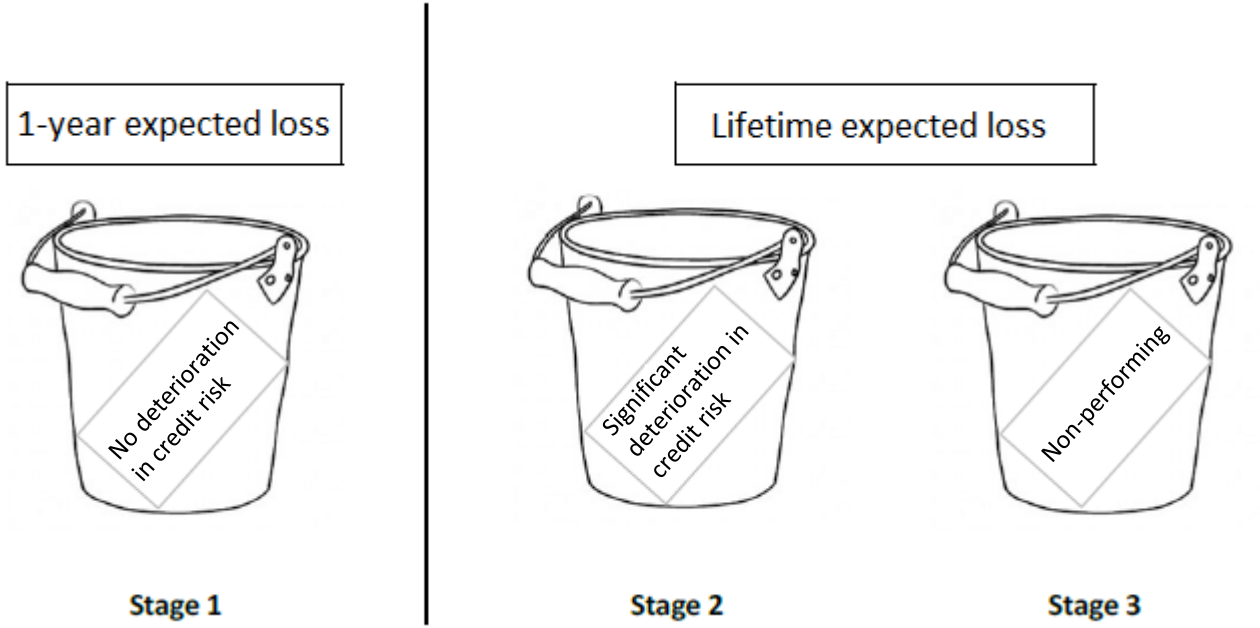
Péter Lang | Central Bank of Hungary

EBA 8th Policy Research Workshop|
Paris, 28th November 2019

AN APPROACH TO STRESS TESTING UNDER IFRS 9

IFRS 9: MAJOR CHANGE IN LOAN LOSS PROVISIONING

- Mandatory for credit institutions in the EU as of 2018
- Based on expected loan losses instead of incurred losses
- Differentiation of loan loss provisioning rules between stages, according to the change in contract-level credit risk since initial recognition



THE NATURE OF THE CHALLENGE

Challenge: to estimate how much loan loss provision (and risk-weighted assets) banks are going to hold *in each quarter of the stress testing horizon*, given a macroeconomic scenario and their loan portfolios

- With the forward-looking impairment recognition rules of IFRS 9, this is a double expected value…
- To calculate this, we need to
  1) Model the probability with which a contract resides in a given stage in a given period
  2) Conditional on being in this stage, what is the expected loss on the horizon pertaining to that stage (one year or lifetime)

ASSUMPTION FOR AN ANALYTICAL APPROACH

Assumption: processes determining in which state a contract is in a certain period have the ***Markov property***, i.e. the development of a contract from a certain point in time depends only on the state of that contract in that particular point in time, and not on the history (previous development) of the contract

- In practice, this means that when modelling transitions among states we cannot – or only in a highly restricted manner – take into account e.g. for how long a contract has been in a given state, or whether it has ever been to a certain state

- However, using this assumption the expected values become analytically computable, there is thus no need for a computationally intensive simulation…

