

How to reach all the Basel III ratios at the same time?

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Motivation of the paper

- 1. Main objective of the paper is to assess the impact of Basel III requirements on banks balance sheets adjustments strategies**
- 2. Taking account for the interactions between capital and liquidity requirements :**
 - Each type of regulatory rules is assumed to be dedicated to a distinct objective.
 - However, substitution or complementarity effects between liquidity and capital ratios could exist
 - Very few papers consider the interaction of the liquidity and capital ratios
- 3. We build a comprehensive and empirical framework :**
 - Based on balance sheet equilibrium and risk parameters linking the regulatory constraint to the balance sheet at individual bank level
 - Which allows to consider the characteristics of the bank business models and to quantify the distance of each bank to Basel III compliance

Relation to the literature

- **Many papers consider the effect of capital or liquidity requirements separately, as if the new regulatory regime was built on a rule-by-rule basis, each rule pursuing a distinct objective.**
 - Most papers estimate the impact of capital requirements on lending rates (Macroeconomic Ass. Group, 2010, IIF, 2011, Hanson and al., 2011, Elliott and al, 2012, Miles and al, 2013, Kapan and Minoiu, 2013). They show a mild impact of capital requirements on bank assets holding.
 - Few papers considered the impact of new liquidity regulatory constraints : for Cornett and al., 2011 banks that rely more heavily on core deposits continued to lend more than other banks.

- **Thus the system-wide impact of the multiple regulatory constraints is rarely assessed (Haldane, 2015) while it is useful to assess if capital and liquidity regulation are complements or substitutes**

Relation to the literature

- **The issue of interactions between liquidity and capital requirements became a central topic in recent theoretical and empirical literature**
 - Higher capital holdings may reduce the need of liquidity buffers, if they give confidence to depositors and investors to provide funding at lower cost. Liquidity regulation is not necessary if capital buffers are sufficiently high. (Admati and Hellwig, 2012).
 - Synergies between capital and liquidity requirements allow avoiding maturity transformation and lending disruptions and help banks to satisfy regulatory constraints in parallel (Farag et al., 2013, Bonner and Hilbers, 2015).
 - But, when liquidity and capital requirements are complements, the difficulty to reach the regulatory constraints simultaneously is reinforced (De Nicolo et al., 2012).
 - Schmalz and al. (2014) show with linear programming and cost minimization that bank can comply by funding adjustment without changing their business model
 - De Bandt et Chahad (2016) conclude with a DSGE model that capital and LCR requirements are complements while LCR and NSFR requirements are substitutes

Structure of the paper

1. main observations about the changes in BS during the 2011-2014 period using the information given by the QIS data

- Progress toward compliance imply large increase in capital and HQLA
- changes in balance sheet items follow internal correlations
- changes in parameters show optimization of risk and liquidity management

2. Modelling the remaining changes in BS composition

- 2 models based on 5 equations are built to determine the remaining adjustments in BS required to fulfill the capital and liquidity shortfalls
- The models are estimated by using the QIS data of a consistent sample of 156 banks (86 in group 1 and 70 in group 2) between 2011 and 2014
- Models using closed formula or non-linear optimization
- Validation of the models' predictions in certain conditions

1. Progress towards compliance

□ The effort to increase regulatory buffers is huge:

- On the 2011-2014 period, the median increase is 56% for capital and 25% for HQLA
- The increase in assets other than HQLA is much smaller than the increase in deposits (median of 1.4% and 11.8% respectively)
- The quasi-stability of assets other than HQLA covers an increase in credit exposures to non-financial sectors (median +2,4%) but a decrease in exposures to financial sectors and trading activity (median -5,1%)

□ But the changes in balance sheet structure is limited at the aggregate level

- Due to their small initial size, change in capital and HQLA contribute for no more than 3% to the change in total balance sheet
- Increase in deposits has the largest contribution to BS changes (almost +5%)

Percent increase and contribution to change in total balance sheet between Dec. 2011 and Dec. 2014 – in %

| | capital | deposits | HQLA | borrowing | assets | credit exp. | market exp. |
|---------------------------------|---------|----------|------|-----------|--------|-------------|-------------|
| median increase | 54,5 | 11,8 | 23,7 | 5,0 | 1,4 | 2,4 | -5,1 |
| median contribution | 3,0 | 5,3 | 2,7 | 1,9 | 1,3 | 10,9 | 13,0 |
| % of inst. with negative growth | 8 | 28 | 31 | 41 | 47 | 44 | 54 |

