Non-Bank Financial Institution (NBFI) Stress Test Model
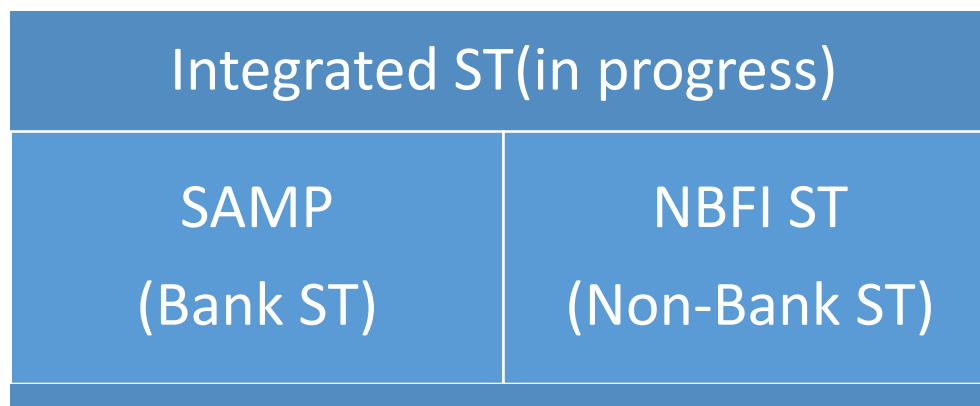
Inro Lee (einro@bok.or.kr)

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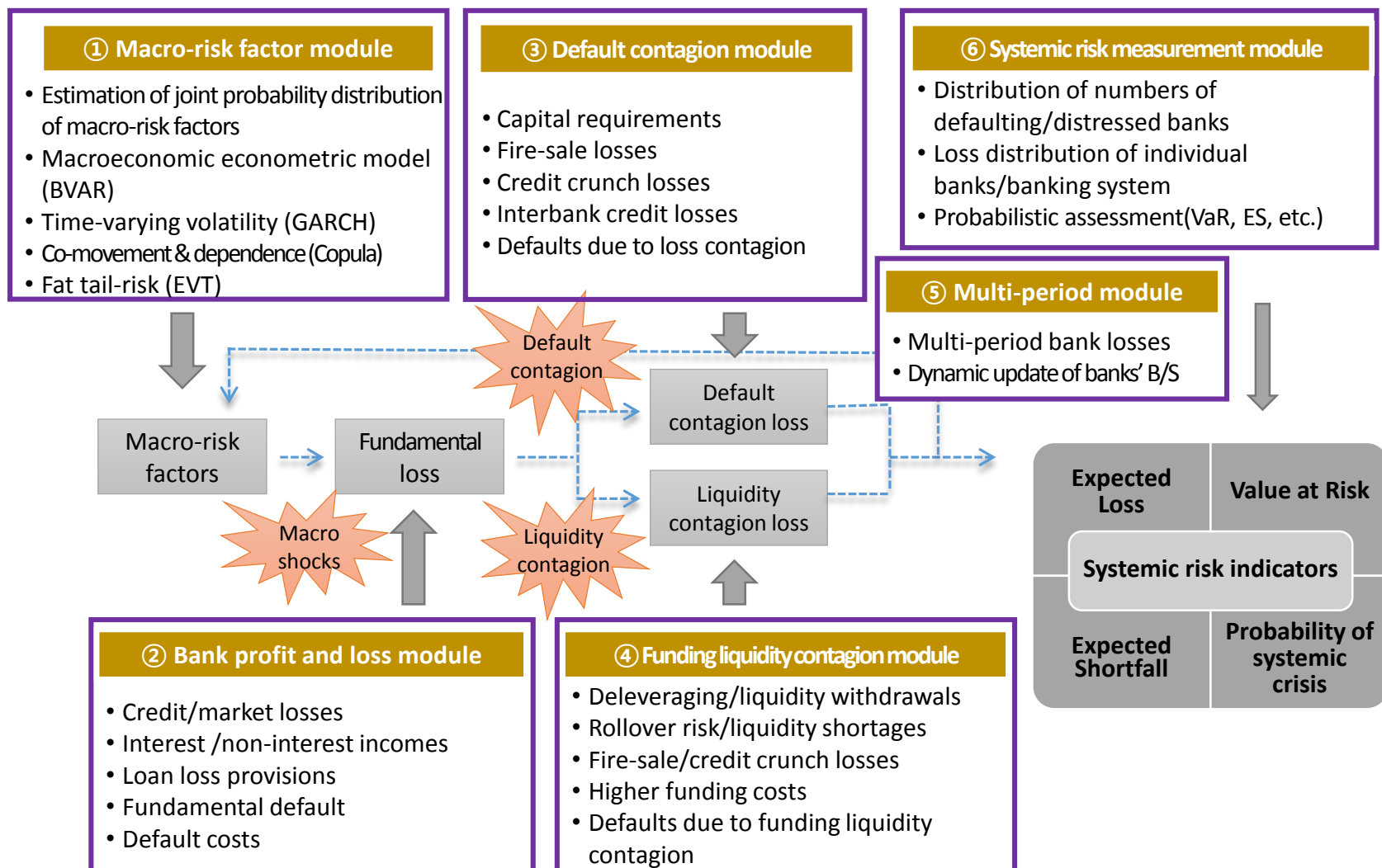
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Contents