EXPECTED LOAN LOSS PROVISION IN A FUTURE PERIOD

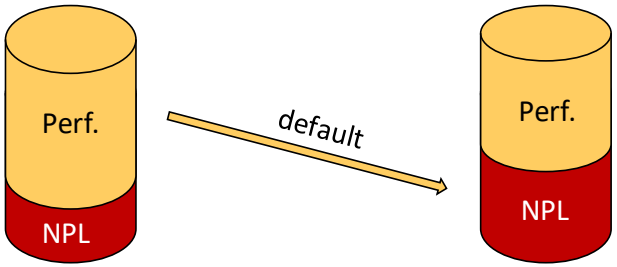
With this assumption, and given the macroeconomic scenario, the loan loss provision LLP_t of a contract for a future period t of the stress testing horizon can be formalised like this:

$$E(LLP_t) = \sum_{k \in K_1} P(k_t = k) \cdot \sum_{s=t+1}^{t+4} \{P(k_s = D \cap k_{s-1} \neq D \mid k_t = k) \cdot LGD_s \cdot EAD_s\}$$
$$+ \sum_{k \in K_2} P(k_t = k) \cdot \sum_{s=t+1}^{T} \{P(k_s = D \cap k_{s-1} \neq D \mid k_t = k) \cdot LGD_s \cdot EAD_s\}$$
$$+ \sum_{k \in K_3} P(k_t = k) \cdot \sum_{s=t_0}^{t} \{P(k_s = D \cap k_{s-1} \neq D \mid k_t = k) \cdot LGD_s \cdot EAD_s\}$$

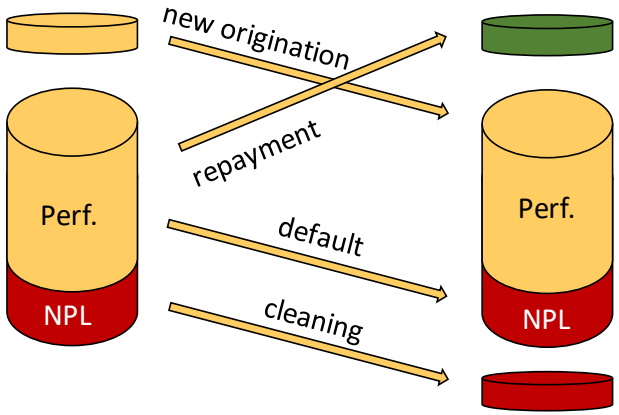
Here, k_t is a random variable referring to the contract's category (state) in period t, which takes on values from sets K_1, K_2 and K_3. The first two sets correspond to sets of states in which loan loss provisioning is based on one-year and lifetime expected losses, respectively. For the states in K_3, default has already occurred, thus the loan loss provision constitutes of losses expected to be incurred between scenario start t_0 and current period t.

Knowing the transition matrix process, as well as assumptions regarding the LGDs and expected exposures in each category, the expected LLP and the RWA is calculable!

DYNAMIC BALANCE SHEET ASSUMPTION



Static BS assumption



Dynamic BS assumption

- The static balance sheet assumption is conservative in a contraction, but underestimates risks during an expansionary period – like now…
- In our new modelling approach:
  1. (performing) **exposures mature**,
  2. **non-performing loans are potentially cleaned from the portfolio** with an assumed cleaning probability in each period,
  3. **new loans are extended**: we assumed a yearly loan origination equivalent in volume and structure to the newly-originated portfolio in the last observable year

ESTIMATING THE TRANSITION MATRIX – DATA

- The current version of the paper estimates transition matrices for the *non-financial corporate portfolio* of the Hungarian banking sector
- *Contract-level data* of the Central Credit Information System (credit register) in Hungary, linked to enterprises' financial statement data from the National Tax and Customs Administration
- The estimation horizon starts in 2010 Q1
- Quarterly frequency
- Contract-level approach

STATES IN THE MODEL

Stage 1

1) Contracts never been past due for more than 30 days so far
2) Contracts currently performing, but have been in arrears previously

Stage 2 ⇦ 3) Contracts delinquent for 30 – 90 days

Stage 3 ⇦ 4) Contracts delinquent for at least 90 days (defaulted contracts)

5) ”Out” state (contracts which have already been cleaned out of the balance sheet)

Note: the definition of the state belonging to Stage 2 does not involve the ”significant deterioration in credit risk” criterion.

