Back-testing bank stress tests

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Abstract

We provide a first evaluation of the quality of banking stress tests that have become one of the main tool of banking regulation around the world. We propose a simple methodology to extract information for stress tests data. We estimate bank level exposures to macroeconomic risks, and we compare the prediction of our model to realized losses and to event-study market returns. We find that stress tests are informative. The model can predict realized losses of banks and market reactions to the release of macroeconomic news.

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Stress tests have become a major tool of banking supervision in the United States and in Europe. Regulatory stress tests are used to set bank capital levels and validate dividend policies. The stress tests exercise mobilize large human and financial resources among regulators and among bankers. Regulators need to design the scenarios, run their own models, and monitor closely the answers provided by the banks. The banks, on the other hand, allocate considerable time and effort to estimating their stress test results.

Yet, despite the clear importance of stress tests, they have not been systematically analyzed. In fact, the data from the test are only used once, to give a pass/fail grade to the banks. The stress tests data are not back tested or used for other research. The issue of course is how to use the data, since the scenarios of the stress tests never actually happen. The central scenario should be close to the realized one on average but that is not very useful since we are precisely interested in deviations from this central scenario. The adverse scenarios, on the other hand, are much more interesting but they are, by definition (and thankfully) usually far from the realized one.

Our goal in this paper is to provide a first assessment of the quality of stress tests in Europe. We want to know whether stress tests results provide reliable information for regulators on the resilience of banks, and whether market participants learn from these tests. To do so, we propose an approach in two steps. In a first step, we use the European stress test results to estimate bank loss rates sensitivity to macroeconomic shocks. Once we obtain these sensitivities, we compute loss rate predictions under actual macroeconomic events. These predicted loss rates can then be backtested against market and accounting data of banks.

Stress tests require banks to model loss rates on their credit exposures under a baseline scenario and under an adverse scenario. These scenarios cover all countries from the European Union. Banks report their projected losses for their main countries of exposure. We use the data from the exercise (i.e. the scenarios for macroeconomic factors – GDP growth, inflation, and unemployment rates – and loss rate projections reported by banks) to estimate bank sensitivity to macroeconomic shocks.

Our main results are as follows. First, we find that a simple model of bank loss rates exposure fits the stress results well. Second, we find that these estimated exposures predict relatively well the realized losses of banks in subsequent years. Third, we estimate the market reaction of banks to macro announcement and we find that our estimated exposures help predict the cross sectional variation of bank stock returns after a macro announcement.

Overview of the EBA 2014 stress tests In 2014, the European Banking Authority (EBA) conducted Euro-wide stress tests on 123 banks covering approximately 80% of total banking assets in the EU [EBA, 2014].[1] The EU-wide stress test was coordinated by the EBA across the EU and is carried out in cooperation with the European Systemic Risk Board (ESRB), the European Commission, the European Central Bank (ECB), and the relevant national regulators. The various tasks involved in the stress tests were split as follows. The ECB was responsible for the overall quality assurance and for the asset quality review that provides the starting point of the stress test. The ESRB and the European Commission provided the underlying macroeconomic scenarios. The EBA developed the common methodology and ensured the disclosure of the results. The ECB and the national authorities could decide follow up actions.

The starting point of the stress test is the balance sheet of banks at end of december 2013. Two macroeconomic scenarios are constructed for the 2014-2016 horizon: a baseline scenario, and an adverse scenario. Macroeconomic and financial variables (GDP growth, HICP inflation, unemployment, interest rates, stock prices, house price and funding) are projected in the adverse scenario in terms of deviations from the baseline scenario. Each bank must then apply the shocks of the scenario to its portfolio and to generate credit, market and funding losses.

Under the adverse scenario the average CET1 ratio decreases by 3 percentage points. The CET1 capital decreases by 182 billion whereas loan losses represent 362 billion. 25 institutions failed to the Comprehensive Assessment (Asset Quality Review and Stress Test). The corresponding capital shortfall amounted to 25.2 billion.

