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Adverse scenario for the European Insurance and Occupational Pensions Authority's EU-wide pension fund stress test in 2017

1. Introduction

In accordance with its mandate, the European Insurance and Occupational Pensions Authority (EIOPA), in cooperation with the ESRB, initiates and coordinates EU-wide stress tests to assess the resilience of institutions for occupational retirement provision (henceforth "pension funds") to adverse market developments. The ECB, in collaboration with the ESRB, has developed the narrative and the methodology and has calibrated the adverse financial scenario for the 2017 exercise. These three elements are presented in this document, which has been approved by the ESRB General Board and transmitted to EIOPA.

The scenario for the individual risk factors presented in this document should be interpreted as a set of one-off, instantaneous shifts in asset prices and yields relative to their levels as at 31 December 2016. The scenario includes 257 individual risk factors[1] designed to cover the investment exposures of pension funds' assets. It also includes the euro swap rate curve as a measure of risk-free interest rates that EIOPA will use to revalue pension funds' liabilities. The scenario combines a drop in risk-free interest rates with a fall in the price of assets held by pension funds (a "double hit" scenario), which results in a deterioration of pension funds' capital positions.

The scenario has been designed for the harmonised valuation of defined benefit (DB) and hybrid pension funds using a common balance sheet approach and the market valuation of assets of defined contribution (DC) pension funds.[2] Assumptions about long-term risk premia, which are needed for other components of EIOPA's stress test, are developed by EIOPA and are not presented in this document.[3] In addition, guidance on applying the scenario is provided separately by EIOPA and is not covered here.

Section 2 outlines the narrative of the scenario and Section 3 presents the calibration of the scenario. The simulation methodology used to calibrate the scenario is presented in Annex 1.

[1] This number excludes aggregates for, for example, the European Union and the euro area.

[2] The common balance sheet approach entails a market-based, risk-sensitive valuation for pension funds' balance sheets and is an essential part of EIOPA's Opinion to EU institutions on a common framework for risk assessment and transparency for pension funds: https://eiopa.europa.eu/Publications/Opinions/EIOPA-BoS-16-075-Opinion_to_EU_Institutions_Common_Framework_IORPs.pdf. The common balance sheet approach enables EU-wide comparisons of the stress test results across Member States and participating institutions.

[3] Assumptions about long-term risk premia are required for the DB/hybrid part of the stress test when conducted under national valuation standards (i.e. not under the common valuation standards), since in many countries the national discount rates are based on the expected long-term returns on assets. The long-term risk premia assumptions are also needed to assess the adverse scenario's impact on the future retirement income of plan members in the DC part of the stress test.

2. Scenario narrative

In view of their sizable investment portfolios and long-term liabilities, DB pension funds are particularly vulnerable to a "double hit" scenario, which would be characterised by an abrupt and large drop in asset prices in conjunction with a decrease in risk-free interest rates. This adverse scenario is assumed to materialise in an environment of heightened uncertainty, with one contributing factor from within the EU stemming from the outcome of the United Kingdom's referendum on its membership of the Union. From outside the EU, signs of rising protectionism in the United States and general uncertainty about the course of US policy over the medium term could weigh adversely on economic and financial conditions in Europe.

The adverse scenario is triggered by a shock to EU equity markets. This assumption is motivated by signs of overvalued equity prices in some regions, both within and outside Europe, and by the fact that pension funds' equity exposures are large when compared with other asset classes they invest in. In response to the equity market shock, risk premia would increase for a number of other asset classes to which pension funds are exposed. The scenario would result in a deterioration of financing conditions in corporate and sovereign debt markets as well as real estate and commodity markets. This is accompanied by increased concerns about the creditworthiness of some EU sovereigns, leading to a renewed widening of sovereign bond yield spreads over "safe-haven" sovereigns. In addition, in the scenario "safe haven" sovereigns would experience a widening of the spread between their yields and risk-free interest rates.

Risk-free interest rates would fall in the scenario, reflecting assumed continuing structural change in demographics with the age distribution skewing increasingly towards an older population, along with an associated further drag on productivity growth. This is assumed to be combined with the cyclical support of low interest rates resulting from accommodative central bank policy in the aftermath of the global financial crisis.