This is because we calculate the PDs taking these states into consideration. Thus, if we based our Stage 2 criterion on the PDs estimated this way, we would run into a circular reference: our calculated PDs would define in which state a contract is, but transitions between states would change the PDs…

THE TRANSITION MATRIX

	Always performing (1)	*Currently performing (2)*	*Delinquent for 30 - 90 days (3)*	*Delinquent for at least 90 days (D)*	*Out (O)*
Always performing (1)	**R**		**1.**	**1.**	
Currently performing (2)		**R**	**2.**	**2.**	
Delinquent for 30 - 90 days (3)		**3.**	**3.**	**R**	
Delinquent for at least 90 days (D)				**R**	**A**
Out (O)					**R**

- Transitions marked with grey are not possible by definition
- There is a transition probability in every row which is determined as a residual (”**R**”), as transition probabilities of each row have to sum to 1
- The transition marked with ”**A**” is exogenously assumed
- Six transition probabilities needed to be modelled. We estimated these in three models

OTHER CONSIDERATIONS FOR THE ESTIMATION

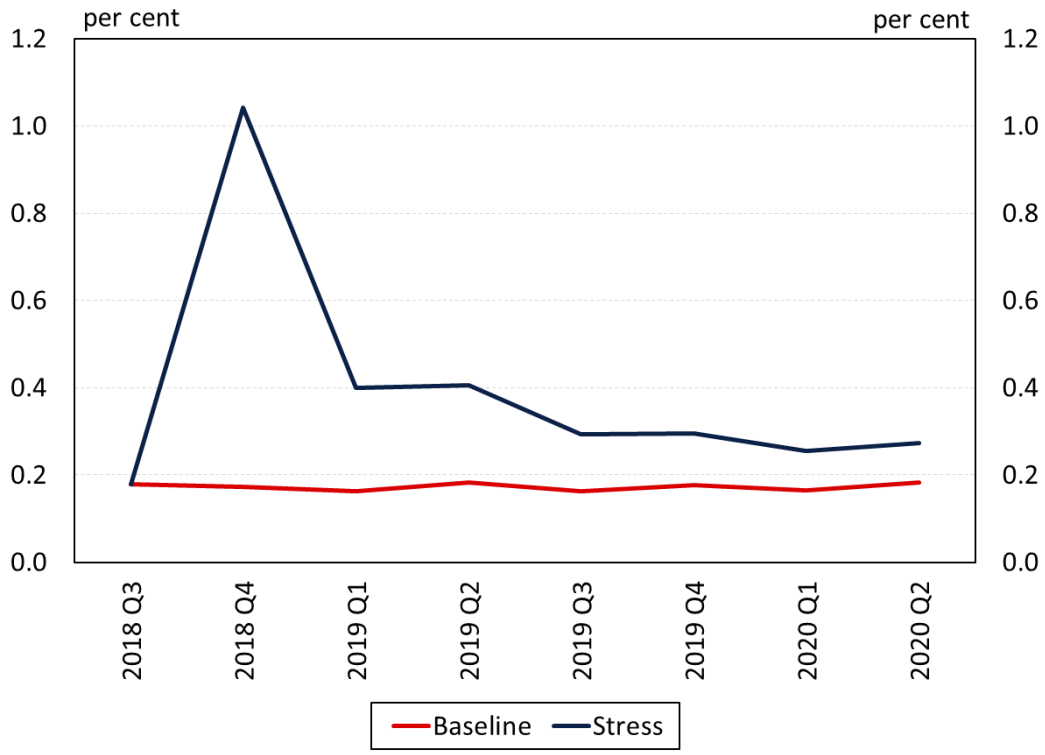
- **Estimation method:** discreet time representation of a proportional hazards model. This corresponds to a generalised linear model, with a complementary log-log link function (Jenkins, 2005).
- **Macro variables**: key for linking the macroeconomic scenario to defaults (and transitions).
  - However, due to the lifetime expected loss calculation, we need predicted transition probabilities till the maturity of our longest loan, so we need to forecast all our explanatory variables till that period!
  - Stress scenario: stress for 2-3 years, then convergence back to the macro model's steady state, and staying there afterwards
- **Contract- and corporate-level variables**: ones which are easy to forecast: (close to) constant, or deterministically varying variables
  - Company size (SME category), region of company headquarters, sector of main activity, company age, majority foreign ownership, export dummy, year of loan origination