Literature Review There is a growing theoretical literature on assets quality reviews and stress tests. Several recent papers study specifically the trade-offs involved in revealing information about banks. Goldstein and Sapra [2014] review the literature on the disclosure of stress tests

[1] The total assets of banks participating to the exercise represent almost 22 trillion (approximatively 82% of the banking system covered).

results. Goldstein and Leitner [2013] focus on the Hirshleifer [1971] effect: revealing too much information destroys risk-sharing opportunities between risk neutral investors and (effectively) risk averse bankers. These risk-sharing arrangements also play an important role in Allen and Gale [2000]. Shapiro and Skeie [Forthcoming] study the reputation concerns of a regulator when there is a trade-off between moral hazard and runs. Faria-e Castro et al. [2014] study a model of optimal disclosure where the government trades off Lemon market costs with bank run costs.

There is much less work on the empirical side. In particular, no paper has attempted to evaluate the quality of stress tests. Glasserman and Tangirala (2015) evaluate one aspect of the relevance of scenario choices in U.S. stress tests. They show that the results of U.S. stress tests are somewhat predictable, in the sense that the ranking across banks of projected stress losses in 2013 and 2014 are correlated. Similarly, the rankings across scenarios in a given year. They argue that this suggests that regulators should experiment with more diverse scenarios, so that it is not always the same banks that project the higher losses. But these results refer only to reported results and they do not speak to the quality of the results themselves.

1 Model

1.1 Estimating loss rates sensitivity to macroeconomic factors

Stress tests require banks to model loss rates on their credit exposures under a baseline scenario and under an adverse scenario. We want to use the data from the stress tests to estimate bank sensitivity to macroeconomic shocks. These scenarios cover all countries from the European Union.[2] Banks report their projected losses for their main countries of exposure.

The first point to understand is that what we call a "scenario" is in fact a set of scenarios because each country in the EU is subject to different macro-economic scenarios. The units of observation in our model is therefore:

- name of the bank $i \in [1 : 122]$

[2]These scenarios also cover a large list of countries outside the EU but only for two macroeconomic factors: GDP growth and inflation. We do not include countries outside the EU in our analysis.

- scenario $s \in \{\text{baseline, adverse}\}$ and projection year $t = \{2014, 2015, 2016\}$
- country of operation $j \in [1:28]$
- portfolio $p \in \{\text{retail, corporate}\}$

We can define a scenario as follows

Definition 1. A **scenario** s is a sequence of vectors $y^s_{j,t}$, representing the macroeconomic factors in country j at time t.

In our application, we will use the following macro-variables

$$y^s_{j,t} = \begin{pmatrix} g^s_{j,t} \\ \pi^s_{j,t} \\ u^s_{j,t} \end{pmatrix}$$

where g is the growth rate of GDP, π is inflation, and u is the unemployment rate, in country j at time t under scenario s. The majority of banks included in the stress test have branches or subsidiaries in several countries.

Definition 2. The **results** of the stress tests is a set of loss rates $l^{s,p}_{i,j,t}$ representing the losses for portfolio p of bank i in country j at time t under scenario s.

Finally, a model is a mapping from scenarios to loss rates

Definition 3. A **model** of portfolio losses is a mapping from scenarios $y^s_{j,t}$ to results $l^{s,p}_{i,j,t}$

$$l^{s,p}_{i,j,t} = F_{p,i,j}\left(y^s_{j,t}\right)$$

It is clear that different portfolios (retail, corporate) have different sensitivities to macroeconomic factors, so the mapping needs to depend on p. In theory, we could imagine that the credit loss rate sensitivity to macroeconomic shocks could also depend on the specific {bank, country} pair. For instance, it is conceivable that the retail portfolio of BNP in France has a different sensitivity to French GDP than the retail portfolio of BNP in Italy to Italian GDP. On the other hand, if we do not restrict the model, we could end up with $3 \times 21 \times 123 = 7749$ degrees of freedom. We therefore estimate two restricted specifications for losses on portfolio p. Model 1 is

$$\log \frac{l^{s,p}_{i,j,t}}{1 - l^{s,p}_{i,j,t}} = \alpha^p_{i,j} + \beta^p \times \left(\theta^p_j \cdot y^s_{j,t}\right) + \epsilon^{s,p}_{i,j,t} \tag{1}$$