1. Observed changes by largest shortfall

- Observed changes depends on the main type of shortfall and groups
 - Group 1 banks are large and international banks and include GSIBs
 - Group 2 banks are mainly domestic and specialized banks
 - Group 1 banks with initial capital or NSFR shortfall and group 2 banks with NSFR shortfall decrease assets
 - Only group 1 banks with NSFR shortfall and group 2 banks with capital shortfall decrease credit exposures: decrease in market exposures is more common

Median change in balance sheet items, by largest shortfall – in %

| | all | | | Group 1 | | | Group 2 | | |
|------------------|---------|------|------|---------|-----|------|---------|------|------|
| | Capital | LCR | NSFR | Capital | LCR | NSFR | Capital | LCR | NSFR |
| number | 26 | 38 | 64 | 8 | 29 | 35 | 18 | 9 | 29 |
| deposits | 6,5 | 4,8 | 4,8 | 0,6 | 5,5 | 3,4 | 7,8 | -0,3 | 8,3 |
| market borrowing | 1,7 | 2,0 | 0,6 | 4,6 | 1,7 | -2,9 | -0,7 | 7,4 | 5,6 |
| assets | 4,6 | 0,1 | -1,5 | -1,4 | 0,8 | -7,9 | 5,1 | -5,7 | 9,2 |
| credit exposures | -3,3 | 4,1 | 0,3 | 3,8 | 4,1 | -1,8 | -6,1 | 3,7 | 8,8 |
| market exposures | -25,0 | -3,5 | -0,1 | -15,4 | 3,6 | -8,3 | -26,7 | -8,8 | 9,4 |

1. Observed changes by business models

□ From type of main shortfall to business models

- NSFR shortfalls are the largest shortfalls in 2011
- Banks with NSFR shortfall have the smallest share of deposits on balance sheet

Shortfalls and deposits compared to total liability 2011 – by type of main shortfall – in %

| | Median Shortfall / Total Liabilities (in %) | | | | Median Deposits / Total Liabilities (%) | | | |
|-------------------|---|------|----------|------|---|------|----------|------|
| | Groupe 1 | | Groupe 2 | | Groupe 1 | | Groupe 2 | |
| | 2011 | 2014 | 2011 | 2014 | 2011 | 2014 | 2011 | 2014 |
| Zero shortfall | 0 | 0 | 0 | 0 | 46.1 | 46.7 | 52.3 | 54.7 |
| NSFR Shortfall | 10.0 | 3.9 | 10.2 | 6.7 | 37.1 | 30.0 | 42.4 | 40.7 |
| LCR Shortfall | 6.3 | 3.3 | 3.1 | 2.0 | 46.6 | 56.4 | 57.9 | 51.6 |
| Capital Shortfall | 0.8 | 0 | 1.7 | 1.0 | 68.1 | 43.5 | 68.7 | 45.9 |

1. Observed changes by business models

□ Balance sheet changes depends on the banks' business model

- Banks with the largest share of deposits have the lowest outflow rate and the highest ASF rate on deposits
- Increase in other assets is higher for banks with larger deposit share and lower risk weights
- This is true globally and for banks with NSFR main shortfall

Coefficient of the regression one by one of indicators of business models in 2011 and change in credit 2011-2014

| | # obs | outflows rate/deposit rate | ASF rate/deposit rate | var credit/deposit rate | risk weight/deposit rate | var credit/risk weight | var credit/var risk weight |
|-------------------|-------|----------------------------------|-----------------------------|-------------------------------|--------------------------------|---------------------------|-------------------------------|
| all | 155 | -0,147** | 0,088** | 0,306** | 0,476** | 0,264** | -0,161 |
| capital shortfall | 23 | -0,538** | 0,109 | 0,024 | 0,099 | 0,108 | -0,206 |
| lcr shortfall | 37 | -0,083 | 0,056 | 0,510** | 0,592** | 0,247 | -0,442** |
| nsfr shortfall | 59 | -0,198** | 0,119** | 0,862** | 0,512** | 0,581** | -0,132 |
| no shortfall | 36 | -0,099 | 0,036 | 0,214 | 0,497** | 0,166 | 0,118 |