MAIN ESTIMATION RESULTS

	Size of shock	Size of impact (percentage points)		
		(1) => (3), (D)	(2) => (3), (D)	(3) => (2), (3)
Risk premium (t-1)	300 basis points	0.38	-	-
Y-o-y difference of log real GDP (t-1)	-5 percentage points	0.38	-	-
Y-o-y difference of log end consumption (t-1)	-3 percentage points	-	6.83	-4.52
Exchange rate depreciation since loan origination (per cent) (t-1)	15 percentage points	0.06	-	-0.83
Average transition probability estimated for 2019 Q1 (per cent)	-	0.60	9.10	61.40

- Shock sizes have been chosen only as an illustration, but represent shocks used in previous stress scenarios
- As a comparison, we also depicted the average predicted transition probabilities for a period
- Compared to these values, the impacts of macro variables seem sizeable

RESULTS: NEW LOAN LOSS PROVISIONS IN EACH QUARTER



NEW LOAN LOSS PROVISIONS ON THE CORPORATE PORTFOLIO OF THE HUNGARIAN BANKING SECTOR

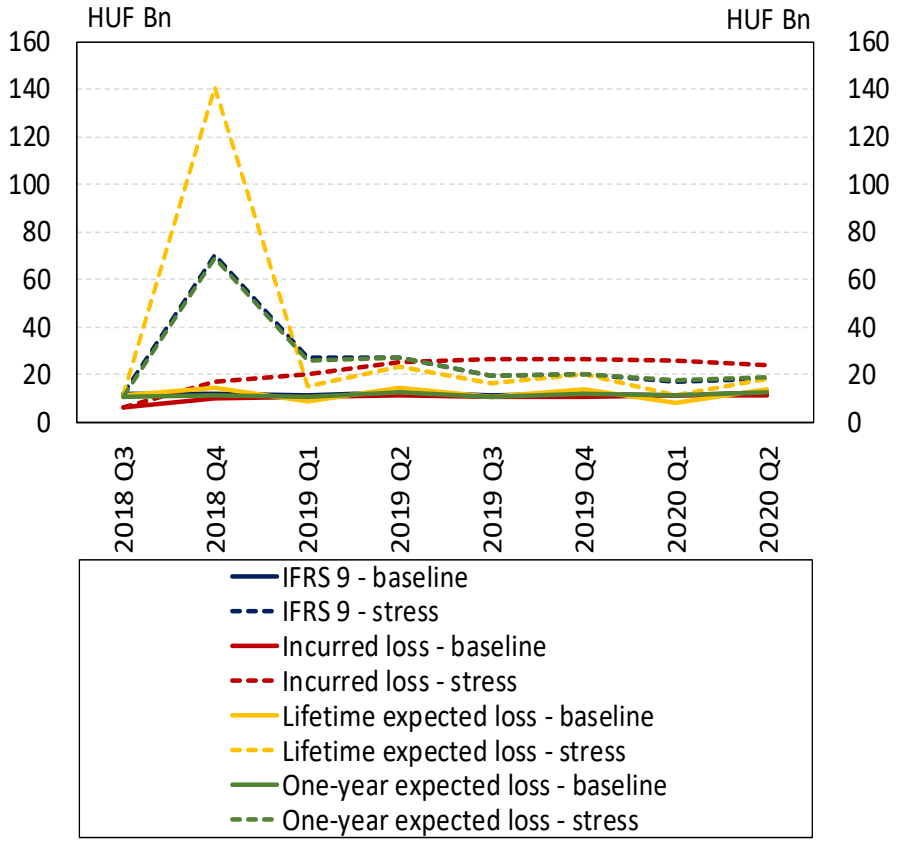
Using the baseline and stress scenarios in the solvency stress test of the November 2018 Financial Stability Report, in proportion to the initial RWA.

Upon the realisation of the shocks of the stress scenario (in 2018 Q4), as a result of a shock-like change in expectations, a considerable amount of impairment must be recognised immediately due to the increase of expected losses.

