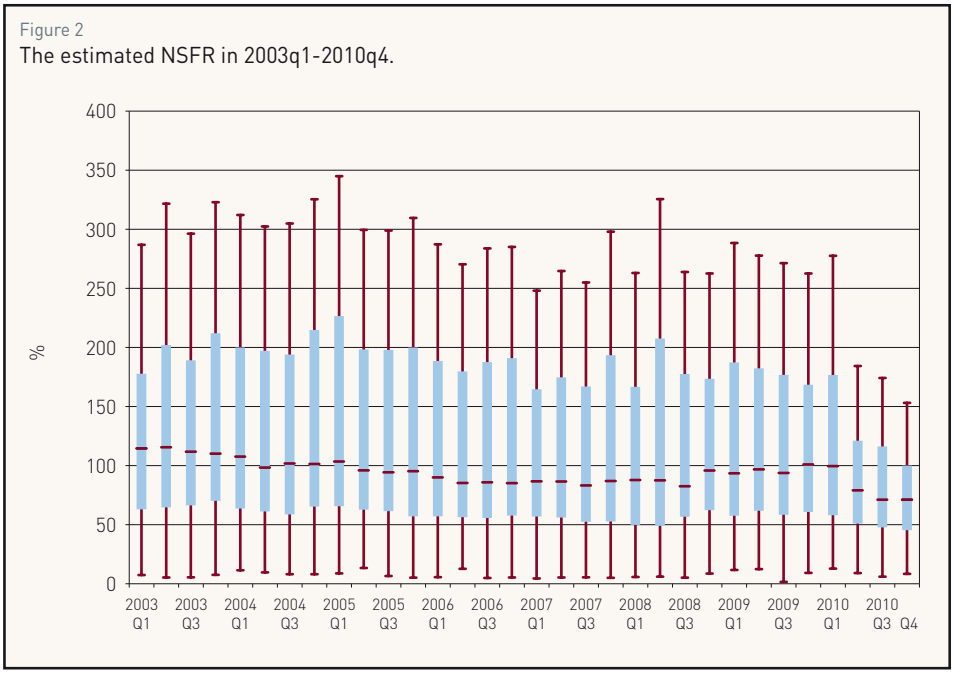
of 80% in 2003q4 to a minimum of 30% in 2010. Currently it stands at 71%, but potentially due to the reduced sample. In the aftermath of the crisis the LCR started to recover essentially due to big banks. The median of the NSFR was initially above 100% before 2005, but declined continuously until the start of the crisis to a level of 80%. It then recovered mainly due to small banks.

It is worth noting the significant differences in the median of the LCR and NSFR between big and small banks. Big banks fare better in terms of the LCR but worse in terms of the NSFR. This can be attributed to several crucial differences in terms of balance sheet characteristics (see Table 1 below). Big banks' average growth rate of loans is higher than the one of small banks. Small banks[10] have a higher ratio of LCR shortfall over total assets than big banks, mainly because of the differences in the ratio of HQLA over total assets rather than in the NO ratio. Conversely, the NSFR shortfall is lower for the smaller banks because of the differences in both the RSF and ASF. Small banks are also better capitalized than big banks.

We perform a simulation exercise in order to assess the optimal balance sheet adjustments that compliance with the LCR and NSFR would require. The simulated model[11] assumes that, in each period and given a vector of prices and adjustment costs, the banks maximize profits by selecting the amount of total loans, Level 1 and Level 2 securities (i.e. securities to be included in the stock of high quality liquid assets of the LCR[12]), capital (i.e. Tier 1 capital), and different categories of deposits, under the constraint of complying with the LCR, NSFR and leverage requirements[13]. The categories of deposits fit the definition of the cash outflows by counterparties of the LCR[14].

The outcome is summarized in Table 1. It presents the average values, by quartiles of size, of the components of the standards, namely the ratios of HQLA, NO, ASF and RSF over total assets, as well as the share of the shortfalls in LCR and NSFR over total assets and the leverage ratio. On average, banks in the third and fourth quartiles of total assets mainly increase the ASF rather than reducing the RSF in order to adhere to the NSFR requirements. Regarding the LCR, moderate changes in the HQLA and the NO suffice for these important banks for complying. The most sizable changes are undertaken by medium-sized banks with increases in basically all components of the LCR and NSFR while small banks need to increase both their HQLA and their RSF.

Figure 2
The estimated NSFR in 2003q1-2010q4.



Source: BCL, authors' calculations

10 We consider as small (big) banks those in the first (fourth) quartile of the total assets distribution. Medium-sized banks are those in the second and third quartiles.