In addition, inflation rates would fall slightly under the adverse scenario. This reflects the impact of weaker demand following the drop in equity prices and associated generalised increases in risk premia, and is consistent with the decline in risk-free interest rates. Even though pension claims are often linked to future inflation, any positive effect on pension funds' solvency position due to the slight fall in inflation would be by far outweighed by the negative impact of the asset price falls and the fall in risk-free interest rates.

3. Scenario calibration

The adverse scenario calibration for all risk factors requested by EIOPA is presented in tables 1 to 8. The instantaneous shifts in asset prices and yield parameters have been calibrated using the ECB's financial shock simulator (see Annex 1 for details) on the basis of data covering the years 2008 to 2016. The EU equity market has been defined as the origin of the shock. Model overlays were used for residential and commercial real estate prices to increase the response of real estate prices across all countries. In addition, a model overlay was introduced to increase the sovereign shock responses for countries where sovereign bond yield responses were deemed too low. Conditional on the sample period (2008 to 2016), the probability of the adverse scenario materialising over a one-quarter horizon is 0.5%.

Table 1: Equity price changes*

Developed economies	-36%
EU	-48%
United States	-24%
Other	-37%
Emerging markets	-27%

* shock origin is the EU equity market.

Table 2: Changes in euro swap rate curve (in basis points)

1Y	2Y	3Y	5Y	7Y	10Y	20Y	30Y
-35	-50	-55	-54	-53	-51	-46	-47

Table 3: Changes in euro inflation swap curve (in basis points)

1Y	2Y	3Y	5Y	7Y	10Y	20Y	30Y
-10	-12	-13	-14	-11	-12	-10	-11

Table 4: Changes in corporate bond yields (in basis points)[4]

	Non-financial	Financial	Financial, covered	All
AAA	32	37	20	28
AA	35	40	21	39
A	45	109	38	60
BBB	50	252	-	106
BB	342	342	-	342
B	659	659	-	659
<=CCC	921	921	-	921
Investment grade	36	110	20	30
High yield	574	645	-	598
All	207	222	20	41

Table 5: Changes in real estate investment trust prices

Global	-28%
EU	-41%
Non-EU	-31%

[4] The aggregates presented in Table 4 are volume-weighted averages of the shock responses at rating-class level. For covered financial bonds, the volumes corresponding to AAA bonds dominate the other rating classes and the aggregate shock is therefore close to the AAA bonds' shock response.

Table 6: Changes in share prices of private equity firms and hedge funds and in commodity prices

Private equity firms (global)	-39%
Hedge funds (global)	-10%
Commodities (global)	-24%

Table 7: Changes in sovereign bond yields (in basis points)

	2Y	5Y	10Y
Belgium	50	53	46
Germany	4	0	0
Ireland	138	104	133
Greece	548	509	489
Spain	116	111	109
France	31	44	47
Italy	153	135	130
Cyprus	103	95	92
Latvia	95	101	109
Lithuania	69	158	163
Luxembourg	9	27	44
Malta	69	81	82
Netherlands	27	40	48
Austria	22	45	49
Portugal	186	173	161
Slovenia	65	58	104
Slovakia	63	69	72
Finland	17	46	48
Bulgaria	103	87	80
Czech Republic	75	85	91
Denmark	37	54	51
Croatia	117	113	103
Hungary	242	283	169
Poland	145	138	119
Romania	70	105	137
Sweden	38	53	53
United Kingdom	52	56	43
Iceland	36	51	49
Liechtenstein	30	41	41
Norway	24	30	33
Euro area	**85**	**82**	**82**
EU	**80**	**79**	**76**
EEA	**79**	**79**	**75**

Note: Nominal amounts of outstanding sovereign debt as of the end of 2015 were used to calculate the euro area, EU and European Economic Area (EEA) aggregates.

