CNB CZECH NATIONAL BANK

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MACRO STRESS TEST OF THE INSURANCE SECTOR

METHODOLOGY

Contents

CONTACT: Financial Stability Department
Na Příkopě 28
115 03 Prague 1
financial.stability@cnb.cz
www.cnb.cz

1. Introduction

The aim of stress testing insurance companies[1] is to assess the resilience of the insurance sector as a whole to future developments as described by hypothetical scenarios. Each year, the CNB uses the macro stress test (MST) presented below to assess the dynamic impact of a macroeconomic scenario on the static balance sheets of individual insurance companies operating in the Czech Republic over a three-year horizon (T_3). The MST has three main building blocks: (1) repricing of insurance companies' assets, (2) repricing of insurance obligations and other technical insurance stocks and flows, and (3) an analysis of solvency and liquidity positions and subsequent combination of the results for individual insurance companies.

The test uses quarterly data available to the CNB from regular reporting by insurance companies (see Table 1). The initial values of the variables entering the test are those for year T_0, which precedes the start year of the test (T_1). For stock variables these are the values at the end of year T_0, and for flow variables they are the values for the whole year T_0. To assess the resilience of insurance companies, the following assessment indicators are studied: (1) solvency capital ratio, i.e., the ratio of eligible own funds to the solvency capital requirement (SCR), (2) the capital shortfall, and (3) the amount of liquid assets in insurance companies' balance sheets. The CNB analyses not only whether or not these indicators exceed their critical levels in each quarter over the three-year horizon, but also – as another important vulnerability indicator – whether they are nearing those critical levels. The critical levels of the indicators in the test are as follows: (1) a solvency capital ratio of less than 100%, (2) a capital shortfall, i.e. the eligible own funds are lower than the SCR, and (3) zero liquid assets, i.e. the insurance company is forced to sell off assets.

The scope of the test – in terms of which of the elements listed below are included – may differ from year to year depending on the current focus of the test and the macroeconomic scenario.[2] This methodology is currently in use. It changes over time, mainly as a result of constant refinements, the use of relevant new data sources and/or the inclusion of other risks tested.

1 The test may also include one reinsurance company, depending on the selected scope of the test. For the sake of clarity, however, this document abstracts from this fact. So, for the purposes of this test, the term "insurance company" covers both insurance companies and the reinsurance company.

2 Three MSTs of insurance companies had been conducted as of June 2021. The 2019 and 2021 tests were broader – they included most of the aforementioned elements and provided insights into what risks are systematically important for the insurance sector. By contrast, the 2020 test was narrower and focused on the asset side. This was motivated by ongoing shocks on financial markets connected with the outbreak of the Covid-19 pandemic, and also by the fact that changes in asset prices had proved to be the key risk to the insurance sector as a whole in the previous test year.

2. Stress test scenarios

The first step of the test is to design the macroeconomic scenario, which determines the type of risk to be tested and the degree of stress to be simulated. The adverse macroeconomic scenario (stress) usually reflects the most important risks, which, were they to materialise, would have major effects on the economy and the financial system. A baseline macroeconomic scenario based on the CNB's official forecast in the first two years is also used in the MST of insurance companies to compare the impact of the stress with the most likely scenario. The output of the macroeconomic scenario is complemented with projections of selected financial variables, generated using the appended CNB satellite models. The MST of insurance companies uses GDP, the three-month and one-year PRIBOR and EURIBOR, the exchange rate and the inflation rate from the official projection model. Koruna, euro and dollar interest rate swap rates, credit spreads of government and corporate bond yields vis-à-vis interest rate swap rates, equity prices and property prices enter the MST of insurance companies from the satellite models.

These scenarios are expanded further for the purposes of the MST of insurance companies. Risk-free yield curves are derived from the interest rate swap rates assumed in the scenarios using the EIOPA methodology. Changes in bond yields are used to calculate a volatility adjustment (VA).[3] Therefore, four scenarios for risk-free yield curves are created for the purposes of the MST of insurance companies: baseline, baseline with VA, adverse, and adverse with VA. Scenarios are also created for other pure insurance variables: premiums, claim settlement costs, the rate of early termination of life insurance policies and the policy renewal rate in non-life insurance. These scenarios are calibrated based on a combination of past experience, related research findings[4] and expert judgement.