Model 2 allows a bank specific slope β_i:

$$\log \frac{l^{s,p}_{i,j,t}}{1 - l^{s,p}_{i,j,t}} = \alpha^p_i + \beta^p_i \times \left(\theta^p_j \cdot y^s_{j,t}\right) + \epsilon^{s,p}_{i,j,t} \tag{2}$$

We allow for a bank fixed effect. If all banks were active in all countries, this would be $28 \times 122 = 3416$ coefficients. The next term is the macro-sensitivity. It has two components. First, $\theta^p_j \cdot y^s_{j,t}$ creates a macro factor for country j (i.e., θ^p_j and $y^s_{j,t}$ are both vectors of size 3, and their product is a scalar). This corresponds to $3 \times 28 = 84$ coefficients. The macro factor summarizes the macro scenario for country j. The difference between model in (1) and (2) is the bank sensitivity to shock parameter β. In model 1, all banks have the same β^p sensitivity to shocks. In model 2, we allow for a bank specific exposure β^p_i, which can capture differences in risk management across banks. This adds another 122 coefficients. We estimate model 2 in two steps.

1.2 Using the model to predit actual outcomes

The second step of our analysis is to use the estimated model to predict actual outcomes. We consider two sets of outcomes: realized losses and stock returns. [3]

1.2.1 Realized losses

Let $Y_t \equiv \{y_{j,t}\}_{j=1..28}$ be the actual realization of the macro variables. One issue is that the disclosure of realized losses is not as granular as the disclosure of stress tests projections. In particular, banks report *consolidated* losses, across their various subsidiaries. With the models estimated in equation (1) or (2), we can predict loss rates on portfolio p

[3] For simplicity, we only present predicted outcomes based on the specification of model 2 in equation (2).

$$\mathbb{E}\left[L^p_{i,t} \mid Y_t\right] = \sum_{j=1}^{21} \frac{\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,t}\right)}{1+\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,t}\right)} \times EXP^p_{i,j} \tag{3}$$

where $EXP_{i,j}$ is the exposure of bank i to country j. These predictions can then be backtested against realized losses by running the following regression:

$$\frac{L^p_{i,t}}{Loans_{i,p,t}} = \alpha_0 + \delta \frac{\mathbb{E}\left[L^p_{i,t} \mid Y_t\right]}{Loans_{i,p,t}} + \varepsilon_{i,t} \tag{4}$$

1.2.2 Macro News and Stock Returns

Comparing our predictions to realized losses is the most natural way to assess the reliability of the stress test, but this approach suffers from limited statistical power: we have to wait for the macro scenario to materialize and then we only get one observation per bank.

To overcome this limitation, we also compare market reactions to macroeconomic releases as a function of our estimated exposure. The change in loss expectation is computed as the difference between loss expectation with the macroeconomic news and the loss expectation with the economists' consensus provided by Bloomberg. Consider the release of a macro series at time τ. Let y_{j,τ^-} be the consensus just before the release, and let y_{j,τ^+} be the consensus just after the release. According to our model, the change in the expected losses for bank i is given by

$$\Delta_\tau \mathbb{E}\left[L_{i,\tau}\right] = \sum_{j=1}^{21} \left(\frac{\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,\tau^+}\right)}{1+\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,\tau^+}\right)} - \frac{\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,\tau^-}\right)}{1+\exp\left(\hat{\alpha}^p_i + \hat{\beta}^p_i \hat{\theta}^p_j \cdot y_{j,\tau^-}\right)} \right) \times EXP_j \tag{5}$$

These predictions can then be backtested against market reactions by comparing the excess return of bank i at time τ to the predicted losses

$$r_{i,\tau} = \alpha_0 + \gamma \frac{\Delta_\tau \mathbb{E}\left[L_{i,\tau}\right]}{CET1_i} + \vartheta_\tau + \varepsilon_{i,\tau} \tag{6}$$

where $CET1_i$ is the core equity tier 1 of bank i.