1. Relationships in BS items changes

- Assets usually increase with capital but decrease with the ratio of capital to total liability **except** for banks in capital shortfall
 - for these banks the increase in capital is used to cope up with regulation
- Assets increase with deposits and market borrowing **but** they increase less or not significantly for banks in NSFR shortfall

Regression of change in credit on other items and rates – % change in contribution to change in total asset 2011-2014- for all banks and by type of shortfall

| | # obs | capital | market borrowing | deposits | liquid assets | ASF | capital /liability |
|-------------------|-------|---------|------------------|----------|---------------|---------|--------------------|
| all | 155 | 4,531** | 0,846** | 0,781** | 0,783** | 0,303 | -0,053** |
| capital shortfall | 23 | 2,270 | 1,205** | 0,859** | -0,665 | 0,425** | 0,336 |
| lcr shortfall | 37 | 3,555** | 0,954** | 0,951** | 0,367 | 0,475** | -0,037 |
| nsfr shortfall | 59 | 7,635** | 0,778** | 0,427 | 1,425** | 0,151** | -1,983 |
| no shortfall | 36 | 3,421** | 0,838** | 0,903** | 0,687 | 0,741** | -0,055** |

1. Changes in risk and liquidity parameters

- **Most of parameters evolve in a way to reduce required buffers :**
 - Reduction deposit outflows rate : the changes in the standards regarding retail and corporate outflows rate may have helped
 - On the contrary, the increase in outflows/market borrowing for all banks and RSF/assets for group 1 may be due to the new treatment of derivatives in LCR and NSFR

Median risk and liquidity parameters – in %
Favorable variation in green – unfavorable variation in red

| | | exposures/ assets | capital ratio*RWA/ assets | inflows/ assets | RSF/ assets | outflows/ deposits | ASF/ deposits | outflows/mark et borrowing | ASF/market borrowing |
|-------------|----------------|----------------------|------------------------------|--------------------|----------------|-----------------------|------------------|-------------------------------|-------------------------|
| data source | leverage ratio | capital ratio | LCR | NSFR | LCR | NSFR | LCR | NSFR | |
| G1 | 2011 | 146,5 | 5,4 | 4,1 | 66,0 | 18,1 | 75,0 | 11,6 | 23,8 |
| | 2014 | 151,7 | 5,2 | 5,1 | 69,1 | 12,4 | 81,5 | 20,8 | 36,9 |
| G2 | 2011 | 127,8 | 6,2 | 3,1 | 77,3 | 10,8 | 81,9 | 5,9 | 40,2 |
| | 2014 | 125,4 | 3,1 | 2,5 | 71,6 | 8,9 | 87,0 | 12,4 | 48,7 |

2. The models (1)

□ A simplified balance sheet in 5 items:

- 4 variables are predicted by the model: HQLA (Z), other assets (C), capital (K), market borrowing (M)
- Changes in deposit (D) αD is set to the effective individual increase between end of 2011 and end of 2014

□ 4 constraints determine 4 variables:

- balance sheet equilibrium constraint, LCR, NSFR, and the maximum of capital required for risk based ratio and leverage ratio
- Balance sheet and prudential metrics are linked by effective “**parameters**” such as capital weights to assets for capital ratio, outflows rate to deposits for LCR,...

□ Regarding modeled changes, adjustment to the minimum ratios are triggered by a shortfall

- Shortfall in ASF (Ba), in HQLA (Bz), and in capital (Bk) as the max of leverage or solvency shortfall
- The models assume that banks in excess of capital, ASF, HQLA don't adjust and initial excess are set to zero before running the models

2. The models (2)

□ 5 equations common to both models:

- Are resolved in a closed formula for the “closed formula model ”
- Are the constraints in the “non linear programming model”

□ EQ 1. Change in assets equals change in liabilities

$$(1) \text{ var. HQLA} + \text{ var. assets} = \\ \text{ var. deposits} + \text{ var. borrowing} + \text{ capital shortfall} + \text{ var. capital}$$

N.B. the capital shortfall is supposed to be fulfilled as an initial adjustment

□ EQ 2. LCR should reach a minimum of 100%

$$(2) \text{ var. weighted HQLA} \\ = \text{ LCR shortfall} \\ + \text{ outflow/var. deposits} + \text{ outflow/var. borrowing} \\ - \text{ inflow/var. assets}$$

□ EQ 3. NSFR should reach a minimum of 100%

$$(3) \text{ asf/var. deposits} + \text{ asf/var. borrowing} + \text{ var. capital} \\ + \text{ capital shortfall} \\ = \text{ NSFRshortfall} + \text{ RSF/var. HQLA} + \text{ RSF/var. assets}$$