3. Asset side analysis

The analysis of the assets, or investment instruments, held by insurance companies at time T_0 is based on comparing the value of these assets under the scenario over the period T_1 to T_3 with the level at the end of T_0. Cash flows arising from the assets (yields in the form of coupons or dividends, and repayments of principal on bonds) are also assessed. The analysis of assets is conducted primarily at the level of individual investment instruments, i.e. individual securities, deposits, derivatives, real estate and so on (see Table 1).

For each instrument, the parameters needed for the test are obtained from data reported by insurance companies and from other sources (Bloomberg, Refinitiv, Centralised Securities Database). These include in particular the type of instrument (equity, bond, investment fund unit, property, real estate, loan provided), the issuer's category and country (corporation or government) and the currency, and for bonds also the maturity date, the coupon parameters and the rating, and for equities also dividend income in previous years.

In the case of bonds, the parameters obtained help define the future cash flows arising from bond holdings, which determine current bond prices. The scenario assumes that risk-free discount rates and credit spreads change depending on the bond's rating, residual maturity and currency. The cash flows are revaluated on the basis of those changes. This determines the hypothetical price path of the bond and the cash flows into the insurance company over the horizon of the chosen scenario. A change in bond prices affects the insurance company's profit/loss and hence its solvency position, while the cash flows also determine its liquidity position. Interest rate derivatives are repriced in the same way as bonds. Their repricing and the related cash flows also affect the insurance company's solvency and liquidity position.

3 See https://www.eiopa.europa.eu/tools-and-data/risk-free-interest-rate-term-structures_en#Risk-freeratespreviousreleasesandpreparatoryphase, where resources are located. The issue of constructing risk-free yield curves is beyond the scope of the methodology for this MST; the above link also provides technical documentation.

4 Including CNB research, for example Hodula, M., Janků, J., Časta, M., Kučera, A. (2020): On the Determinants of Life and Non-Life Insurance Premiums. CNB WP 8/2020. https://www.cnb.cz/export/sites/cnb/en/economic-research/.galleries/research_publications/cnb_wp/cnbwp_2020_08.pdf.

The price haircuts assumed in the scenario are applied to the equities, direct participating interests and real estate held by the insurance company. The cash flows into the insurance company arising from equities, direct participating interests and real estate over the scenario horizon are also revised according to the scenario, as changes in these flows affect the insurance company's liquidity position. Loans provided by the insurance company are subject to the same stress as corporate bonds.[5]

The look-through approach is applied to the insurance company's investment fund units. An investment fund unit is revalued depending on the composition of the fund's portfolio: the same stress is applied to the individual asset categories in the fund's portfolio (equities, bonds, real estate, etc.) as to the assets in the relevant categories held directly by the insurance company. This means that in the case of a pure equity investment fund the change in the value of a unit will equal the change in the value of the equities held by the insurance company, while in the case of a mixed equity and bond fund it will equal the average change in the prices of the equities and bonds held by the insurance company. A scenario for prices of equities, which are the asset category under the greatest stress in the test, is used for the part of investment fund portfolios to which the look-through approach cannot be applied for data reasons (for example, the investment fund's portfolio consists partly of units in other funds).

Table 1
Overview of data entering the MST of insurance companies

Data area	Type of information	Source
Assets	Individual investment instruments, their value and other parameters	Statements of insurance companies, Bloomberg, Refinitiv, Centralised Securities Database
	Balance sheet value of other asset categories	Statements of insurance companies
	Information on asset composition of investment funds whose units are held by insurance company	Statements of insurance companies
Liabilities	Value of technical provisions, expected future cash flows, balance sheet value of other accounts payable	Statements of insurance companies
	Discount rates, risk-free yield curves	EIOPA, Refinitiv
Financial derivatives	Value of derivative and its parameters	Statements of insurance companies, EMIR database
Own funds	Value of SCR and eligible own funds	Statements of insurance companies
	Dividend policy	Statements of insurance companies, annual reports
Insurance technical account	Premiums written/earned, claim settlement costs, share of reinsurance, investment income, other costs (operational)	Statements of insurance companies

5 Loans or other accounts receivable, which are used in synthetic hedging via repo operations, are excluded from the test. Whether a loan/receivable is included in synthetic hedging is determined by identifying the related liability in the insurance company's balance sheet. Synthetic hedging occurs in simplified terms as follows: an insurance company seeking to hedge borrows money in foreign currency, converts it into CZK at the spot rate and deposits it at a bank operating in the Czech Republic. It repays the foreign currency loan using income on foreign currency investments and "releases" the koruna deposit against it. This means that the CZK income is not subject to foreign exchange risk.

