## Stress testing

Defining stress testing is hard, since it doesn’t have one clear, official definition. The International Monetary Fund defines stress testing as "a range of techniques used to assess a vulnerability of a portfolio to major changes in the macroeconomic environment or to exceptional, but plausible events" (Blaschke et al., 2001). Taskinsoy (2019) defines stress testing as a simulation technique to assess financial stability via identifying strengths and vulnerabilities as well as the ability of financial institutions and -sectors to withstand both endogenous and exogenous shocks. Stress tests do not give an indication of the likelihood of a certain event to happen, it will only give insight in how much can be lost in a certain scenario (Peria et al., 2001).

Stress testing can be categorized along two dimensions as micro prudential or macro prudential. Micro prudential stress testing is narrow and focused on individual financial institutions. Financial institutions use it for internal risk management purposes. Supervisors use it to assess the health of financial institutions and the resilience of the sector they represent, for example banking or insurance sectors (Taskinsoy, 2019). Macro prudential stress testing measures the resilience of the entire financial system to extreme but plausible events (Taskinsoy, 2019). Adrian and Brunnermeier (2016) highlight the importance of forward-looking risk measures and its role of systemic importance.

Any stress test, whether micro- or macro prudential, must fulfill at least four key elements (Taskinsoy, 2019). First, identify existing and potential risk exposures to stress. Second, construct a stress testing framework and select scenarios that are both plausible and extreme. Third, decide the models and methods to quantify the impact under stress conditions. Fourth, measure and interpret the stress testing outcomes (Borio et al., 2014).

There are several ways to categorize the different methods of stress testing. First one is based on historical scenarios or hypothetical events. Historical scenarios are based on events in the past, for example the emerging market debt and currency crises of the late 1990s. They can be useful when some aspect of an historical scenario is expected to recur. However, such scenarios are backward looking and may lose relevance through time (Ruban and Melas, 2010). Hypothetical scenarios on the other hand consider plausible future developments. They allow a flexible formulation of an event and can use a mixture of elements. For example, a shock from a previous historical event can be combined with other developments that never occurred. An advantage is that they can be tailored. Shortcomings are that they can be labor-intensive, it may be difficult to convince decision makers that truly innovative scenarios are plausible and so the construction of hypothetical scenarios can still be limited by historical events.

Second way is to categorize the modelling used in tests to be either deterministic or stochastic (Ionescu & Yermo, 2014). With deterministic stress testing, scenarios are defined a priori without any reference to their likelihood. Deterministic approach employs predetermined, fixed scenarios. These often include an expected (best-estimate) scenario and a downturn scenario that may vary the degree of severity. In stochastic stress testing, scenarios are randomly generated to produce a distribution of results on the basis of distributions of the underlying assumptions. They employ randomly generated scenarios and deliver outcomes of a resulting probability distribution of one or more target variables.

There are a few shortcomings in stress testing. Micro prudential stress testing can be narrowly focused, resource intensive, costly and risk measurement methods may vary between financial institutions. Macro prudential stress testing is costly, time consuming and complex (Taskinsoy, 2019). In general, if the stress tests are not relevant for an institution or portfolio or when it ignores spillovers between markets and risks, it can give misleading information to managers. Risk managers can get a false sense of security when stress tests are poorly specified. As a consequence, incorrect measures might be taken to protect the institution against a certain risk.