Financial Soundness Indicators (FSIs) and Stress Testing

Gaston Gelos
International Monetary Fund

October 29, 2015

Outline

1. Financial Soundness Indicators
   - Definition
   - Evidence
   - Available Resources

2. Stress Testing
1. Financial Soundness indicators (FSIs)

A bit of history…

“How can the IMF strengthen its surveillance over countries’ financial systems in the context of Article IV consultations?”

“What indicators of the soundness and vulnerabilities of financial systems (that is, macroprudential indicators) can be used most effectively to monitor financial system stability?”

“Should the international community establish guidelines and standards for the compilation of such indicators and, in general, aim for harmonization of efforts in this area?”

September 27, 1999
Financial Soundness Indicators (FSIs)

“Indicators of strengths and vulnerabilities of a financial system”

Two questions:
1) Where to look at? What is the coverage?
2) How to assess strengths and vulnerabilities?

<table>
<thead>
<tr>
<th>Sectoral Coverage</th>
<th>Core set of FSIs</th>
<th>Encouraged set of FSIs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Banks</td>
<td>Banks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Non-banks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Markets</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Corporate sector</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Households</td>
</tr>
</tbody>
</table>

Strengths and vulnerabilities

• For banks, focus is on:
  — Capital adequacy
  — Asset quality
  — Earnings and profitability
  — Liquidity
  — Sensitivity to market risk

Based on CAMELS framework used by supervisors for assessing soundness of individual banks.
• FSIs also cover nonbanks and some market indicators.
2013 Revisions

- Revised and expanded in 2013 to account for growing role of shadow banking
- Bank indicators revised to reflect Basel III. Three new indicators added: Common-Equity-Tier 1 to RWAs, Liquidity Coverage Ratio, net stable funding ratio.
- Also added: credit growth to private sector,
- Real estate price developments added to core set
Additional Set for Deposit Takers

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I10</td>
<td>Large exposures to capital</td>
</tr>
<tr>
<td>I19</td>
<td>Geographical distribution of loans to total loans</td>
</tr>
<tr>
<td>I20</td>
<td>Gross asset position in financial derivatives to capital</td>
</tr>
<tr>
<td>I21</td>
<td>Gross liability position in financial derivatives to capital</td>
</tr>
<tr>
<td>I22</td>
<td>Trading income to total income</td>
</tr>
<tr>
<td>I23</td>
<td>Personnel expenses to noninterest expenses</td>
</tr>
<tr>
<td>I24</td>
<td>Spread between reference lending and deposit rates (base points)</td>
</tr>
<tr>
<td>I25</td>
<td>Spread between highest and lowest interbank rates (base points)</td>
</tr>
<tr>
<td>I26</td>
<td>Customer deposits to total (non-interbank) loans</td>
</tr>
<tr>
<td>I27</td>
<td>Foreign-currency-denominated loans to total loans</td>
</tr>
<tr>
<td>I28</td>
<td>Foreign-currency-denominated liabilities to total liabilities</td>
</tr>
<tr>
<td>I29 (NEW)</td>
<td>Credit growth to private sector</td>
</tr>
</tbody>
</table>

Additional FSIs

- For Other Financial Corporations
- For Money Market Mutual Funds
- For Insurance Companies
- For Pension Funds
- For Nonfinancial Corporations
- For Households
- For Real Estate Markets
Capital Adequacy

• Capital adequacy and availability ultimately determine the robustness of financial institutions to withstand shocks to their balance sheets.

• Aggregate risk-based capital ratios (regulatory capital/risk-weighted assets) are the most common indicators of capital adequacy.

• Simple leverage ratios (capital/assets), often complement this measure.

Capital Adequacy and Basel III

BCBS Basel III framework strengthens quantity and quality of capital

Quality, level of capital: Greater focus on common equity. Minimum raised to 4.5% of risk-weighted assets.

Capital conservation buffer: Comprising common equity of 2.5% of risk-weighted assets, bringing the total common equity standard to 7%.

Countercyclical buffer: Imposed within a range of 0-2.5% comprising common equity, when authorities judge systematic risk is building.
Capital Adequacy and Basel III

- **BCBS Basel III framework**: strengthen quantity and quality of capital

- **Leverage ratio**: A non-risk-based leverage ratio will serve as a backstop to the risk-based capital requirement. Also helps contain system wide buildup of leverage.

