IMPACT OF COVID-19 ON STRESS TEST MODELS

CONTEXT

Since the 2008 financial crisis, the banking regulatory framework has been constantly reinforced in order to strengthen the financial system. In this context, regulators have emphasised the importance for banks of using stress tests to better identify potential weaknesses in their banking books, trading books and liquidity positions in the event of market turmoil.

As part of the increased use of stress tests, regulators have developed specific exercises (e.g. CCAR in the US, STEBA in Europe etc.) to assess not only a bank's resilience to different market downturns but also their overall governance and processes in place when facing these events in real conditions.

In Europe, the EBA has been coordinating regular EU-wide stress testing exercises since 2009. In November 2020, the EBA published the methodology for the 2021 EU-wide stress test exercise [(1)]. The scenarios will be released at the end of January 2021 and will include one baseline and one adverse scenario. The baseline scenario is the ECB best-estimate of the macro-economic environment over the 2021-2023 period, while the adverse scenario represents a severe but plausible negative deviation from this baseline scenario. These scenarios are provided in terms of macro-economic variables such as GDP, unemployment rate, HICP, stock prices, real estate prices, exchange rates, short and long-term interest rates etc.

[1] https://www.eba.europa.eu/eba-publishes-methodology-2021-eu-wide-stress-test

Using these variables, banks need to estimate the impact on their financial and risk metrics under both scenarios. To that end, they use econometric models which link the impact on bank metrics (output) from changes in macro-economic variables (input). So, when properly calibrated, these models are able to predict realistic timing and magnitude of changes to the financial and risk metrics depending on the inputs. For instance, under stress, they predict higher defaults and losses, higher capital requirements (RWAs), lower revenues and lower liquidity in addition to the timing of these impacts.

Obviously, the models can only provide realistic outcomes if their calibration is appropriate for their use. Indeed, the calibration of econometric models – like most financial models – is based on historical data to establish the relationship between outputs and inputs. This assumes that, when being used, the new scenario inputs are representative of the historical data on which the model was calibrated.

This condition might – and will likely - create an issue for banks when performing the 2021 STEBA exercise. This is due to the particular macro-economic environment created by the pandemic crisis and its consequences in terms of the behaviour of macro-economic variables, which is unprecedented compared to the historical data used for calibrating the models.

This can therefore result in counterintuitive and/or unrealistic model outcomes. For instance, the significant GDP fall observed in 2020 followed by the huge GDP rebound expected for 2021 (as predicted by the IMF [2] and expected to be in the 2021 STEBA as well) might lead to unrealistic model outcomes.

This paper crystallises this likely – although undesired – effect. To that end, we show model outcomes likely to be observed by banks in the 2021 STEBA when using their model under current calibration. We will then propose solutions and considerations for banks to mitigate the risk of having to deal with unrealistic model outcomes for the 2021 STEBA.

STRESS TEST MODELS

As explained above, stress tests are carried out through econometric models that predict the impact on financial and risk metrics (e.g. RWA, impairment, revenues etc.) from changes in macroeconomic variables (e.g. GDP growth, Unemployment rate etc.) for which ECB provides values under baseline and adverse scenarios. A typical stress test calculation process is depicted on Figure 1.