2 Data

We gather four types of data: the EU 2014 stress test results, accounting data on realized losses, macroeconomic news, and equity returns.

2.1 Stress Test Data

Our main data set is the publicly disclosed European stress test results.[4] This publication gives access to information on 123 European banks. One bank did not have any exposure on retail and corporate customers and is thus not included in our framework. The stress test is divided in different blocks reflecting the main risks in banks' balance sheets. We focus on the credit risk block as it discloses a very rich set of data to estimate bank sensitivity to macroeconomic shocks: credit exposures by asset classes and country as well as associated loss rates in each scenario/year.

We focus our analysis on corporate and retail portfolios which represent by far the largest share of bank credit activities. Each bank breaks down its credit exposures up to the 10 largest countries of exposure of its banking book. For each country of exposure we have information on bank loss rate in years 2014, 2015 and 2016 under two scenarios defined by the EBA: a baseline scenario – which reflects the expected macroeconomic conditions to be realized in the country of exposure in the next 3 years – and an adverse scenario – which reflects an extreme but plausible deterioration in macroeconomic conditions over the same period. For bank i in country j we therefore have 6 predicted loss rates for the retail portfolio, and 6 for the corporate portfolio.

The European stress test was carried out under a general principle of static balance sheets. It assumes no asset growth over the 3 years horizon of the test and maturing assets are assumed to be replaced with similar exposures in terms of type, credit quality and maturity at the start of the exercise. No replacement or write-down of defaulted assets is allowed in the exercise. However, some banks carrying the exercise in 2014 were subject to a restructuring plan approved by the European commission before December 2013 – the starting date of the stress test. These restructuring plans concern 32 banks in the stress test exercise which received state support (e.g. government recapitalization) in the aftermath of the 2008 financial crisis. These banks were authorized to

[4]See www.eba.europa.eu/risk-analysis-and-data/eu-wide-stress-testing/2014/results

apply a dynamic balance sheet assumption on the troubled assets they were supposed to cut-off under the restructuring plans. Given the nature of banks under this assumption and the fact that they could diminish their exposure on troubled assets in the exercise, we exclude them from our backtesting framework.

2.2 Macroeconomic Data

Data on macroeconomic news – which we define as announcements above or below consensus – are from Bloomberg. Bloomberg references 15,470 economic announcements for all European Union countries over 2013-2014. We collect the date, country, nature of the macroeconomic announcement and the economist forecast as published by Bloomberg (which is the median of a panel of economists' forecast). The model we calibrate from stress test data only relies on three macroeconomic factors: GDP growth, inflation and unemployment rates. Thus, we only retain year-on-year real GDP growth, unemployment rate and year-on-year inflation rate publications. The number of publications drops to 2,148. We then eliminate all publications where the consensus equals the actual figure as they should not represent an element of surprise for the market. We also drop publications where no consensus was published because we cannot quantify the surprise of the publication for the market. Finally, we compute the unexpected macroeconomic shock as the difference between the actual published figure and the forecast. Our final set of announcements contains 949 publications of unexpected macroeconomic shocks.

To compare model predictions with accounting credit losses, we need the full value of the macroeconomic indicators and not only their elements of surprise. We then also collect Eurostat harmonised macroeconomic series for EU countries from 2013 to June 2015. These series are used to compare the model predictions with accounting credit losses. As before, we only retain publications of real gdp growth, inflation and unemployment rates.

2.3 Bank market and accounting data

We collect the end of year loan loss provisions in 2013 and 2014 to be compared with the model predictions. We collect total loans in Bankscope to normalize losses between banks. Bankscope covers 92 banks from the stress test exercise.