2. The models (3)

- EQ 4. and 5. Total capital at least fulfills the more stringent of leverage or risk based capital constraint

$$(4) \text{var. capital} + \text{capital shortfall} = \text{lev} (\text{var. asset. exp.} + \text{var. HQLA}) - (\text{capital} - \text{lev} \times \text{exposures})$$

$$(5) \text{var. capital} + \text{capital shortfall} = \text{capital requirement/var. assets} + \text{capital requirement/var. HQLA} - (\text{capital} - \text{sol. RWA})$$

- Capital ratio (sol) includes GSIB surcharge ; without surcharge, it is set to 10.5% without TLAC and 20,5 with TLAC
- Leverage ratio (lev) is set to 3% without TLAC and 6,75% with TLAC

- Gains maximization is based on a hierarchy of costs and yields

$$(6) \quad \text{Max } 0,015\text{var. HQLA} + 0.035\text{var. assets} \\ - 0,125(\text{var. capital} + \text{capital shortfall}) - 0,026\text{var. deposit} \\ - 0,024\text{var. borrowing}$$

NB: asset returns and deposit costs include management costs

3. Does the model explain the observed changes ? (1)

- ❑ Correlations between predicted and observed changes for all banks and by type of shortfalls shows that for both models:
 - change in capital is best predicted for banks with capital shortfall,
 - change in market borrowing is best predicted for banks with NSFR shortfall,
 - change in HQLA is best predicted for banks with LCR shortfall
 - For banks with capital shortfall, assets seem quite well predicted by both models as well as market borrowing for banks with NSFR shortfall
 - Correlations are not better in the sub-sample of banks that comply in 2014

Coefficients of regressions of predicted changes on observed changes, by type of model and type of shortfall (in column) and by variable (in row)

| | closed formula | | | | linear programming | | | |
|------------------|----------------|---------|----------|---------|--------------------|---------|---------|---------|
| | all | capital | LCR | NSFR | all | capital | LCR | NSFR |
| number | 119 | 23 | 37 | 58 | 105 | 20 | 33 | 52 |
| capital | 0,232** | 0,624** | -0,021 | -0,130 | 0,312** | 0,750** | 0,201** | -0,041 |
| market borrowing | 0,042 | 0,302 | -0,381** | 0,206** | 0,151** | 0,326 | 0,069 | 0,178** |
| liquid assets | 0,188** | 0,096 | 0,379** | 0,117 | 0,070 | -0,164 | 0,301** | 0,040 |
| assets | 0,152 | 0,529** | 0,045 | 0,129 | 0,172** | 0,554** | 0,272** | 0,093 |
| ASF | 0,839** | 0,941** | 0,505** | 0,903** | 0,737** | 0,871** | 0,430 | 0,745** |

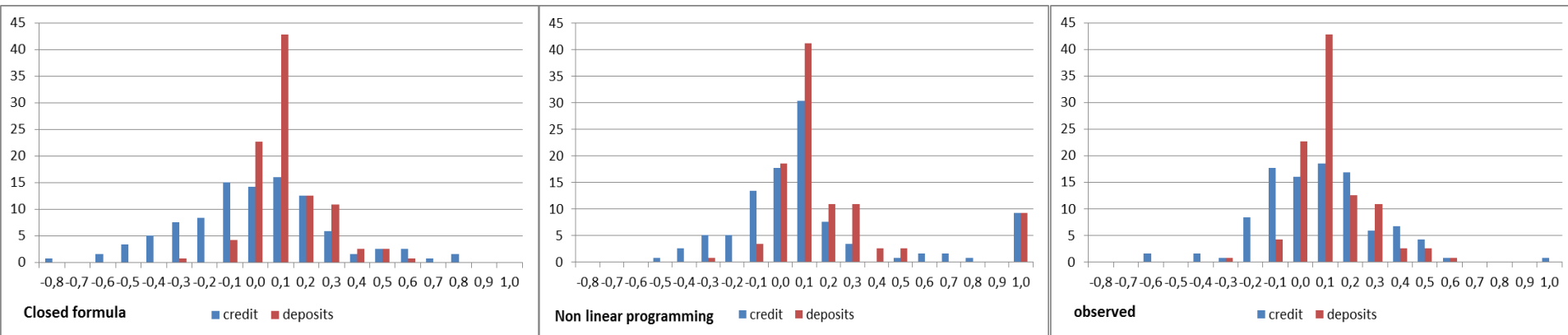
3. Does the model explain the observed changes ? (2)