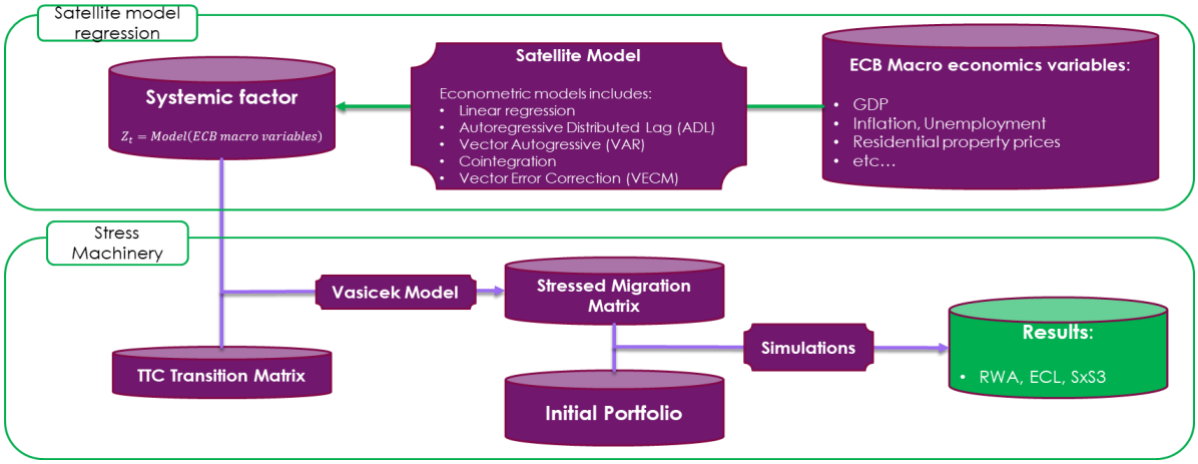

Figure 1. Typical stress test implementation process

Econometric models can include different combinations of macro-economic variables (1, 2, 3 or more variables) and lags[3] of these variables (0, 1, 2 lag …). The key factors influencing the choice, number and lags of macro-economic variables entering the model are:

[2] https://www.imf.org/en/Publications/WEO/weo-database/2020/October

[3] The lag represents the past-period of a variable, with the period typically being 1 month, 1 quarter or 1 year. For instance, if the period is expressed in year, the « lag-1 » represents the variable last year.

1. the scope of the model in terms of portfolio (e.g. corporate, residential mortgages, credit cards, commercial real estate …); and
2. the metric that it tries to predict (PD, LGD, ECL, RWA …).

As such, an econometric model can be written using the general form:

$$Y_t = F(X1_t, X2_t, \dots, XN_t)$$

where

- Y_t is the metric one tries to predict at time t;
- $F(\dots)$ is the modelling function [4];
- $X1_t$ is one of the macro-variables provided by ECB (e.g. GDP growth) at time t [5];
- $X2_t$ is another macro-variable (e.g. unemployment rate) at time t;
- …

For most Wholesale portfolios like large and mid-corporate, commercial real estate etc., the commonly used model for predicting stressed PD is the well-known Vasicek model. Obviously, each bank calibrates its Vasicek model differently using its own historical experience in terms of defaults and losses, resulting in different parameters and potentially different variables inside the model. That said, industry practice shows that banks have models using the same variables and only differing in their parametrisation. The reasons are that:

i. risk factors are often driven by similar macro-economic variables (corporate defaults in one country are often driven by the state of the country economy, the latter being well represented by GDP growth for instance); and
ii. macro-economic variables entering the model need to be intuitive in terms of business.

As a result, many banks have GDP growth as a key macro-economic variable inside their stress test models among other variables. This observation is true for other types of portfolios and models as well.

Given the pandemic crisis, the use of GDP growth in stress models will represent a key challenge for banks when performing the 2021 STEBA exercise as explained in the next section.

MACRO-ECONOMIC VARIABLES AND COVID-19

The Covid-19 pandemic has affected the whole world to various degrees. Political responses to stop the virus have impacted individual country economic performance. This is readily visible in Figure 1 where one plots key macroeconomic variables using Oct-2020 IMF World Economic Outlook data.

To understand the impact that these projections will have on the 2021 STEBA exercise, one identifies 2 areas by using different colours:

- the blue area being representative of the data typically used by Banks for calibrating their stress test models and ranging over the 2000-2018 period; and
- the pink area being representative of the data used by banks for projecting their financial and risk metrics in the 2021 STEBA exercise (taking into account that some models use lags of macroeconomic variables), ranging from 2019 to 2025.

As can be seen, GDP growth is the most impacted variable by Covid-19. In fact, lockdown and movement restrictions essentially stopped economic activity, reducing the supply and demand for goods and services. From 2000 to 2018, GDP growth fluctuates slightly with a variance of around 1.4%. The inflation and unemployment rate also have a lower volatility with respectively 0.83% and 0.80% standard-deviation. In the projection period, unemployment and inflation are expected to respectively increase by ~2% and decrease ~1%, while GDP growth plunges from 1.5% to -9.7% in 2020 and then suddenly rebounds to 6.0% in 2021.

The forecast behaviour of GDP is not captured at all in the calibration period (blue area), even though this period includes the Global Financial Crisis which shows at most a GDP fall of -2.9% in 2009 and a rebound of the economy

[4] E.g. Vasicek function, linear regression, multi-variate logistic regression, structural model, vintage model etc.
[5] Under this formulation, lags would be represented by $X1_{t-1}, X1_{t-2}$ …

at 2.2% in 2011. This unprecedented behaviour of GDP growth is therefore expected to result in similarly unprecedented projected outcomes as shown in the next section.