Our equity return sample comprises 45 listed banks. Bank equity price are collected on Bloomberg. For each announcement date, we then compute the return for all listed banks of our sample on a [-2;0] price window. We prefer to focus on a 2 days window in order to capture potential information leakage of macroeconomic news to market participants.

3 Results

3.1 Estimation of the Model

We start by estimating Model 1 using the stress test results, separately for the corporate and retail portfolios. We have 3,148 loss rates observations for the corporate portfolio and 2,760 observations for the retail portfolio. For model 1, we estimate the parameters with OLS. For the corporate portfolio, the model thus estimates 122 α_i^p parameters plus 84 θ_j^p parameters. In the same vein, the model estimates a set of 117 α_i^p and of 84 θ_j^p parameters for the retail portfolio.

Table 1 presents synthetic information on the estimation of bank loss rate sensitivity to macroeconomic shocks. Given the large number of estimated parameters, we only report the R^2 of the models. We can see from the table that our restricted model captures between one half and two-thirds of the information contained in the stress test results. As expected, we find that GDP growth is good news for credit losses: the coefficients are negative and significant for 26 countries and 24 countries in the corporate and retail portfolios, respectively. Inflation is mostly good news, but not always: the coefficients for inflation are negative for 21 countries for the corporate portfolio and 26 countries for the retail portfolio, but others are positive. It is not surprising to observe different signs between countries. From a macroeconomic perspective, it depends on whether inflation reflects a positive demand shock or a negative supply shock. In addition, banks use fixed interest rates in some countries and floating rates in others. For the unemployment rate, all coefficients except for one country in the retail portfolio are positive, as expected, and they are significant at the 10% level in 26 countries for the corporate portfolio and 16 countries for the retail portfolio. There is, however, a strong negative correlation between GDP growth and unemployment rates so it is difficult to estimate both coefficients.

For model 2, we use the estimates of θ_j^p from model 1 to construct the macro factor. In a second step, we estimate 122 α_i^p plus 122 β_i^p parameters for the corporate portfolio, and 117 α_i^p plus 117 β_i^p for the retail portfolio. We see that allowing for bank-specific average sensitivity β_i increases the R^2 significantly, especially in the retail portfolio.

3.2 Descriptive Statistics

Table 2 presents sample descriptive statistics on realized losses and returns, together with the model's predictions. Bankscope data covers the end-of-year results for 2013 and 2014. The median expected losses in the two models are close to the median of realized losses in the sample of banks. Realized losses are more skewed than model-implied losses, so we miss the max and the mean.

In the second half of Table 2, however, the model's predictions cannot be directly compared to realized equity returns because the model does not perform the NPV calculation. The average and median realized returns are essentially zero.

3.3 Predicted vs. Realized Losses

We start our backtesting of stress test models by comparing predicted and realized losses. We use Eurostat harmonized macroeconomic indicators to predict accounting losses on a yearly basis using equation (3). We compare the predictions with loan loss provisions reported by banks in their profit and loss accounts. Both losses predictions and accounting loan loss provisions are normalized by bank loan portfolios at the end of the corresponding year. Table 3 reports the regressions of loan loss provisions on the model's predictions. The first 3 columns present the results for model 1 from equation (1) and the last 3 columns present the same analysis for model 2 from equation (2).

Column (1) is a pooled OLS model with year dummies. The coefficient on predicted losses is very significant but it is less than one which would be the natural benchmark. Columns (2) and (3) show that the model is stable over time. As expected, the explanatory power of the model is higher for the 2014 data since the stress test was based on balance sheets in December 2013.

Columns (4) to (6) are based on the predictions from Model 2. The explanatory power of the model is significantly higher than with model 1 and the coefficient is not statistically different from one in 2014.

This test on accounting data is a first proof that Stress Test results are informative. For the main test, using 2014 data, the model accounts for more than a third of the variation in losses across banks. Moreover, we do not detect a systematic tendency of stress tests to under-predict realized losses.