- Both models predict change in credit lower than change in deposits, as was observed between 2011 and 2014
- Adding profit maximization reduces the dispersion and especially very large increase or decrease (more than +30/-30%) compared to close formula

Changes in other assets – mean and standard deviation in %

| | closed formula | non linear program. | observed |
|------|----------------|---------------------|----------|
| mean | -1,45% | -1,46% | 0,99% |
| SD | 27,42% | 21,87% | 22,12% |

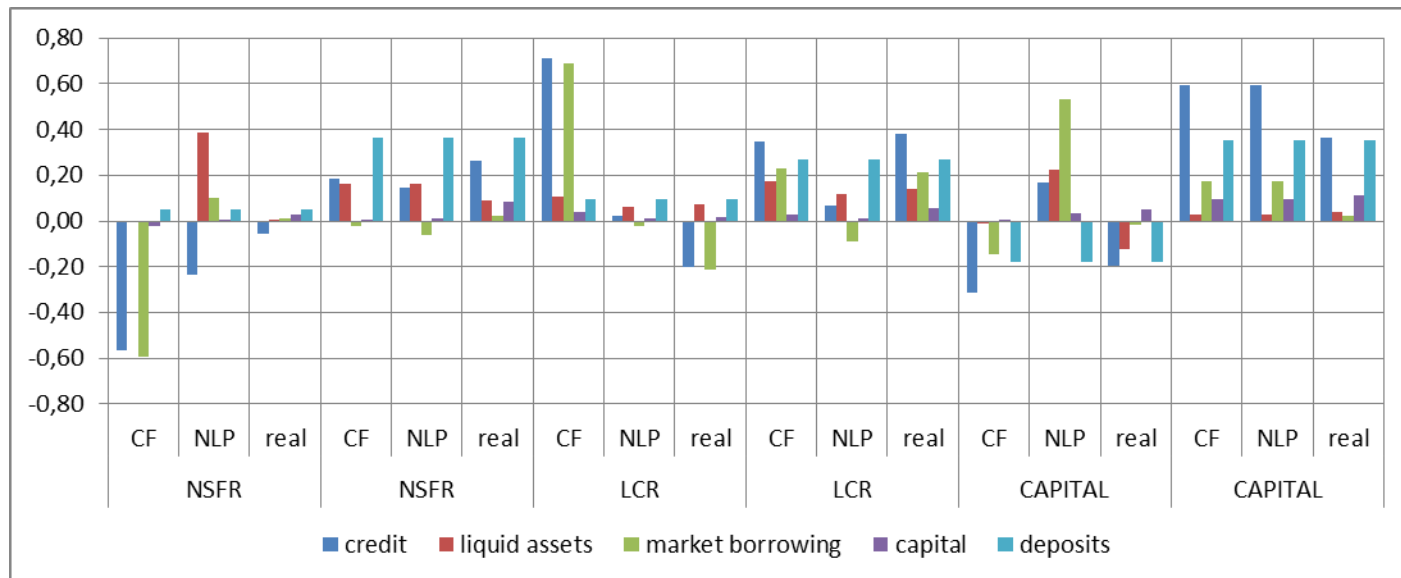
Distribution of changes in deposits and other assets in % – modeled and observed



3. Does the model explain the observed changes ? (3)

- Different strategies are observed depending on the parameters and the initial BS:
 - Closed formula usually predicts better when shortfalls are larger
 - In both models, market borrowing is better predicted when its outflows rate is larger and capital is better predicted when ASF on deposit is larger
 - The share of deposit in total liability is not a criterion

Individual examples of changes in BS items – modeled and observed – by type of shortfall



3. Substitutability is stronger in theory than in practice

- Models set a positive correlation for adjustments between ASF and capital and between ASF and HQLA but no correlation between capital and HQLA
- On real data, we find a positive correlation only for adjustments between ASF and HQLA . This proves :
 - substitutability between liquidity requirements (LCR and NSFR)
 - complementarity between capital and liquidity requirements