- Overview of (BOK) Stress Test Framework

- Development Background of NBFIs Model

- Features of NBFIs Model

- Main Details of NBFIs Model

- Stress Test Results

- Future Plans

- BOK holds two type of Stress Test model, **SAMP** and **NBFI ST model**.

  - SAMP : **S**ystemic Risk **A**ssessment Model of **M**acroprudential **P**olicy. (Oct. 2012)

  - NBFI ST model : **N**on-**B**ank **F**inancial **S**tress **T**est model.(June 2018)

- We are **integrating SAMP and NBFI ST model** for whole financial Sector Stress test.
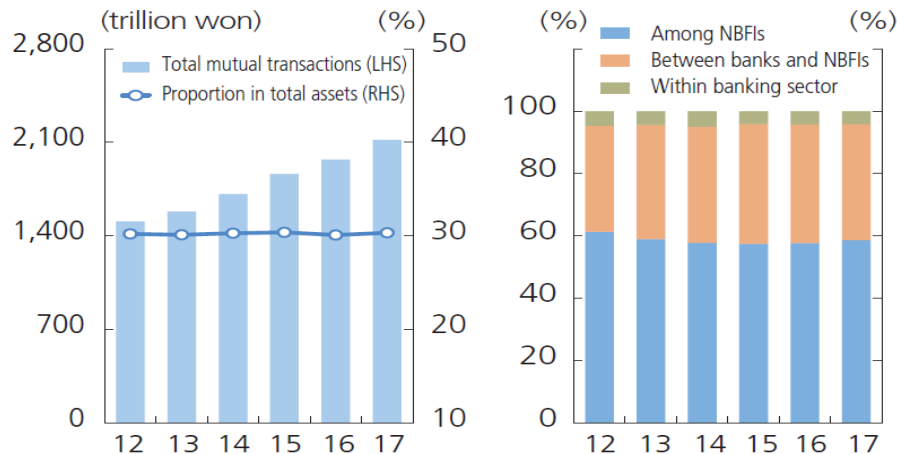
Integrated ST(in progress)	
SAMP (Bank ST)	NBFI ST (Non-Bank ST)

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Overall structure of SAMP

① Macro-risk factor module

- Estimation of joint probability distribution of macro-risk factors
- Macroeconomic econometric model (BVAR)
- Time-varying volatility (GARCH)
- Co-movement & dependence (Copula)
- Fat tail-risk (EVT)

③ Default contagion module

- Capital requirements
- Fire-sale losses
- Credit crunch losses
- Interbank credit losses
- Defaults due to loss contagion

⑥ Systemic risk measurement module

- Distribution of numbers of defaulting/distressed banks
- Loss distribution of individual banks/banking system
- Probabilistic assessment (VaR, ES, etc.)

⑤ Multi-period module

- Multi-period bank losses
- Dynamic update of banks' B/S

② Bank profit and loss module

- Credit/market losses
- Interest /non-interest incomes
- Loan loss provisions
- Fundamental default
- Default costs

④ Funding liquidity contagion module

- Deleveraging/liquidity withdrawals
- Rollover risk/liquidity shortages
- Fire-sale/credit crunch losses
- Higher funding costs
- Defaults due to funding liquidity contagion

Macro-risk factors → Fundamental loss

Default contagion

Macro shocks

Liquidity contagion

Default contagion loss

Liquidity contagion loss

Expected Loss	Value at Risk
Systemic risk indicators	
Expected Shortfall	Probability of systemic crisis

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- **NBFIs are Important**!