11 See Kopecky and VanHoose (2004) for applications of a similar approach.

12 See items 39 to 42 in BIS (2010).

13 The details of the optimization program and the simulation procedure are available under request.

14 See items 54 to 83 in BIS (2010).

Table 1:
Average of the components of the shortfalls over total assets, by quartiles of total assets. Historical and Simulated data.

	Quartiles of Size	Shortfall						
		LCR	NSFR	HQLA	NO	ASF	RSF	Capital
Historical Data	1	0.029	-0.156	0.042	0.071	0.456	0.300	0.088
	2	0.062	0.024	0.048	0.110	0.302	0.326	0.035
	3	0.054	0.067	0.036	0.090	0.296	0.363	0.030
	4	-0.025	0.146	0.082	0.056	0.267	0.412	0.021
	Total	0.030	0.020	0.052	0.082	0.330	0.350	0.043
Simulated Data	1	-0.087	-0.030	0.133	0.047	0.528	0.498	0.506
	2	-0.122	-0.100	0.163	0.041	0.549	0.449	0.396
	3	-0.041	-0.140	0.085	0.044	0.451	0.311	0.108
	4	-0.060	-0.040	0.098	0.037	0.367	0.327	0.076
	Total	-0.080	-0.075	0.122	0.042	0.477	0.402	0.284

Sources: BCL, authors' calculations

4 ESTIMATION RESULTS

In this section we present the results of the econometric estimation of alternative specifications of the model of equation 1 [15]. In our estimation we resort to GMM type estimators since we include the lag of the dependent variable and other potentially endogenous variables as regressors (Holtz et al., 1988; Arellano and Bond, 1991; Arellano and Bover, 1995; Blundell and Bond, 1998).

4.1 Monetary Policy Transmission

This section is based on the historical data series. We will present the estimated long-term marginal effects of a contractionary monetary policy shock on the growth rate of total loans and discuss the underlying economic intuition.

We firstly analyze the monetary policy effects using the specification that combines the shortfalls in both ratios. The bank lending channel in Luxembourg works through the smallest banks with a large shortfall in the NSFR. On average, banks in the first quartile of total assets and in the last quartile of the NSFR shortfall over total assets reduce total loans by 0.169% after an increase of one percentage point of the short-term interest rate. This result prevails since banks with a lack of stable funding are prone to lose funds following a contractionary monetary policy shock. Moreover, if these banks are small it would be harder for them to access alternative sources of funding.

Further, our estimation reveals that medium-to-small sized banks do not react to monetary policy shocks, while medium-to-big and big banks with a small NSFR-shortfall increase their loans by 0.119%. The explanation for the positive reaction of bigger banks' loan supply following a tightening in the monetary policy is that Luxembourg's banking sector plays the role of a liquidity provider within their group. A stricter monetary policy increases the demand for funds which is partly satisfied by an increase in loans from Luxembourg's banks. In addition, larger banks also tend to have a better access to short-term wholesale funding.

We turn now to the analysis of models disaggregating the shortfalls into their components. The analysis of the long-term marginal effects indicates that liquidity is not a relevant characteristic for the identification of the bank lending channel in Luxembourg. In contrast, the long-term marginal effects of a contractionary

15 The econometric results presented in the following sections are based on specifications that do not include the growth rate of Luxembourg's GDP or any other variable potentially related to the demand for loans because of their high correlation with the changes in the short-term interest rates. The correlation coefficient between a lag of the growth rate of Luxembourg's GDP and the change in the short-term interest rate equals 0.65.

monetary policy shock are significantly higher for big banks with a low ratio of HQLA (0.074%) than for big banks with high HQLA (0.004% and not significantly different from zero). This suggests that HQLA do not play the fundamental role of safeguarding the portfolios against liquidity problems. Clearly, banks with few HQLA are those that are more active on the market for loans and tend to function as liquidity providers. Conclusively, they are more likely to react positively to monetary policy shocks. However, small banks mainly funded by unstable sources (i.e. big net outflows) are better prepared to cushion monetary policy shocks than other small banks with more limited NOs. The average long-term marginal effect of a contractionary monetary policy shock is equal to -0.120% for the former banks but it is not significantly different from zero for the latter banks. Conversely, the ability of medium and big-sized banks to shelter monetary policy shocks is reduced the bigger are the NOs. Intuitively, larger funding bases prevent contractions of the loan supply more robustly than a bigger stock of HQLA may do. Furthermore, as big banks tend to have a higher leverage ratio compared to small ones, exceedingly unstable funding bases tend to overcompensate, for such banks, the positive effect of bank size.