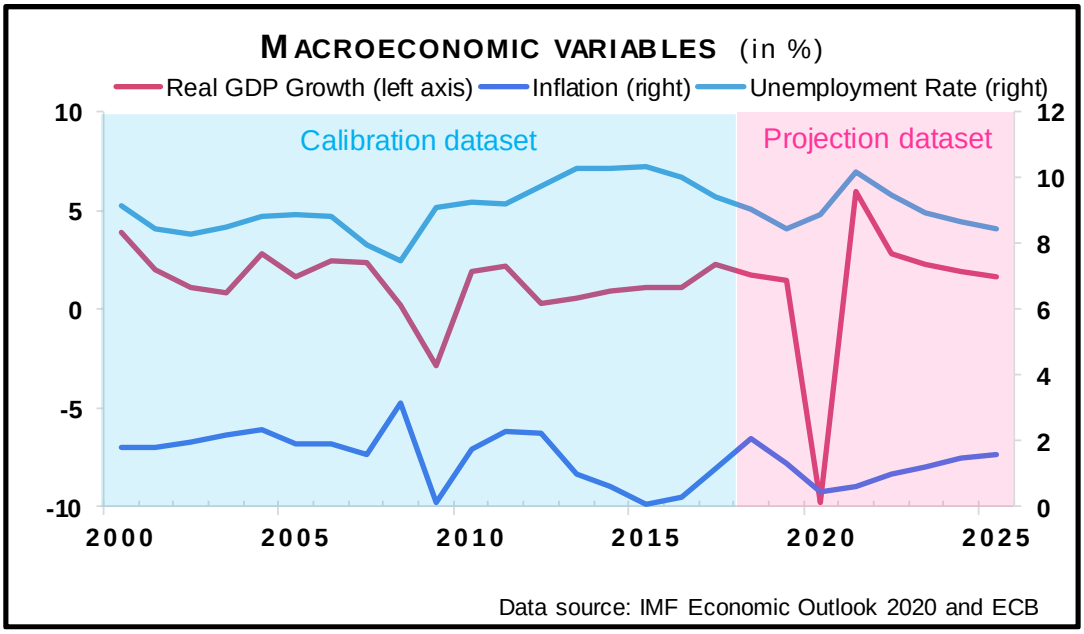

Figure 1. Macroeconomic variables from 2000 to 2025 for France

STRESS TEST OUTCOMES

To illustrate the effect mentioned above, we have constructed a simple Vasicek model using publicly available default rates from Standard&Poor's [6] over the period 2003-2018 and represented this in blue in Figure 2.

For calibrating the model, several macro-economic variables (incl. their lags) have been tested in order to find the best fit against the historical data. Ultimately, the best fit is obtained using GDP growth with a goodness of fit R^2=61%, which indicates a reasonable fit. This is confirmed when comparing the predicted default rates (in pink) against the historical values (in blue) over the 2003-2018 period where one sees that the 2 curves are nearly identical over that period. In particular, the model is able to capture the peak default rate at 4.2% in 2009 during the GFC, which is ideal for a stress test model.

However, when being used to project the default rates over the 2020-2025 period, one sees that the predicted default rate goes up to 21.1% in 2020, i.e. ~5x higher than during the GFC. This predicted value is driven by the sharp GDP fall in 2020 at -9.7%. This predicted value has never been seen over the last 40 years and therefore seems quite unrealistic. Clearly, one would expect that the pandemic would lead to an increase in default rates, maybe quite significantly and most likely higher than during the GFC. However, a value of ~20% is not expected. Similarly, the rebound of GDP in 2021 to 6.0% results in a predicted default rate of ~0.2%. Again, this extremely low value seems quite unrealistic.

[6] Standard & Poor's. (2020). 2019 Annual Global Corporate Default And Rating Transition Study