  - **The share of NBFI** is gradually **expanding** in financial system.

  - **Interconnectedness** among NBFIs is **intensifying**.

  - **Regulation and supervision** of NBFIs are **relatively weak**.

  - ➔ There is **a high possibility of risks** building up in NBFIs.

Amount of financial institutions' mutual transactions[1]

Proportions of mutual transactions across sectors[1][2]

(trillion won)   (%)

- Total mutual transactions (LHS)
- Proportion in total assets (RHS)

- Among NBFIs
- Between banks and NBFIs
- Within banking sector

Notes: 1) End-period basis (flow of funds statistics)
      2) Proportions in the total amount of mutual transactions
Source: The Bank of Korea

* NBFIs

1. Insurance companies

2. non-bank depository institutions

(mutual credit cooperatives and savings banks)

3. securities companies

4. credit card companies

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- **NBFI ST model is top-down macro stress testing model**

    - NBFIs ST model can quantitatively assess the effects that changes in macroeconomic and financial sectors.

- **It is individual sector based model**

    - Business models and risk factors are different from each other.

    - It can also assess the resilience of the individual financial institutions.

- **It is a modeling platform for macro stress tests**

    - It is designed to reflect 2nd round effect such as transmission of risks among financial institutions (credit risk, liquidity risk, and market risk)

- **It is a tool for macroprudential analysis**

    - BOK evaluates policy effectiveness for NBFIs.

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- NBFI ST model is composed of

  - ① a business profit and loss module, ② a credit loss module, ③ a market profit and loss module, ④ an interest earnings module, ⑤ an other profit and loss module, ⑤ -1 a risk/asset amount adjustment module , ⑥ risk transmission model, ⑥-2 a risk/asset amount adjustment module.

Structure of Non-bank financial institution stress test model
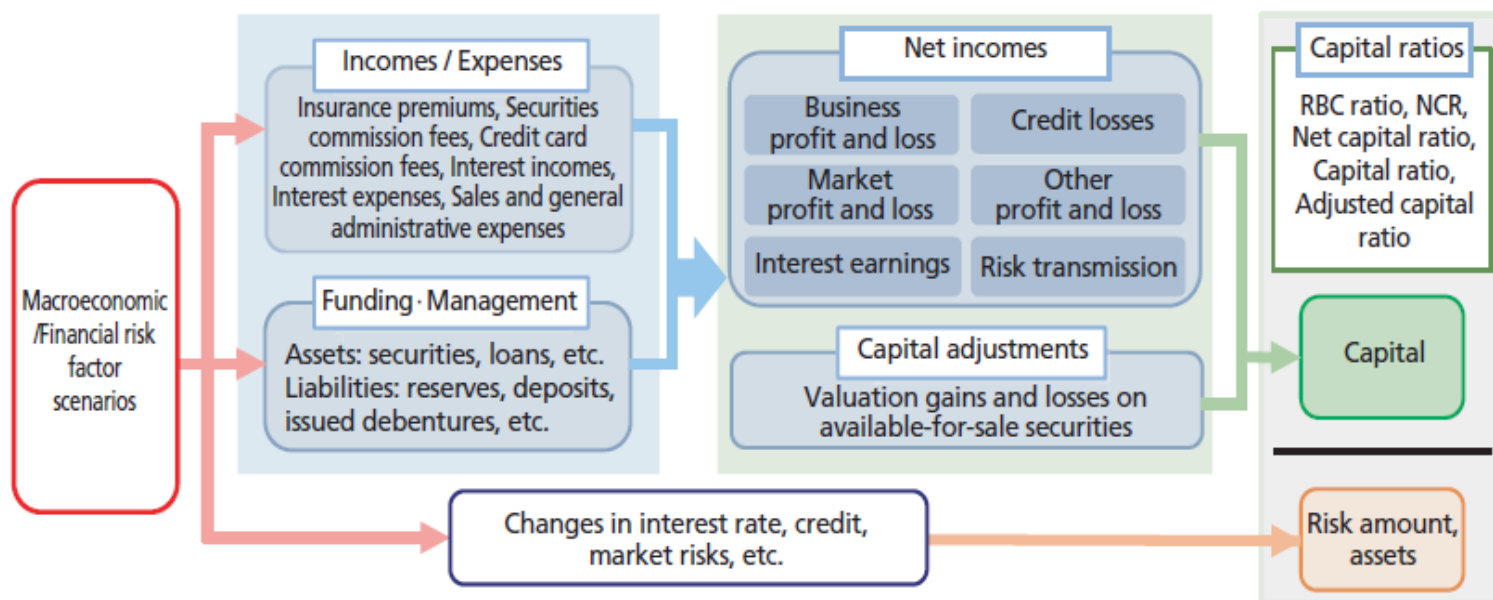
① Business profit and loss module