Controlling for Baseline Projections The previous results indicate that stress test models contain information on bank real sensitivity to macroeconomic shocks. One could however argue that macroeconomic outcomes in 2014 were close to the baseline scenario of the stress test. In that case, the model projections could just reflect the fact that stress test result for the baseline scenario are correlated with realized losses in 2014. It is thus important to test whether the model brings additional information to the stress test results.

In Table 4 , we control for the baseline projection, which we obtain by aggregating baseline losses by country of exposure and normalizing total loans in 2014 as we did for our other measures. Column (1) shows that baseline losses are a good predictor of actual losses in 2014. The coefficient is not statistically different from one.

We can now ask whether our model brings in additional information relative to these baseline projections. Columns (2) and (3) show that our model's predictions improve the fit and render the baseline insignificant. Column (5) shows that Model 2 can predict 14% of the deviations from the baseline, and again with a coefficient close to one.

Overall our results show that stress tests provide useful information on banks' exposures. They are based however on a relatively small sample of observations. To overcome this limitation, we propose in the next section to compare market reactions to the change in expected losses at macroeconomic releases.

3.4 Macro News and Equity Returns

Table 5 compares the change in predicted losses obtained from equation (5) with equity returns on the day of macroeconomic announcements. The change in expected loss is the difference between the expected loss after the macroeconomic release and the expected loss under the last economists' consensus provided by Bloomberg. Our sample now includes only 45 listed banks.

The first three columns of Table 5 use model 1, and the last three columns use model 2. Columns (1) and (4) are based on a simple OLS model without fixed effects. To control for contemporaneous shocks, we include a market return variable based on the Eurostoxx 600. We observe that unexpected losses predicted from the model are indeed negatively correlated with banks' equity return. The coefficient is significant at the 1% level. The effects seems also economically significant as an increase in 1 p.p of expected losses over common equity tier 1 leads on average to an equity return between -0.669% and -1%. As an alternative to the market return, column (2) and (5) include event-date fixed effects. The results indicate that the models estimated with stress test data allow us to rank banks' losses after a particular macroeconomic shock. Columns (3) and (6) show that bank fixed effects do not affect our results.

Our results show that stress tests are informative and that market participants use a pricing model that is consistent with the one that we propose. At this point, we do not have a way to know whether markets learn from the stress tests or whether they agree with the results.

4 Additional Market-Based Evidence of Informativeness

Stress test results show bank vulnerability by country of exposure. We can therefore compute a bank-specific factor using market indexes weighted by the sensitivity of banks to macroeconomic shocks. The advantage of this approach is that we can use daily market returns.

We first need to construct a measure of bank sensitivity to shocks by country of exposure. To do so, we compare the deviation between losses in the adverse and baseline portfolio for each bank. We normalize the result by the deviation of all banks for the same country of exposure. As scenario had different level of severity depending on the country of exposure, we proceed with the normalization in order to only capture bank sensitivity and not the severity of the scenario. More precisely, our measure is computed as follows:

$$\beta_{i,j} = \frac{\sum_{t=1}^{3} \frac{L_{i,j,t}^{adverse}}{L_{i,j,t}^{baseline}}}{\sum_{t=1}^{3} \frac{\sum_i L_{i,j,t}^{adverse}}{\sum_i L_{i,j,t}^{baseline}}} \tag{7}$$

where L is the amount of losses of bank i in country j in year t under a stress test scenario {baseline, adverse}. The stress test market factor can then be computed as a weighted average of country market equity returns:

$$F_{i,\tau}^{ST} = \frac{\sum_{j=1}^{28} \beta_{i,j} \times EXP_{i,j} \times r_{j\tau}^{m}}{\sum_{j=1}^{28} \beta_{i,j} \times EXP_{i,j}} \tag{8}$$

where r_j^m is a domestic market return and EXP is the credit exposure. As an additional control, we also construct a factor using only the exposures (setting all β's to one).

Table 6 compares our stress test market factors to other market factors using daily returns in 2013 and 2014. We use a broad index (Eurostoxx 600), the exposure-weighted factor, and the sensitivity-exposure-weighted factor from equation (8).