Finally, we analyze a specification that includes the components of the NSFR shortfall (i.e. ASF and RSF) as regressors. The results are consistent with previous ones but, the exclusion of the LCR shortfall in this specification may have biased downwards the reaction of small banks toward a monetary policy tightening. The long-term marginal effects of a monetary policy contractionary shock estimated for small banks using this specification are significantly lower (the average long-term marginal effect for banks in the first quartile of total assets equals -0.243%). This highlights the fundamental role that short-term wholesale funding plays in helping small banks to cushion monetary policy shocks. As expected the availability of stable funding prevents total loans to diminish after a monetary policy shock and higher amounts of RSF enhance the transmission of contractionary monetary policy shocks. Nevertheless, the negative effect from RSF overcomes the positive effect from ASF for banks which are big enough or for those with an exceedingly high RSF ratio.

4.2 The impact of compliance with the new standards on the bank lending channel

In order to understand the potential impact of compliance with the Basel III regulations we perform three complementary analyses in this sub-section. As a benchmark we use the results from the specification that combines the shortfalls in both ratios to calculate the elasticities of the long-term marginal effects of a contractionary monetary policy shock. This allows us to argue, in a qualitative way, how the Basel III regulations might impact the bank lending channel. Then we predict the long-term marginal effects of a monetary policy shock (also calculated relying on the same specification) by extrapolating the previous results assuming that banks adhere to the regulations. In addition, we predict the long-term marginal effects of a monetary policy shock by making use of the model that combines the components of LCR and NSFR shortfalls and of the simulated balance sheet data. Finally, we use the simulated data to estimate the long-term marginal effects of a monetary policy shock directly.

4.2.1 Analysis based on historical data

Table 2 depicts the elasticities of the long-term marginal effects of a contractionary monetary policy shock with respect to changes in the shortfalls. The analysis of the elasticities allows us to conclude that complying with the NSFR would reduce the importance of the bank lending channel in Luxembourg (the elasticities are significantly negative and significant for all the quartiles but the fourth one). However, complying with the LCR is likely to enhance the relevance of the bank lending channel such as it currently operates in Luxembourg (the elasticities are negative for the first two quartiles but positive for the last two)[16]. The intuition of this result is straight-forward if we take into consideration the fact that a higher LCR

16 These effects are slightly statistically non-significant (p-value = 0.102), we will analyze them as if they were fully significant. The p-values are equal for every quartile because the calculation of the long-term marginal effect engages only two estimated coefficients.

shortfall is related to a larger funding base relative to the holdings of HQLA. Thus, complying with the LCR would tend to reduce the availability of funds to feed the growth of loans.

Table 2:
Average elasticities of the Long-term marginal effect of monetary policy contractionary shock with respect to the shortfall in each ratio.

	Quartiles of LCR shortfall				
	1	2	3	4	Total
Elasticities with respect to NSFR shortfall	-3.676	-7.556	-3.332	-0.736	-3.825
p-value	0.053	0.053	0.058	0.222	0.096
	Quartiles of NSFR shortfall				
	1	2	3	4	Total
LCR shortfall	-0.544	-0.738	0.379	0.796	-0.027
p-value	0.102	0.102	0.102	0.102	0.102

Sources: BCL, authors' calculations

We turn now to the quantitative analysis of the impact on the bank lending channel of the compliance strategy that banks would have to implement in order to adhere to the standards. Also relying on the same specification, we simulate the long-term marginal effect of a one point increase in the short-term interest rate assuming that banks comply, respectively, with the LCR but not with NSFR, and with the NSFR but not with the LCR. There is no particular assumption about the strategy a bank would implement to comply with the each standard, the positive shortfalls are simply, *ceteris paribus*, set to zero. We performed t-student test in order to compare the statistical significance of the differences observed between the estimated long-term marginal effects of a contractionary monetary policy shock and the simulated ones. The results of these tests confirm the conclusion of the analysis on the marginal effects' elasticities with respect to the NSFR shortfall. However, the predicted enhancement of the banks' reaction to a monetary policy shock after complying with the LCR standard, as measured by the simulated long-term marginal effects, is not as significant as the elasticities have suggested.