- The business profits and losses of the respective sectors includes those on insurance premiums, securities commission fees, and credit card commission fees

$$I_{i,t}=\beta_0+\beta_i I_{i,t-1}+\beta_1 x_{1,t-k_1}+...+\beta_n x_{n,t-k_n}$$

where I is the rate of increase in business profit and loss, and x_n are the macroeconomic and financial risk factors.

② Credit loss module

- DR is estimated using the non-performing loan (NPL) ratio or the delinquency rate through a regression model

$$L_s^c=\sum_i DR_{i,s}\cdot LGD_{i,s}\cdot EAD_{i,c}$$

where $DR_{i,s}$ are the scenario default rates based on the different exposures, $LGD_{i,s}$ the scenario loss given default rates, and $EAD_{i,c}$ the current exposures.

③ **Market profit and loss module**

- NBFIs ST model marked to market the changes in values of securities held following changes in financial market variables such as interest rates, stock prices and exchange rates.

$$\text{(Bond)}\ L_s^B = -\Delta r \cdot D \cdot B_c$$

$$\text{(Stock)}\ L_s^S = \Delta k \cdot S_c$$

$$\text{(Foreign exchange)}\ L_s^F = \Delta z \cdot F_c$$

where Δr is the change in interest rates, the D duration, B_c the bond exposure, Δk the rate of stock price change, S_c the stock exposure, Δz the rates of change in the exchange rates, and F_c the foreign exchange exposure.

④ **Interest earnings module**

- The interest expenses from interest-bearing liabilities were subtracted from the interest income on interest-bearing assets, to calculate the interest earnings.

$$P_s^R = (r^A + \Delta r_s^A) \cdot A^R - (r^L + \Delta r_s^L) \cdot L^R$$

where A^R and L^R are interest-earning assets and liabilities respectively, r^A and r^L the lending and deposit interest rates, and Δr_s^A and Δr_s^L the changes in lending and deposit interest rates.

⑤ **Other profit and loss module**

- Other profit and loss was estimated through a regression model using macroeconomic and financial risk indicators as the explanatory variables. Sales and general administrative expenses were calculated by reflecting the rates of inflation and growth.

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⑥ Risk transmission module (2nd round effect)

- Overall risk transmission by sector is estimated through **the mutual exposures** within the individual non-bank financial sectors.

- The amounts of loss stemming from risk transmission were estimated through **the liquidity risk, the credit risk, and market risk channel.**

⑦ Risk·asset amount adjustment module

- Each sector's capital ratio calculation is estimated by reflecting the macroeconomic/financial risk factor scenarios.