### BASEL III Capital Requirements

- **Minimum Risk-based Capital Ratio**: 8%
  - Common Equity Tier: 4.5%
  - Additional Tier 1 Capital: 1.5%
  - Tier 2 Capital: 2.0%

- + 2.5% Capital Conservation Buffer, comprised of CET1

- Countercyclical Capital Buffer up to 2.5%,
  - To be determined by national authorities
Capital Adequacy and Basel III

**Tier 1 capital**: Common shares, equity capital and disclosed reserves considered freely available to meet claims against the bank.

**Tier 2 capital**: Financial instruments and reserves that are available to absorb losses but that might lack permanency, have uncertain values, entail costs if sold, or otherwise lack the full loss-absorption capacity of Tier 1 capital items.

**Risk-weighted assets**: Weighted total of each class of assets and off-balance sheet asset exposures, with weights related to the credit risk associated with each type of asset.

---

**Capital Adequacy and Basel III**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Leverage Ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Common Equity Capital Ratio</td>
<td>3.3%</td>
<td>4.0%</td>
<td>4.3%</td>
<td></td>
<td></td>
<td></td>
<td>4.5%</td>
</tr>
<tr>
<td>Capital Conservation Buffer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum common equity plus capital conservation buffer</td>
<td>3.3%</td>
<td>4.0%</td>
<td>4.5%</td>
<td>5.25%</td>
<td>5.75%</td>
<td>6.175%</td>
<td>7.0%</td>
</tr>
<tr>
<td>Phase-in of deductions from CET1*</td>
<td>20%</td>
<td>40%</td>
<td>40%</td>
<td>80%</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum Tier 1 Capital</td>
<td>4.3%</td>
<td>5.5%</td>
<td>6.0%</td>
<td></td>
<td></td>
<td></td>
<td>6.0%</td>
</tr>
<tr>
<td>Minimum Total Capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8.0%</td>
<td></td>
</tr>
<tr>
<td>Minimum Total Capital plus conservation buffer</td>
<td>8.0%</td>
<td>8.625%</td>
<td>9.25%</td>
<td>9.875%</td>
<td>10.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Bank for International Settlements
Asset Quality

Solvency Risk: often derives from decline in asset quality (often because of deterioration in borrowers’ financial health).

- Non-performing loans (NPLs) / total gross loans

What is the capacity of bank capital to withstand losses from NPLs? Have banks delayed addressing asset quality problems?

- Non-performing Loans (net of provisions)/capital

Asset Quality

Lack of diversification in loan portfolio may make bank vulnerable to shocks:

- Sector (e.g. real estate): Loan concentration in a specific economic sector
- Region (e.g. country risk): Geographical distribution of loans

Concentration of credit risk in a small number of borrowers may also result from connected lending.

- Connected lending: share of capital lent to related parties.
Earnings and Profitability

• Banks’ profitability serves as buffer:

  — Return on assets (ROA): Net income / average total assets

  — Return on equity (ROE): Net income / average total equity

  — Spread between lending and deposits rates

Liquidity

*Liquidity transformation* is inherent to banking business model. (Maturity of liabilities typically lower than maturity of assets.)

A liquidity crisis has the potential to push solvent banks into insolvency.

- Liquid assets / total assets: how much balance sheet shrinkage could be absorbed before selling illiquid assets?
- Liquid assets/ short-term liabilities: short-term liabilities would have to be covered by asset sales if access to funding was lost.
Liquidity and Basel III

BCBS Basel III framework: establish international global liquidity standard

The *liquidity coverage ratio (LCR)* will require banks to have sufficient high-quality liquid assets to withstand a 30-day stressed funding scenario specified by supervisors.

The *net stable funding ratio (NSFR)* is a longer-term structural ratio designed to address liquidity mismatches. It covers the entire balance sheet and provides incentives for banks to use stable sources of funding.

### Basel III phase-in arrangements

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Liquidity coverage ratio – minimum requirement</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Net stable funding ratio</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sensitivity to Market Risk

Market risk: risk of losses arising from changes in market prices.

Indicator of sensitivity to *interest rate risk*: duration of assets and liabilities

- The greater the mismatch in duration or “average” life between assets and liabilities, the greater the interest rate risk, and the greater the likely impact of changes in interest rates on earnings and capital.