Coefficients of the regression of changes in buffers' amounts two by two

| | | closed formula | | | non-linear programming | | | observed 2011-2014 | | |
|---------|-------------|----------------|-------------|--------------|------------------------|-------------|--------------|--------------------|-------------|--------------|
| | | ASF-HQLA | ASF-capital | capital-HQLA | ASF-HQLA | ASF-capital | capital-HQLA | ASF-HQLA | ASF-capital | capital-HQLA |
| all | # | 51 | 155 | 155 | 58 | 58 | 45 | 58 | 47 | 45 |
| | coefficient | 0,338** | 0,104** | 0,339 | 0,216** | 0,448** | 0,063 | 0,221** | - 0,131 | 0,181 |
| nsfr | # | 14 | 12 | 12 | 18 | 12 | 12 | 18 | 12 | 12 |
| | coefficient | 0,242 | 0,097** | 0,006 | 0,243** | 0,076 | - 0,003 | 0,278** | - 0,202 | - 0,870 |
| lcr | # | 21 | 37 | 18 | 23 | 21 | 20 | 23 | 21 | 20 |
| | coefficient | 0,461** | 0,087** | 0,831 | 0,189** | 0,072** | 0,107 | 0,145 | - 0,312 | 0,694 |
| capital | # | 7 | 5 | 4 | 7 | 5 | 5 | 7 | 5 | 5 |
| | coefficient | 0,541** | 0,056 | - 1,348 | 0,253 | 2,563** | 0,249 | 0,625** | 0,035 | 0,276 |

- de Bandt and Chahad (2016) draw the same conclusion with a DSGE model

4. Which impact of TLAC?

Comparison between modeled impacts with and without TLAC

- As from 2011 because not enough banks to be compared in 2014 (only 5 banks in capital shortfall without TLAC)
- TLAC impacts only GSIBs
- Diminished growth in credit for the same growth in deposits or capital

Coefficient of regression of contribution of other assets over contribution of other items with and without TLAC (columns), by type of shortfall and models (rows) - 2011

| | without TLAC | | | | with TLAC | | | |
|-------------------|------------------------|---------|----------|--------------------|-----------|---------|----------|--------------------|
| | # obs | capital | deposits | capital /liability | # obs | capital | deposits | capital /liability |
| | closed formula | | | | | | | |
| all | 119 | 5,930** | 1,257** | -0,041 | 125 | 4,888** | 1,257** | -0,041 |
| capital shortfall | 23 | 5,264** | 1,421** | -0,009 | 36 | 3,169** | 1,421** | -0,009 |
| lcr shortfall | 37 | 4,918** | 0,942** | -0,009 | 32 | 4,076** | 0,942** | -0,009 |
| nsfr shortfall | 58 | 4,822** | 1,282** | -1,128 | 55 | 4,887** | 1,282** | -1,128 |
| | non linear programming | | | | | | | |
| all | 108 | 6,071** | 1,092** | -1,342 | 110 | 3,146** | 1,044** | -0,016 |
| capital shortfall | 20 | 5,158** | 1,300** | 0,086 | 32 | 1,048 | 1,123** | 0,001 |
| lcr shortfall | 35 | 7,221** | 1,051** | -0,006 | 29 | 3,754** | 1,085** | -0,006 |
| nsfr shortfall | 53 | 4,665** | 0,932** | -2,515** | 49 | 4,098** | 0,936** | -2,613** |

Main conclusions

❑ Observed adjustments, globally....

- Large increase in capital and HQLA (56% and 25% resp.) that do not contribute for more than 3% of total balance sheets
- An increase in assets lower than the increase in deposits
- A decrease in market exposure but an increase in credit exposures
- As expected, banks optimize the regulatory buffer charge

❑ ...and by business models:

- Increase in other assets is higher for banks with larger deposit share and lower risk weights
- Only group 1 banks with NSFR shortfall and group 2 banks with capital shortfall decrease credit exposures:

❑ The models predicts the future adjustments with certain conditions

- Observed and modelled changes are highly correlated for capital and HQLA
- Correlation extends to other assets for banks in capital shortfall
- Closed formula model works better shortfalls are high and in both models, market borrowing is better predicted when its outflows rate is larger and capital is better predicted when ASF on deposit is larger

❑ Finally, which Basel III mechanics are at work?

- Credit increases with capital but decreases with the ratio capital/liability (except for banks with capital shortfall)
- Liquidity requirements (LCR and NSFR) are substitutable while capital and liquidity requirements seems complementary
- Thus TLAC will probably imply a lower increase in assets with the same increase in deposit or capital