Financial sector interconnectedness map,[1][2][3] as of end-2017
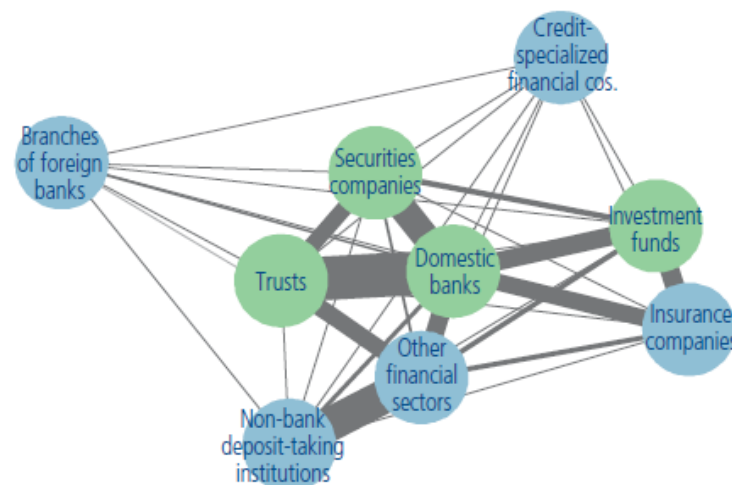
Notes: 1) ● indicate the four highest-ranked financial sectors in terms of their mutual transaction volumes.
2) Interconnectedness map using network visualization analysis, with centrality, concentrations and line thicknesses all proportional to the mutual transaction volumes
3) Trusts refer to trust accounts of banks, securities and insurance companies, Non-bank deposit-taking institutions to community credit cooperatives, the National Credit Unions Federation of Korea, savings banks, etc., and Other financial sectors to the national federations of the different Non-bank deposit-taking institutions, public financial institutions, holding companies, etc.
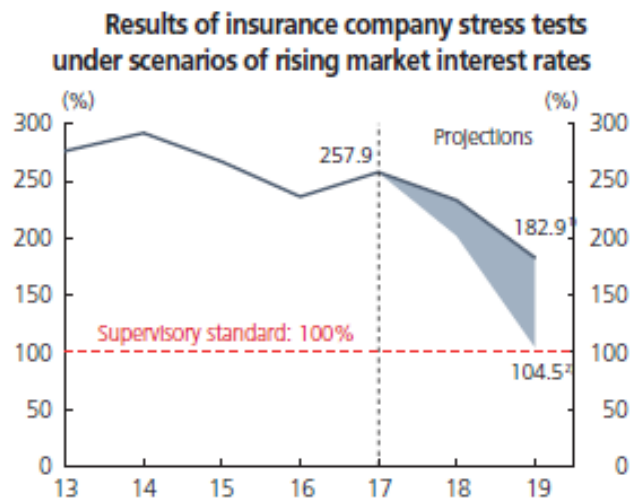Source: The Bank of Korea

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- (Scenario) Stress test assumed **two exceptional circumstances**.

  - **Rises in market interest rates**[1] or **economic slowdowns**[2] continued for two years from the end of 2017.

  1) The scenario assumes increase in market interest rates of either 200bp or 300bp

  2) The annual economic growth rates remained below the BOK's forecasts by either 1.7%p (Adverse) or 3.5%p (Severe).
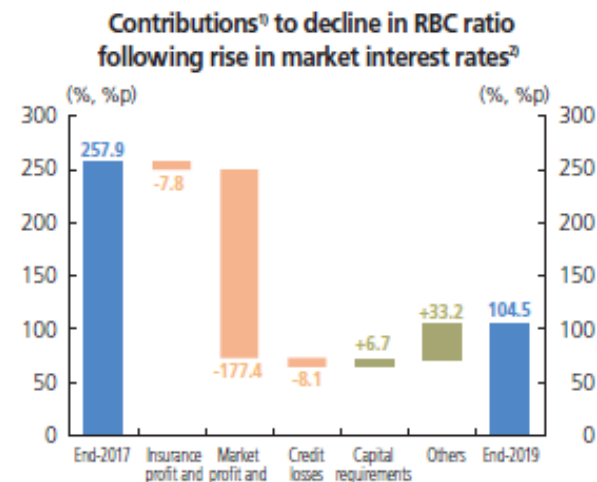

Domestic market interest rate[1] increase scenarios

Note: 1) Based on average CD (91-day) rate for Q4 of each year
Source: The Bank of Korea

Economic slowdown[1] scenarios[2]

Notes: 1) Based on annual real GDP growth rate
2) The numbers underlined in gray are the Bank of Korea's economic forecasts (April 2018)
Source: The Bank of Korea