4. Analysis of liabilities side and insurance technical flows

The scenario impact testing also involves key insurance technical variables: insurance technical provisions, premiums collected, claim settlement costs, the lapse rate (in life insurance) and the retention rate for shorter-term (usually one-year) policies (in non-life insurance).

Insurance technical provisions are calculated by discounting the expected future cash flows arising from insurance obligations. The scenarios evaluate changes in discount rates represented by shifts in risk-free yield curves, which also change the value of insurance technical provisions and hence profit/loss and own funds. In the test, these changes are considered for longer-term life insurance policies (of over one year). For insurance companies which use VA, changes in insurance technical provisions are assessed in two variants: with and without VA for discounting by means of risk-free yield curves. This method of calculating the impact of shifts in risk-free yield curves on technical provisions is simplified, as it neglects the loss-absorbing capacity of technical provisions to respond to the changes in the risk-free yield curves (e.g., by decreasing the originally expected shares in investment profits to be paid to policyholders). Therefore, this method represents the upper bound of the impact of shifts in risk-free yield curves on technical provisions. Under the adverse macroeconomic scenario, the effect of a potential increase in the lapse rate, which represents a source of additional liquidity stress on insurance companies, is also assessed. For simplicity, the effect of an increase in the lapse rate on the solvency position of insurance companies is not considered.

In the case of unit-linked life insurance policies, technical provisions are adjusted directly for the change in the value of the assets held for these policies. This offsets the impact of the change in asset value on the insurance company's solvency position. Any lapses and increased liquidity need are also relevant for such insurance.

In the case of policies with a duration of up to one year (primarily in non-life insurance), the changes in premiums, claim settlement costs and other related insurance variables[6] under the scenarios are considered. This also affects the profit/loss in individual years (and hence the change in the insurance company's own funds). Under the scenarios, the loss ratio (the ratio of claim settlement costs to premiums) affects the insurance company's profit/loss and hence its ability to offset any devaluation of investment assets. Any mismatch between premiums received and claim settlement costs also affects the insurance company's liquidity.

5. Indicators for evaluating risks tested

The aforementioned impacts of the scenarios on assets, liabilities and insurance technical flows determine insurance companies' solvency and liquidity positions, or the change in these positions compared to the starting position at time T_0. The MST generates the dynamic evolution of the solvency capital ratio, the capital shortfall and the liquidity buffer, and provides a comparison thereof with the following critical levels: (i) a solvency capital ratio of 100%; (ii) a capital shortfall; and (iii) an exhausted liquidity buffer and hence a need to sell assets.

Given the simplifying assumptions made, arising not only from the scenario but also from other factors (see below), the test results should be considered quite conservative, especially in the solvency area.

6 The renewal rate and creation of new non-life insurance policies affect total premiums and claim settlement costs in the scenarios. This also relates to reinsurance, commission and other costs in non-life insurance, for which similar changes are considered as changes in premiums.

Evaluation indicators

(1) Solvency capital ratio (T) = own funds eligible to cover SCR (T)/SCR ($T=T_0$)

(2) Capital shortfall (T) = min(own funds eligible to cover SCR (T) - SCR ($T=T_0$); 0)

where the own funds eligible to cover the SCR (T) = the own funds eligible to cover the SCR (T_0)

+ the effect of asset repricing ($T-T_0$)
+ additional profit on assets (the cumulative sum of T_1, T_2, … T)
+ profit or loss on the insurance technical account (the cumulative sum of T_1, T_2, … T)
- dividends paid (the sum of T_1, T_2, … T)
- other fixed costs (administrative expenses, etc.)
- tax on profit (the cumulative sum of T_1, T_2, … T)

where the result of the insurance technical account at time T_1, T_2, … T (generally T_x) = the result of the insurance technical account (T_0)

+ the change in the difference in earned premiums and claim settlement costs in non-life insurance (T_x-T_0)
+ profit/loss due to change in value of technical provisions in life insurance ($T_x - T_{x-1}$)

and the tax on profit relates to the profit in each period that is affected by the result of the insurance technical account, the effect of asset repricing, the additional profits on assets and fixed costs in that period.

For insurance companies that apply VA, the indicator values are also calculated on the assumption of non-application of VA. This makes it possible to assess the importance of VA application for the solvency position of insurance companies.