Column (2) shows that using exposures weights double the R^2. Column (3) shows that our stress test market factor has a higher coefficient and a smaller standard error than other factors. Columns (4) to (6) show that the sensitivity-weighted factor renders the other factors insignificant and is robust to fixed effects.

This robustness exercise confirms that, with an alternative methodology, the stress test contains valuable information on banks' resilience to shocks.

5 Conclusion

Regulatory stress tests conducted extensively on banks in the EU involve detailed investigation of bank solvency and resilience under different macroeconomic conditions including, but not limited to, severe adverse scenarios. However, there is very limited back-testing of such data. We provide the first assessment of of the quality of stress tests in Europe. We want to know whether stress tests results provide useful information on the resilience of banks to macroeconomic shocks. Our main results are as follows. First, we find that a simple model of bank loss rates exposure fits the stress results well. Second, we find that these estimated exposures predict relatively well the realized losses of banks in subsequent years. Third, we estimate the market reaction of banks to macro announcement and we find that our estimated exposures help predict the cross sectional variation of bank stock returns after a macro announcement.

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Table 1: Summary of Model Estimation

This table presents a summary output of the models presented in equations (1) and (2). Model 2 is estimated in two steps. For model 1 and the first step of model 2, we estimate the θ_j^p parameters. In the second step for model 2, we use $\hat{\theta}_j^p \cdot y_{t,j}^s$ to estimate the β_i parameters of the model. The table shows which parameters are included in each step and the respective adjusted R^2 of the model.

	$\ln \frac{loss\ rate}{1-loss\ rate}$			
	Model 1 & 1st step of model 2		2nd step of model 2 Using $\hat{\theta}_j^p \cdot y_{t,j}^s$ from step 1	
	Corporate	Retail	Corporate	Retail
	(1)	(2)	(3)	(4)
# of α parameters	122	117	122	117
# of θ parameters	84	84		
# of β parameters			122	117
Adjusted R^2 (%)	60.15	53.34	64.44	63.80
Observations	3,148	2,760	3,148	2,760

Table 2: Descriptive Statistics

Provisions / Loans is the ratio of loan loss provisions over total loans from Bankscope in december 2013 and 2014. *Exp. losses* is the model prediction of loan losses with Eurostat macroeconomic figures for GDP growth, inflation and unemployment rates. *Equity return* is the equity return over a [-2;0] price window. $\triangle$*Exp. losses / CET1* is the difference between the model loss prediction after a macroeconomic release and the model loss prediction with the economists' consensus from Bloomberg over common equity tier1 of the bank.

	Realized losses			News shocks		
		Model 1	Model 2		Model 1	Model 2
	$\frac{Provisions}{Loans}$	$\frac{Exp.loss}{Loans}$	$\frac{Exp.loss}{Loans}$	Equity return	$\frac{\triangle Exp.loss}{CET1}$	$\frac{\triangle Exp.loss}{CET1}$
N	183	183	183	5,071	5,071	5,071
Min (%)	-0.88	0.00	0.00	-37.5	-1.49	-7.34
Median (%)	0.57	0.40	0.41	0.05	0.00	0.00
Max (%)	25.43	10.79	6.48	49.21	3.36	4.6
Mean (%)	1.33	0.74	0.72	0.04	0.00	0.00
StD (%)	2.76	1.20	0.93	3.19	0.13	0.18

Table 3: Predicted and Realized Losses

Regressions of bank loan loss provisions over total loans on stress test losses predictions with Eurostat macroeconomic data. *Exp. loss / Loans* is defined as model prediction of credit losses (either from model 1 or model 2) over the loan portfolio of the bank.