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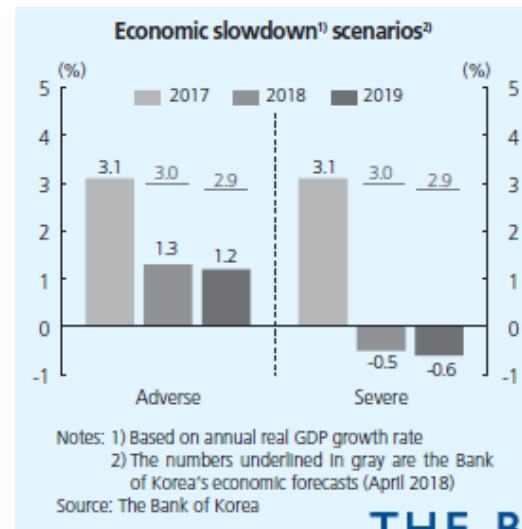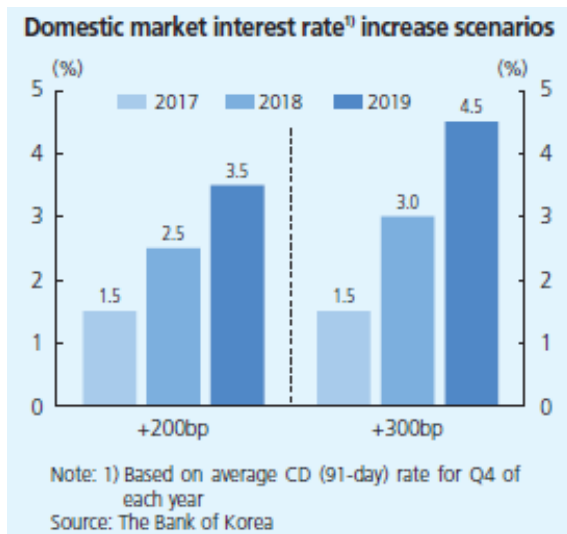
- **Test results** under scenario of rise in market interest rates are as follows.

  - RBC ratio falls from 257.9% as of year-end 2017 to 182.9% (-75.0%p) two years later when interest rates **rise by 200bp**, and to 104.5% (-153.4%p) in the case of **a 300bp increase**.

Results of insurance company stress tests under scenarios of rising market interest rates

(%)

Projections

257.9

182.9[1]

Supervisory standard: 100%

104.5[2]

13 14 15 16 17 18 19

Notes: 1) Based on scenario of 200bp rise in market interest rates (during two years from end-2017)
2) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
Source: The Bank of Korea

Contributions[1] to decline in RBC ratio following rise in market interest rates[2]

(%, %p)

257.9
-7.8
-177.4
-8.1
+6.7
+33.2
104.5

End-2017 | Insurance profit and loss | Market profit and loss | Credit losses | Capital requirements | Others | End-2019

Notes: 1) Valuation gains and losses on available-for-sale securities included in Market profit and loss, and 2nd round effects, reserves/accumulated funds, corporate taxes and interest earnings included in Others
2) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
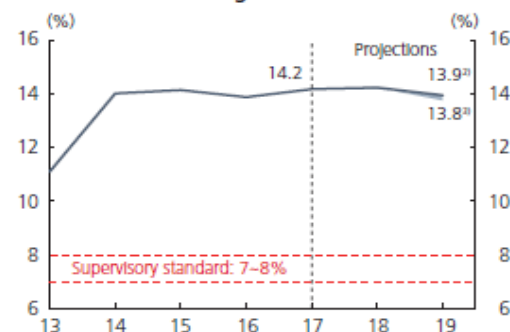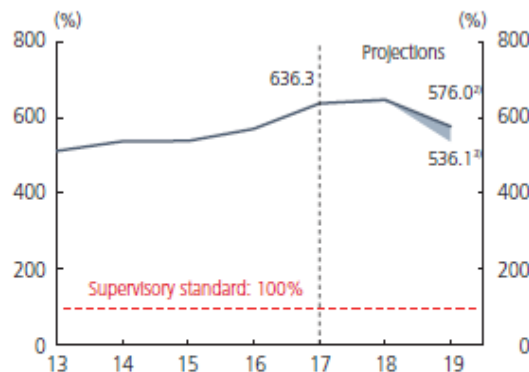Source: The Bank of Korea