Indicator of sensitivity to *exchange rate risk*: net open position in foreign exchange to capital

- Measures the mismatch (open position) of foreign currency asset and liability positions to assess the potential vulnerability of the deposit-taking sector’s capital position to exchange rate movements.

Indicator of *sensitivity of bank capital to equity prices*: net open position in equities to capital
Financial Soundness Indicators in the Region

Bank Regulatory Capital to Risk-Weighted Assets (in percent)

Bank Capital to Assets (in percent)

Sources: IMF FSIs.

Financial Soundness Indicators in the Region

Bank Non-Performing Loans to Total Loans (in percent)

Bank Provisions to Non-Performing Loans (in percent)

Sources: IMF FSIs.
Financial Soundness Indicators in the Region

Sources: IMF FSIs.

IMF Financial Soundness Indicators

FSIs only offer very partial, preliminary picture

Computed at the aggregate level... distribution may matter!

Many tools to assess the soundness of the financial sector.
  • Quantitative measures (stress-testing, credit-tot-GDP gap, systemic risks measures, etc.)
  • Qualitative assessment and judgment!
IMF Financial Soundness Indicators

Example: use FSIs to create a heatmap on credit cycle and financial soundness

Selected Evidence: contemporaneous

- Laeven and Valencia (2008) identify systemic banking crises

"...in a systemic banking crisis, a country’s corporate and financial sectors experience a large number of defaults and financial institutions and corporations face great difficulties repaying contracts on time. As a result, non-performing loans increase sharply and all or most of the aggregate banking system capital is exhausted."
Selected Evidence: early warning

• Probability of banking crisis decreases with better capitalization and liquidity measures
  
  

Selected Evidence: early warning

• Probability of crisis increases with lower ROE

  • Costa Navajas and others (2013): Logit model for 80 countries using annual data (2005-2012)

Selected Evidence on FSIs

Costa Navajas and others (2013)

---

Selected Evidence on FSIs

Costa Navajas and others (2013)
Selected Evidence on FSIs

Costa Navajas and others (2013)

Selected Evidence on FSIs

Costa Navajas and others (2013)
Selected Evidence on FSIs

• “Excessive” credit growth and asset prices (i.e. housing prices) are good predictors of financial distress

• Methodologies: noise-to-signal ratios/ Probit-Logit models

• Examples:
  - Borio and others (2002, 2009)
  - Mendoza-Terrones (2008)
  - GFSR (2011)
  - Dell’Ariccia and others (2012)

Selected Evidence on FSIs

• GFSR Chapter 3, April 2009: “micro” case study

  • Were FSIs able to distinguish between institutions that would eventually require government assistance from those that did not?

  • Sample: 36 commercial and investment banks across the world

Results:

- Capital adequacy ratios were unable to clearly identify institutions requiring intervention.

---

**Table 3.1. Selected Indicators on Fundamental Characteristics in Financial Institutions**

<table>
<thead>
<tr>
<th></th>
<th>Nonintervened Banks</th>
<th>Intermed Commercial Banks</th>
<th>Intermed U.S. Investment Banks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital adequacy (in percent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital/assets</td>
<td>14.5</td>
<td>19.4</td>
<td>17.9**</td>
</tr>
<tr>
<td>Common equity/assets</td>
<td>3.7</td>
<td>4.4</td>
<td>6.8***</td>
</tr>
<tr>
<td>Tier 1 capital/risk-weighted assets</td>
<td>4.9</td>
<td>10.8</td>
<td>8.1***</td>
</tr>
<tr>
<td>Tier 1 and 2 capital/risk-weighted assets</td>
<td>7.3</td>
<td>15.8</td>
<td>11.0**</td>
</tr>
<tr>
<td>Asset quality (in percent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nonperforming loan ratio</td>
<td>2.3</td>
<td>2.3</td>
<td>1.4***</td>
</tr>
<tr>
<td>Provision for loan losses/loans</td>
<td>0.1</td>
<td>0.1</td>
<td>0.8***</td>
</tr>
<tr>
<td>Leverage</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Debt to common equity</td>
<td>7.5</td>
<td>7.6</td>
<td>8.1***</td>
</tr>
<tr>
<td>Short-term debt(^1)</td>
<td>0.4</td>
<td>0.5</td>
<td>0.7***</td>
</tr>
<tr>
<td>Liquidity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loans/deposits</td>
<td>1.1</td>
<td>1.3</td>
<td>1.2</td>
</tr>
<tr>
<td>Loans/assets</td>
<td>0.6</td>
<td>0.5</td>
<td>0.5***</td>
</tr>
<tr>
<td>Earning and profit (in percent)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return on assets</td>
<td>1.2</td>
<td>1.2</td>
<td>1.9***</td>
</tr>
<tr>
<td>Return on equity</td>
<td>3.6</td>
<td>4.8</td>
<td>4.1</td>
</tr>
<tr>
<td>Stock market performance</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price/earnings ratio</td>
<td>15.5</td>
<td>12.6</td>
<td>16.8</td>
</tr>
<tr>
<td>Earnings per share</td>
<td>0.6</td>
<td>1.0</td>
<td>0.6</td>
</tr>
<tr>
<td>Book value per share</td>
<td>14.8</td>
<td>21.7</td>
<td>14.1</td>
</tr>
</tbody>
</table>