Table 8: Changes in residential and commercial property prices

	Residential	Commercial
Belgium	-6.5%	-6.7%
Germany	-6.5%	-6.8%
Estonia	-6.4%	-13.5%
Ireland	-3.3%	-10.1%
Greece	-7.8%	-8.0%
Spain	-6.4%	-8.7%
France	-4.8%	-7.8%
Italy	-5.8%	-7.1%
Cyprus	-5.7%	-10.5%
Latvia	-6.6%	-10.0%
Lithuania	-9.4%	-11.1%
Luxembourg	-3.8%	-5.5%
Malta	-4.3%	-8.8%
Netherlands	-5.2%	-7.7%
Austria	-9.1%	-10.2%
Portugal	-3.4%	-3.7%
Slovenia	-5.4%	-10.8%
Slovakia	-5.7%	-13.2%
Finland	-4.8%	-6.5%
Bulgaria	-10.9%	-13.3%
Czech Republic	-2.1%	-3.2%
Denmark	-11.7%	-13.5%
Croatia	-5.3%	-7.1%
Hungary	-4.3%	-6.9%
Poland	-8.7%	-12.9%
Romania	-9.8%	-11.3%
Sweden	-11.7%	-13.1%
United Kingdom	-5.8%	-13.8%
Iceland	-6.2%	-9.1%
Liechtenstein	-6.2%	-9.1%
Norway	-6.2%	-9.1%
Euro area	**-5.9%**	**-7.5%**
EU	**-6.2%**	**-9.1%**
EEA	**-6.2%**	**-9.1%**

Note: Nominal GDP as of 2015 was used to compute the euro area, EU and EEA aggregates.

Annex 1: Simulation methodology

The financial shock simulator is part of the suite of stress test models and simulation tools used by the ECB's Directorate General Macroprudential Policy and Financial Stability. The tool is a variant of the conditional value at risk (CoVaR) approach discussed by Adrian and Brunnermeier (2014)[5], however the way in which it is implemented at the ECB differs in some aspects that will be outlined below. The tool is regularly used to calibrate adverse scenarios for the ECB's Financial Stability Review and for the adverse scenarios the ESRB provides as an input for the stress tests of the European supervisory authorities. In particular, it has already been used in the design of the adverse scenarios for EIOPA's 2014, 2015 and 2016 stress tests.

The financial shock simulator builds on well-known risk measurement techniques that are widely used in the banking industry and is well suited to the design of conditional shock scenarios. It is characterised by two key features.

First, it is a non-parametric technique in the sense that neither the distributions of the individual risk factors nor their joint dependence (the "copula") are constrained by assumptions about their functional form. High-frequency financial market variables are characterised by non-normal features (e.g. excess kurtosis, volatility clustering) and thus the assumption of normality for their marginal distributions is inappropriate in many cases. Moreover, for the joint dependence between markets, a joint-normal distribution does not allow for changing dependence in its tails. The non-parametric approach overcomes these restrictions, thereby enabling better capture of tail dependence structures which are particularly relevant for stress test scenarios.

Second, the tool is based on an expected shortfall concept, i.e. not involving value at risk (VaR), which is known to have several conceptual deficiencies.[6] The expected shortfall is estimated using a Monte Carlo simulation method, which produces a large number of multivariate forward paths for the financial market variables included in the simulation. These simulations are then conditioned on a specific shock origin to obtain a set of responses of all variables to the shock, while taking the (tail) dependence between individual markets into account.

Along with the technical infrastructure that has been developed to conduct the shock simulations, a large-scale database (over 1,500 indicators) is in place and regularly maintained to enable the tool to operate in a flexible manner. The database includes, inter alia, yields and credit spreads at various maturities for sovereign, non-financial and financial corporate bonds, interbank money market interest rates, equity market prices, currencies, and private equity firm and hedge fund performance indicators for a large cross-section of countries in Europe and the rest of the world.

[5] Adrian, T. and Brunnermeier, M., "CoVaR", *Federal Reserve Bank of New York Staff Reports*, No 348, 2014.

[6] In particular, it neglects losses that can be expected beyond the VaR threshold – i.e. the actual tail risk. Expected shortfall, on the other hand, is a coherent risk measure that takes into account the expected losses beyond the VaR threshold.

For the pension fund stress test scenario, the combined EU equity market was chosen as the shock origin for the scenario. The scenario can be seen as internally consistent, as it takes into account the joint dependence between equity markets and all remaining factors over a particular historical sample period for the EU as a whole.