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Results[1][2] of mutual credit cooperative stress tests under scenarios of rising market interest rates
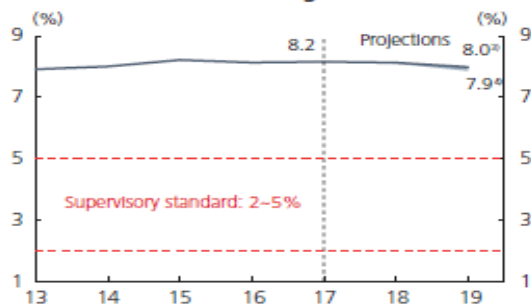
Notes: 1) Net capital ratio based on aggregate of five mutual credit cooperatives - Nonghyup, credit unions, Suhyup, NFCF and MG community credit cooperatives
2) Supervisory standards (5% for Nonghyup, 2% for credit unions, Suhyup and NFCF, 4% for MG community credit cooperatives)
3) Based on scenario of 200bp rise in market interest rates (during two years from end-2017)
4) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
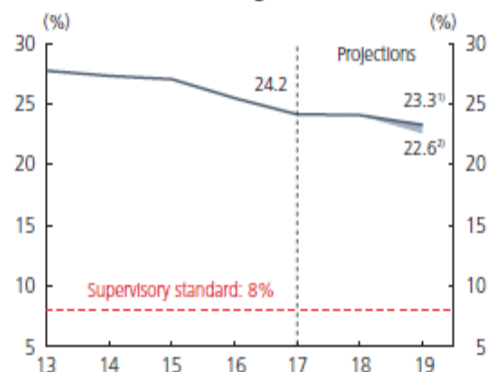Source: The Bank of Korea

Results[1] of savings bank stress tests under scenarios of rising market interest rates

Notes: 1) Supervisory standards (asset volumes of 1 trillion won or more 8%, asset volumes of less than 1 trillion won 7%)
2) Based on scenario of 200bp rise in market interest rates (during two years from end-2017)
3) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
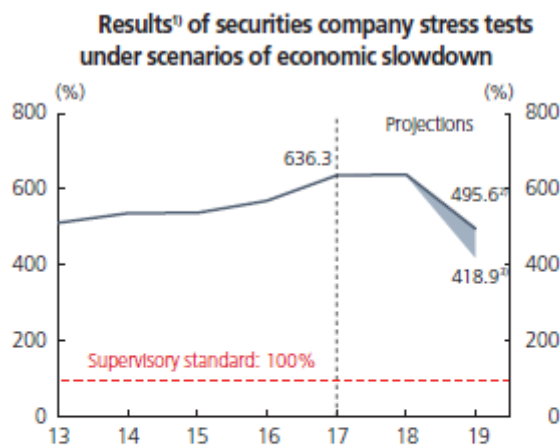Source: The Bank of Korea

<Figure I- 8> Results[1] of securities company stress tests under scenarios of rising market interest rates

Notes: 1) NCRs before 2015 estimated retroactively, based on current method of calculation
2) Based on scenario of 200bp rise in market interest rates (during two years from end-2017)
3) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
Source: The Bank of Korea

Results of credit card company stress tests under scenarios of rising market interest rates
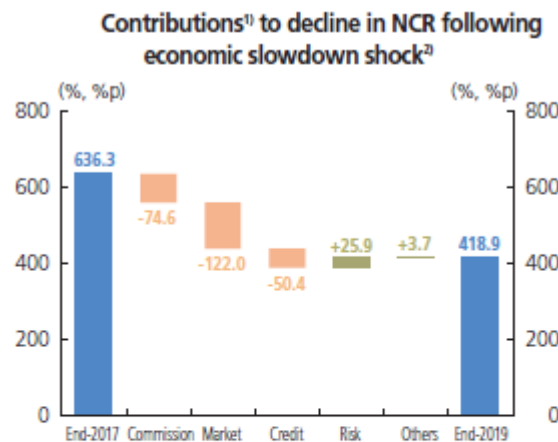

Notes: 1) Based on scenario of 200bp rise in market interest rates (during two years from end-2017)
2) Based on scenario of 300bp rise in market interest rates (during two years from end-2017)
Source: The Bank of Korea

- **Test results** under scenario of domestic economic slowdown are as follows.

  - **NCR** falls from 636.3% at year-end 2017 to 495.6% **(-140.7%p)** in the case of **adverse scenario**, and to 418.9%(**-217.4%p**) under **the severe scenario**.