4.2.2 Prediction on simulated data

A potential limitation of the previous analysis lies in the neutrality assumption of the balance sheet ad-hoc modifications adopted to reach compliance with the standards, i.e. there is no substitution effect on other balance sheet components. In order to overcome this weakness, we predict the long-term marginal effect of a monetary policy shock by using the balance sheet figures resulting from the simulation exercise described above. The results indicate that the bank lending channel in Luxembourg would not be strongly affected after compliance with the liquidity standards. The marginal effects are smaller in absolute terms but continue to be statistically significantly different from zero. Moreover, the marginal effect for small banks with a lower NSFR shortfall remains almost constant but statistically significant after compliance (i.e. -0.073%). Conversely, big banks will tend to see their ability to shelter monetary policy shocks slightly improved (i.e. 0.085% after compliance versus 0.078% before). Two reasons, related to the optimal adjustments prescribed by the simulation exercise, are underlying this result. First, the LCR shortfall will be lower and even negative for most banks, pushing-up the marginal effects. Secondly, compliance with NSFR seems to be achieved by increasing the ASF rather than reducing the RSF, sustaining the negative impact of a contractionary monetary policy shock for small banks. However, it is likely that banks with extremely high NSFR shortfall are also constrained to reduce the RSF in order to adhere to the NSFR. As previously stated, in our sample such banks are mainly the big ones.

4.2.3 Counterfactual analysis

We finally argue that complying with the new liquidity regulations might modify the mechanism of monetary policy transmission. Then, we adopt an alternative approach in order to estimate to which extent complying with the liquidity standards would affect the bank lending channel. We perform a counterfactual exercise that consists in fitting alternative specifications of equation 1, similar to the previously described regression models, but using bank level simulated data. The estimated long-term marginal effects of a contractionary monetary policy shock are exposed in Table 3. A general conclusion from the following analysis would be that the bank lending channel effectiveness for cooling down the economy is likely to be strongly limited after compliance with the standards.

Table 3:
Average Long-term Marginal Effect of Monetary Policy shock: counterfactual exercise.

	Quartiles of Size				
Quartiles	1	2	3	4	Total
of HQLA					
1	0.108	0.112	0.024	-0.022	0.045
	(0.161)	(0.120)	(0.280)	(0.197)	(0.207)
2	0.150	0.122	0.096	-0.053	0.069
	(0.053)	(0.186)	(0.230)	(0.240)	(0.176)
3	0.154	0.069	0.123	-0.062	0.070
	(0.038)	(0.175)	(0.168)	(0.233)	(0.140)
4	0.114	0.048	0.016	-0.066	0.029
	(0.165)	(0.173)	(0.412)	(0.232)	(0.239)
of NO					
1	0.088	0.065	-0.014	-0.073	0.022
	(0.167)	(0.132)	(0.344)	(0.244)	(0.218)
2	0.117	0.077	0.057	-0.050	0.040
	(0.069)	(0.133)	(0.266)	(0.187)	(0.174)
3	0.144	0.087	0.095	-0.044	0.062
	(0.034)	(0.137)	(0.270)	(0.273)	(0.188)
4	0.173	0.062	0.086	-0.038	0.090
	(0.076)	(0.283)	(0.251)	(0.190)	(0.181)
of ASF					
1	0.259	0.220	0.180	0.005	0.122
	(0.014)	(0.012)	(0.094)	(0.304)	(0.163)
2	0.140	0.113	0.030	-0.095	0.032
	(0.052)	(0.073)	(0.365)	(0.159)	(0.162)
3	0.087	0.050	0.012	-0.112	0.036
	(0.111)	(0.164)	(0.393)	(0.109)	(0.197)
4	0.100	0.050	-0.041	-0.073	0.024
	(0.144)	(0.245)	(0.350)	(0.217)	(0.238)
of RSF					
1	0.267	0.174	0.127	0.044	0.126
	(0.078)	(0.055)	(0.144)	(0.346)	(0.183)
2	0.171	0.102	-0.003	-0.081	0.027
	(0.031)	(0.132)	(0.434)	(0.199)	(0.192)
3	0.090	0.057	0.008	-0.121	0.032
	(0.104)	(0.136)	(0.363)	(0.089)	(0.148)
4	0.092	0.048	-0.019	-0.077	0.029
	(0.128)	(0.245)	(0.388)	(0.206)	(0.238)
Total	0.138	0.072	0.054	-0.050	0.053
	(0.084)	(0.166)	(0.285)	(0.226)	(0.190)

Note: p-values in parenthesis
Sources: BCL, authors' calculations

A visual inspection is enough to see the differences in the effects compared to those currently at work. Firstly, big banks are no longer able to cushion monetary policy shocks, as can be seen in the last row of Table 3 the effects are even negative though not significant. Small banks are better prepared after compliance with the standards to shelter a monetary policy tightening; 100 basic points increase in the short-term interest rate triggers an increase of 0.138% of the loan supply of small banks. Secondly, while NO continues to play a similar role as before compliance, HQLA tend to help small banks to better cushion the impact of the contractionary shock in monetary policy. In contrast, for bigger banks the sheltering effect is not significant. Finally, the higher the RSF ratio the lower the marginal effect.