	Provisions / Loans					
	Model 1			Model 2		
		2013	2014		2013	2014
	(1)	(2)	(3)	(4)	(5)	(6)
Exp. loss / Loans	0.692***	0.679**	0.706***	1.217***	1.717***	0.874***
	(0.163)	(0.300)	(0.111)	(0.200)	(0.413)	(0.123)
2013 year dummy	0.006			0.006*		
	(0.004)			(0.004)		
Constant	0.005*	0.011***	0.005***	0.001	0.004	0.004**
	(0.003)	(0.004)	(0.002)	(0.003)	(0.005)	(0.002)
Adjusted R^2	0.10	0.04	0.31	0.17	0.15	0.35
Observations	183	92	91	183	92	91

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 4: Deviations from Baseline Predictions

Regressions of bank loan loss provisions over total loans on stress test losses predictions with Eurostat macroeconomic data in 2014. *Exp. loss / Loans* is defined as model prediction of credit losses (either from model 1 or model 2) over the loan portfolio of the bank. *Baseline ST losses / Loans* is the 2014 loan losses under the Stress test baseline scenario as published by the European Banking Authority (EBA).

	Provisions / Loans			$\frac{Provisions - Baseline\ ST\ loss}{Loans}$	
		Model 1	Model 2	Model 1	Model 2
	(1)	(2)	(3)	(4)	(5)
Baseline ST loss / Loans	0.866***	0.280	0.016		
	(0.158)	(0.243)	(0.263)		
Exp. loss / Loans		0.546***	0.863***		
		(0.178)	(0.221)		
(Exp. - Baseline ST loss) / Loans				0.529***	0.868***
				(0.177)	(0.221)
Constant	0.003*	0.004**	0.004**	0.003*	0.003**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)
Adjusted R^2	0.24	0.31	0.35	0.08	0.14
Observations	91	91	91	91	91

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 5: Macro News and Equity Returns

Regressions of bank equity return on a [-2;0] price window on stress test model predictions at macroeconomic releases dates. $\triangle$*Exp. losses / CET1* is the difference between the model loss prediction after a macroeconomic release and the model loss prediction with the economists' consensus from Bloomberg over common equity tier1 of the bank. *Market return* is the return of the Eurostoxx 600. Standard-errors are clustered at the bank level.

	Bank equity return					
	Model 1			Model 2		
	(1)	(2)	(3)	(4)	(5)	(6)
$\triangle$Exp. loss / CET1	-0.926***	-0.747**	-0.759**	-0.669***	-0.496**	-0.491*
	(0.234)	(0.288)	(0.327)	(0.182)	(0.220)	(0.253)
Market return	1.092***			1.092***		
	(0.101)			(0.101)		
Constant	-0.000	0.000	-0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.000)
Adjusted R^2	0.07	0.24	0.25	0.07	0.24	0.24
Observations	5,071	5,071	5,071	5,071	5,071	5,071
Date FE	N	Y	Y	N	Y	Y
Bank FE	N	N	Y	N	N	Y

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 6: Model-Weighted Market Factor and Equity Returns

Regressions of bank equity daily return on a market factors, exposure weighted market factor and stress test weighted market factor. *European market return* is the return of the Eurostoxx 600. *Exposure market factor* is the average of country market indices return weighted by country exposure size. *Stress test market factor* is the average of country market indices return weighted by country exposure size times the $\beta_{i,j}$ sensitivity to the adverse scenario. $\beta_{i,j}$ is defined in equation (7). Standard-errors are clustered at the bank level.

	Bank equity daily return					
	(1)	(2)	(3)	(4)	(5)	(6)
European market factor	1.162***					
	(0.078)					
Exposure market factor		1.193***		-0.365	-0.328	-0.318
		(0.084)		(0.430)	(0.422)	(0.412)
Stress test market factor			1.281***	1.659***	1.593***	1.581***
			(0.056)	(0.441)	(0.436)	(0.426)
Constant	0.000	0.000	0.000	0.000	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Adjusted R^2	0.15	0.30	0.32	0.32	0.35	0.35
Observations	22,294	22,294	22,294	22,294	22,294	22,294
Date FE	N	N	N	N	Y	Y
Bank FE	N	N	N	N	N	Y

* $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$