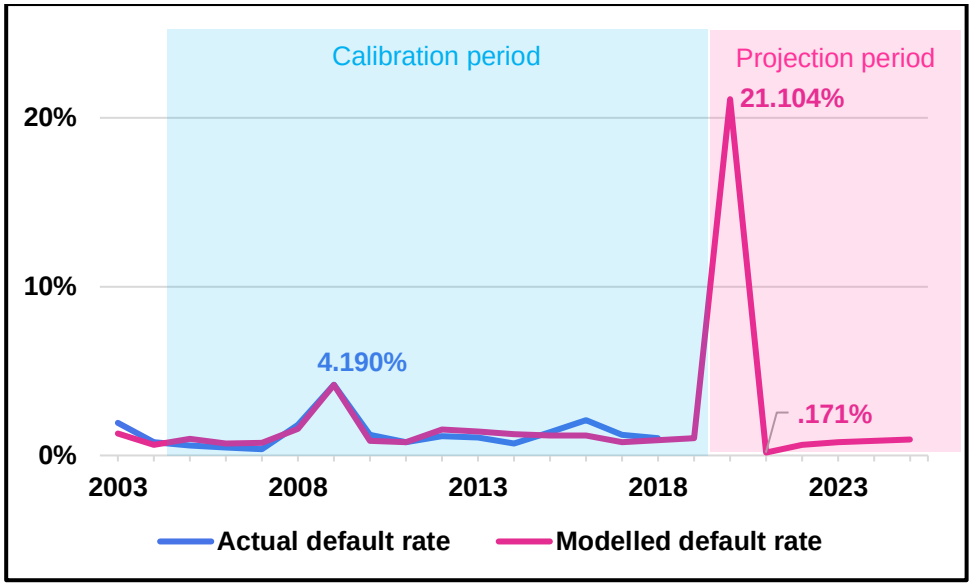

Figure 2. S&P historical default rates (blue) vs. predicted values (pink)

Obviously, each bank would end up with outcomes of different magnitudes than the ones shown above depending on their model function, calibration, variables entering the model etc. Nonetheless, banks should expect model outcomes to show "unexpected behaviour" if calibrated over identical periods and with the same variables.

While the above issue is illustrated using default rates, a similar impact is naturally expected with other metrics as well, such as RWA, ECL, impairments etc.

SOLUTIONS

One of the solutions to circumvent the problem of dealing with the 2020 and 2021 trends in terms of the macro-economic environment is to develop models which do not rely on variables exhibiting these unexpected (and yet actual) behaviours[7]. However, there are a number of issues with this. Developing good models takes time, regardless of whether the model is intended to "challenge" an existing model (fast model build) or whether it will be built from scratch (full model build). Indeed, in both cases, the development requires minimum modelling steps such as: data preparation, sound methodology, appropriate fitting, statistical tests, back-testing[8], benchmarking[9] – these last two steps being core to stress test model build – validation and model approval. This development time, although reduced for challenger models, might not fit into the rather constrained STEBA agenda – in particular for banks with diverse portfolios. Moreover, even if time allows for the development of challenger models, nothing prevents these challenger models from also displaying inappropriate outcomes.

Therefore, banks will likely need to find alternative solutions to challenge their model outcomes. Under this time constraint, the most appropriate solution is to use expert judgment. However, expert judgment requires thoughtful arrangements, organisation and controls – especially when used extensively and under time pressure. This clearly falls under the umbrella of governance.

HOW CAN REPLY ASSIST?

In conclusion, our advice for banks is to account for the likely possibility of using expert judgment more extensively during the 2021 STEBA exercise and as such to strengthen their governance over the development and implementation of these operational changes. This can take several forms

- include additional business experts (e.g. credit reviewers, members from debt recovery team, business lines) in existing meetings and working groups to challenge model outcomes;
- use more extensively historical losses based on internal and/or external data;

[7] Examples of variables being Residential Property Prices, HICP
[8] Tests based on historical events.
[9] Tests based on hypothetical scenarios.

- document expert adjustments made on model outcomes with transparency; and
- provide additional oversight when approving STEBA results at various levels of seniority.

Reply can provide support to banks on these processes given its experience in stress testing, knowledge of industry practices and expertise in regulations, e.g.

- setting-up and/or adapting existing governance, committees, working groups etc.;
- coordinating and steering committees and working groups;
- providing support for challenging stress outcomes;
- defining and implementing appropriate controls around adjustments made on model outcomes;
- providing support on documenting all of these adjustments.

CONTACTS

Dr Olivier DEBLIQUY, Senior Manager

Mobile: +33 (0)6 34 78 34 79
o.debliquy@reply.com

Dr Christian NGUENANG, Manager

Mobile: +33 (0)6 34 78 34 81
c.nguenangkapnang@reply.com

Anne LE HÉNAFF, Partner

Mobile: +33 (0)6 89 90 03 34
a.lehenaff@reply.com

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Avantage Reply France

3, rue du Faubourg Saint Honoré, 75008 Paris, France