(3) Liquidity buffer (T) = Liquidity buffer before fire sale of assets (T)
+ Fire sale of assets (T)

where ***Liquidity buffer before fire sale of assets (T)*** = *Liquidity buffer (T-1)*

+ inflows from assets (yields, principal payments)
+ inflows from insurance products (premiums)
- outflows from insurance products (claim pay-outs, including the value of the saving component in life insurance in the event of regular or early policy termination)
- other outflows (operational expenses, dividends)

and ***Fire sale of assets (T) = min(Liquidity buffer before fire sale (T); 0)***

A fire sale of assets thus occurs in the test when the liquidity buffer (cash and funds on demand bank accounts) before the fire sale is not sufficient to cover the outflows. For simplicity, the test assumes that insurance companies sell Czech government bonds if forced to sell assets.[7]

The results for individual insurance companies are aggregated into total values for the sector. The test thus generates information on the total solvency capital ratio, or the identification of insurance companies that exceeded the 100% capital ratio threshold, on the total capital shortfall (i.e. the sum of the negative differences between eligible own funds and the SCR) and on the size of the aggregate liquidity buffer and the volume of fire sales. Another important test output is the distribution of insurance companies by the given variables, especially the number of insurance companies with insufficient own funds to cover the SCR and the number of insurance companies that have an insufficient liquidity buffer and would have to sell assets.

7 This assumption is not material to the results of the stress test, because the test currently abstracts from the second-round effects of asset sales. Nevertheless, it will make it possible to link the liquidity stress arising from macro stress tests of various sectors of the domestic financial system and the multiplication of that stress through sales on the Czech government bond market in subsequent years of the test.

Simplifications

The aforementioned calculations and results of the MST of insurance companies involve a number of simplifying assumptions. These simplifying assumptions are a direct consequence primarily of insufficient data. They are thus not assumptions underlying the construction of the scenarios, which are a natural consequence of a lack of knowledge about future developments. A comparison of the results of the MST and the results of supervisory stress tests, where the extent of missing data and thus of the simplifications made is lower, can be used to estimate the consequences of applying simplifying assumptions.

The simplifications lead for the most part to more conservative results than those that would be obtained if the simplifications were not made. This is because insurance companies can react to adverse developments to mitigate their impacts, a fact which the MST often abstracts from. The MST models the static balance sheet at time T_0, i.e. it assumes no changes in the balance sheet structure outside the modelled paths of the value of assets, liabilities, profits/losses and own funds and expected cash flows.

The main simplifications are as follows (the sign in parentheses shows the expected impact of the simplification, i.e. (+) more conservative test results, (-) less conservative test results, or (+/-) a potential two-way effect):

(+/-) The test assumes no additional effects and no correlation between the factors affecting future cash flows which are used to calculate the value of insurance technical reserves.

(+) Dividends paid assume that dividend policy (i.e. the ratio of dividends to previous-year profit) will remain at the level of the average distribution ratio over the last three years.[8]

(+/-) The SCR is not recalculated.

(-) The test abstracts from the fact that some insurance companies have to comply with a minimum capital requirement which for them exceeds the SCR.[9]

(+/-) Insurance companies do not reinvest principal received or other sources of liquidity but leave them as deposits on current accounts.

(+/-) Tax is derived from profits and losses calculated under Solvency II (i.e., assuming the revaluation of assets according to their market prices, for instance) rather than the book profit.

(+/-) Administrative expenses and other operational costs are assumed to be constant.

(+/-) The effect of the exchange rate is not taken into account, nor are derivatives (other than interest rate derivatives) and synthetic hedging included in the test, because, in addition to interest rate derivatives, insurance companies mainly use hedging against foreign exchange risk, which is thus low in the long term and immaterial in terms of the MST.

(-) The test abstracts from any liquidity stress arising from holdings of derivatives (margin calls).

(+/-) The test abstracts from insurance companies' membership of, and links within, financial groups and from stress arising from the links between insurance companies and other financial institutions beyond the scope of the shocks modelled.

(+/-) The test abstracts from risks arising from reinsurance and assumes no additional (positive or stress) effects arising from changes in reinsurance policies over the test horizon on the solvency or liquidity position. However, the calculation does take into account assignment of part of premiums and claim insurance costs to the reinsurance company to the extent corresponding to the situation as of the base year T_0.

8 The year 2020, when dividend payments were suspended due to the coronavirus pandemic, is excluded from this calculation.

9 However, as these insurance companies have only a relatively low share of the domestic insurance market, this simplification does not lead to any major distortion of the aggregate test results.