Results[1] of securities company stress tests under scenarios of economic slowdown

Notes: 1) NCRs before 2015 estimated retroactively, based on current method of calculation
2) Based on scenario of economic growth 1.7% points lower (Adverse) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
3) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
Source: The Bank of Korea

Contributions[1] to decline in NCR following economic slowdown shock[2]

Notes: 1) Valuation gains and losses on available-for-sale securities included in Market profit and loss, and 2nd round effects and interest earnings included in Others
2) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
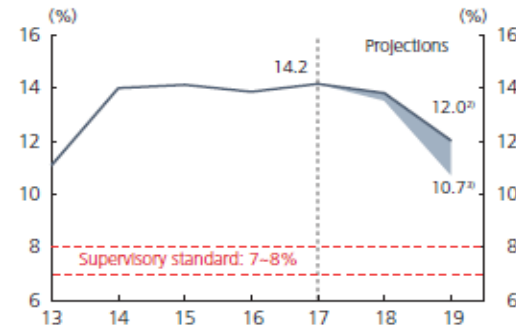Source: The Bank of Korea

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Results of insurance company stress tests under scenarios of economic slowdown
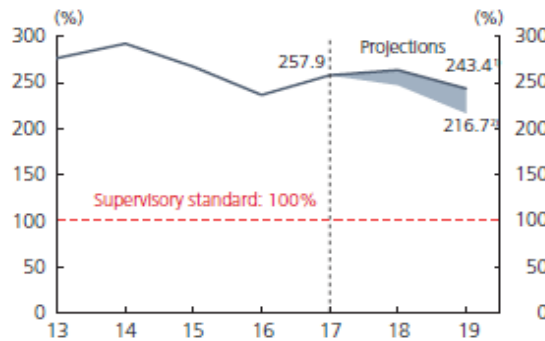
Notes: 1) Based on scenario of economic growth 1.7% points lower (Adverse) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
2) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
Source: The Bank of Korea

Results[1] of savings bank stress tests under scenarios of economic slowdown
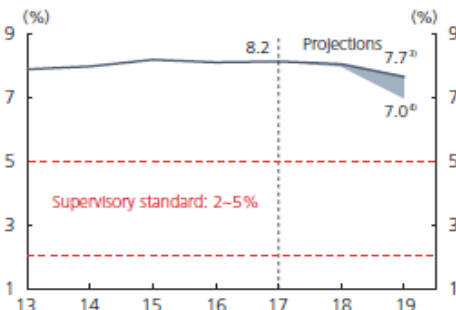

Notes: 1) Supervisory standards (asset volumes of 1 trillion won or more 8%, asset volumes of less than 1 trillion won 7%)
2) Based on scenario of economic growth 1.7% points lower (Adverse) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
3) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
Source: The Bank of Korea

Results[1)2)] of mutual credit cooperative stress tests under scenarios of economic slowdown

Notes: 1) Net capital ratio based on aggregate of five mutual credit cooperatives - Nonghyup, credit unions, Suhyup, NFCF and MG community credit cooperatives
2) Supervisory standards (5% for Nonghyup, 2% for credit unions, Suhyup and NFCF, 4% for MG community credit cooperatives)
3) Based on scenario of economic growth 1.7% points lower (Adverse) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
4) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
Source: The Bank of Korea

<Figure I-20> Results of credit card company stress tests under scenarios of economic slowdown
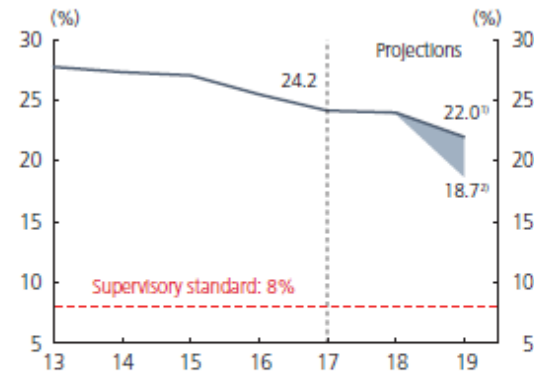
Notes: 1) Based on scenario of economic growth 1.7% points lower (Adverse) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
2) Based on scenario of economic growth 3.5% points lower (Severe) than the Bank of Korea's economic forecast (April 2018), for two consecutive years
Source: The Bank of Korea

- We are in progress of **constructing an integrated stress testing model**.
  - It links banking sector model (SAMP) with this NBFI ST model

    ➔ In the future it will be able to assess **overall financial system resilience** more intricately, by reflecting the mutual transactions carried out across financial sectors.

- BOK plans to continually improve the NBFI ST model in the future, together with **expanding its database** on non-bank financial institutions.
  - In this process it plans to take into consideration **changes in the sectoral business environments**, **supervisory regulation and accounting systems**, etc., and work to **enhance its NBFI ST model's validity**.

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