The results confirm the previous statements; the effectiveness of the bank lending channel in Luxembourg tends to disappear. The striking result concerning the ability of small banks to protect their loan portfolio from a monetary policy tightening stems from the increase in their stock of HQLA which is positively related to the marginal effects, and from the softer burden that adhering to the NSFR imposes on them compared to big banks.

5 CONCLUSION

The aim of this article is to study the potential impact of the Basel III liquidity standards on monetary policy transmission through the bank lending channel in Luxembourg using bank level data.

A first contribution of this paper is the assessment of the relevance of the bank lending channel in Luxembourg. One of the innovations of this study is that, in addition to those bank characteristics usually considered in the literature, we test the potential explanatory power of the new liquidity standards for identifying distributional effects of monetary policy shocks. Our results indicate that the LCR and NSFR are vehicles of relevant information for identifying the bank lending channel. More precisely, we find that the bank lending channel in Luxembourg mainly works through small banks with a large shortfall in the NSFR.

Moreover, in contrast to the findings of studies focusing on other European countries, we find a significant asymmetry between the lending responses to monetary policy shocks of small and big banks. The small banks are less able to shelter their loan portfolio from monetary policy shocks, although the ability of small banks to absorb monetary policy shocks is improved as they have a higher ratio of Available Stable Funding (essentially composed of liabilities with maturity greater than one year) or benefit from a better access to short-term funding (i.e. bigger Net Outflows over total assets). Conversely, liquidity does not play a highly significant role for small banks. On the other hand, big banks are able to increase their loans following a monetary policy tightening which supports our argument that they are liquidity providers. In comparison to the results for small banks, higher ratios of ASF, NO or HQLA tend to reduce the ability of big banks to cushion contractionary monetary policy shocks. This arises since big banks with high ASF ratio are those that also have high ratios of RSF over total assets. The negative effect of the latter overcompensates for the positive effect of the former. Also, big banks tend to have higher leverage ratios than small banks and thus, for those banks, exceedingly high NO ratios are likely to overcompensate for the positive effect of the bank size. Finally, if banks hold HQLA for the purpose of long-term investment or as collateral then a higher share of HQLA is likely to reduce the effect of bank size.

The second contribution in the paper is the estimation and the analysis of LCR and NSFR time series. We show that the liquidity of Luxembourg's banks, as measured by the LCR, declined during the build-up to the crisis in 2008 from a maximum of 80% in 2003q4 to a minimum of 30% in 2010, and has just started to recover. Regarding the evolution of the NSFR we show that its median was above 100% before 2005, but declined steadily until 2008 to a level of 80%. This description suggests that further balance sheet restructuring is likely to take place in the medium term. Then, we estimate the optimal balance sheet adjustments using a constrained optimization where banks maximize their profits given that they have

to adhere to both liquidity ratios and the Basel III leverage standard. The simulation outcome uncovers large differences in the adjustments of small and big banks. While small banks tend to be pushed toward wholesale sources of funding, big banks are pointed toward retail and small NFC customers even if they have already a significant share of these types of deposits.

Based on the identified mechanism of monetary policy transmission, we estimate the impact of compliance with the liquidity standards using both ad-hoc and optimal balance sheet adjustments. The results suggest that complying with the NSFR will significantly reduce the relevance of the bank lending channel as it has just been identified in this paper. Conversely, complying with the LCR can potentially enhance the bank lending channel as it is currently working in Luxembourg. When we consider optimal balance sheet adjustments we can more adequately take into account potential substitution effects resulting from the balance sheet changes needed to adhere to the liquidity standards. The estimation of the long-term marginal effects on the growth rate of loans of a contractionary monetary policy shock using the optimal balance sheet changes shows that the monetary policy effects tend to be closer to zero but still significant.

One can further argue that complying with the new liquidity regulations might potentially modify the mechanism of monetary policy transmission. Then, we estimate a set of models based on the simulated bank level data. The results confirm previous conclusions; the bank lending channel in Luxembourg would tend to be less effective for cooling down the economy.

The introduction of the Basel III liquidity regulations in Luxembourg is, therefore, likely to lead to a banking sector that is, on the one hand, more resilient to crises but, on the other hand, also less likely to react to monetary policy shocks. We conclude that the short-term interest rate may lose part of its power as an instrument for central bank intervention.

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