Furthermore, due to the worsening of transition probabilities, some additional impairment appears along the horizon.

Thus, the introduction of the IFRS 9 loan loss provisioning method will lead to a different impairment volume and dynamics than the previous approach, which might aggravate the procyclical behaviour of the banking sector.

NEW LOAN LOSS PROVISIONS WITH DIFFERENT PROVISIONING REQUIREMENTS



NEW LOAN LOSS PROVISIONS ACCORDING TO VARIOUS PROVISIONING REQUIREMENTS

For the non-financial corporate portfolio of the Hungarian banking sector, using the baseline and stress scenarios in the solvency stress test of the November 2018 Financial Stability Report.

- When calculating lifetime expected losses for all states, about twice as much loan loss provision to be recognised upon occurrence of the shock than according to IFRS 9
- Calculating one-year expected losses for all non-default states leads to roughly the same provisioning in the model as IFRS 9
- Loan losses materialise in the incurred loss approach only at defaults

CONCLUSION

- We have shown a way to introduce IRFS 9-compatible loan loss provisioning (and a dynamic balance sheet assumption) into solvency stress tests. To compute expected LLPs for each period of the stress testing horizon, we first estimated the matrix process of transition probabilities until the maturity of each contract, and then calculated LLPs and RWAs using these estimates. (Similar models in the literature: Skoglund and Chen (2017), Abad and Suarez (2017))

- Our results point to a change in impairment volumes and dynamics resulting from IFRS 9, which might aggravate the procyclical behaviour of the banking sector.

THANK YOU FOR YOUR ATTENTION!

APPENDIX: DETAILED ESTIMATION RESULTS

	(1) => (3), (D)	(2) => (3), (D)	(3) => (2), (3)
Macro variables			
Risk premium (t-1)	0.087 ***	-	-
Y-o-y difference of log real GDP (t-1)	-5.243 ***	-	-
Y-o-y difference of log end consumption (t-1)	-	-14.952 ***	4.265 ***
Exchange rate depreciation since loan origination (per cent) (t-1)	0.293 ***	-	-0.155 ***
Contract- or corporate-level variables			
SME category (reference: micro-enterprises)			
Small	-0.495 ***	-0.217 ***	0.035 ***
Medium-sized	-0.613 ***	-0.616 ***	0.026
Large	-1.098 ***	-0.783 ***	-0.493 ***
(Partially) owned by central or local government	-0.983 ***	-0.490 ***	-0.021
Majority foreign ownership	-0.174 ***	-	0.008
Export activity	-0.130 ***	-0.013	0.150 ***
Company age (reference: 1 closed year at most)			
2-5 years	-0.192 ***	-0.210 ***	-0.018
6-10 years	-0.471 ***	-0.449 ***	0.038
11-15 years	-0.713 ***	-0.574 ***	0.057 *
16-20 years	-0.887 ***	-0.643 ***	0.052 .
21-30 years	-1.039 ***	-0.746 ***	0.032
Over 30 years	-2.389 ***	-1.073 ***	0.298 **
Year of loan origination (reference: 2008)			
2000 and before	-0.049	-0.966 **	-1.709 ***
2001	-0.230 *	-0.439	-1.430 ***
2002	-0.551 ***	-0.370 *	-1.428 ***
2003	-0.690 ***	-0.618 ***	-0.728 ***
2004	-0.485 ***	-0.242 **	-0.687 ***
2005	-0.609 ***	-0.139 ***	-0.028
2006	-0.240 ***	-0.018	-0.002
2007	-0.022	-0.023	-0.009
2009	-0.107 ***	-0.097 ***	-0.060 ***
2010	-0.167 ***	-0.114 ***	-0.086 ***
2011	-0.184 ***	-0.083 ***	-0.168 ***
2012	-0.327 ***	0.060 *	-0.038 *
2013	-0.522 ***	0.171 ***	-0.032
2014	-0.652 ***	0.041	0.100 ***
2015	-0.703 ***	0.057	0.130 ***
2016 and after	-0.656 ***	0.046	0.167 ***
Intercept	-3.819 ***	-1.329 ***	0.032
Area under ROC curve	0.715	0.638	0.596