*Sources: Thomson Reuters; and IMF staff estimates.

*Note: A t-test is performed to determine whether two samples are likely to have come from the same two underlying populations that have the same mean. The intervened commercial banks and the U.S. investment banks are compared to the nonintervened banks. *, **, and *** represent the statistically significant differences at the 10, 5, and 1 percent levels, respectively.

\(^1\) Short-term and other debt payable within one year.
Case Study

Results:

• Liquidity ratios are not very informative of the differences between intervened and non-intervened financial institutions.

• NPL / total loans for the intervened commercial banks were lower than for the non-intervened commercial banks.

---

Case Study

Results:

• Return on assets (ROA) for intervened institutions are higher than those in the non-intervened commercial banks.

![Figure 3.3. Return on Assets (In percent) 1998-2008](image)

Sources: Thomson Reuters; and IMF staff estimates.
Note: The ratios of nonintervened banks, intervened banks, and intervened U.S. Investment banks are the average of all institutions in each category.
FSI, Policies, and Cycles

Better bank “financial soundness” can help mitigate volatility of financial cycles. But trying to improve financial soundness in the midst of a downturn can do the opposite—further aggravating the contraction of credit.

Che and Shinagawa (2014):
• Better initial scores in certain financial soundness indicators (FSIs) associated with milder, shorter downturns
• Improving FSIs during a downturn worsens credit contraction. ➔ need to mindful about timing of regulating changes in banks’ FSIs.

IMF webpage

• “FSI Compilation Guide” with details on concepts and definitions

• Data and metadata available for IMF FSI-reporters

• Data for extended set of countries (133, including FSI reporters and non-reporters)
Summing up

• FSIs: indicators of strengths and vulnerabilities of a financial system
  • Simple to understand
  • Universal and broadly available

• But they should be handled with care…
  • Low frequency
  • Aggregate indicators may mask risks
  • Sometimes they lag, not lead
  • Currently, poor coverage for nonbanks
2. Stress Testing
Stress Testing

• Borrowed notion from engineering:
  “technique of testing a structure or system beyond normal operating capacity, often to breaking point, to confirm specifications are met, determine breaking limits or examine models of failure”

• Finance:
  - Assess the resilience of a financial institution (or the financial system) to large but plausible shocks
  - Consider individual or combined shocks
  - Can integrate macroeconomic effects

Evolving use and expectations

Lessons from the global crisis
- Gaps in risk identification, propagation, and coverage
- Shock sizes too moderate

ST as crisis management tools
- U.S. SCAP, EU EBA gave stress tests a new (public) role
- Results linked to interventions

Macroprudential focus
- Increased emphasis on systemic risk oversight
- Macroprudential ST an integral part of oversight
Stress test workflow

Risk assessment matrix (preliminary)

Stress scenario design
- Macro scenarios
- Single factor shocks

“Extreme but plausible”: scenario calibration

Coverage, horizon, etc.

inputs

Stress test models
- Top down
  - Contagion risk
  - Sovereign risk
  - Funding risk
  - Market risk
  - Credit risk
- Bottom up

outputs
- Model outcomes
- Hurdle rates
- Stress test results

“Best practice” principles

Define appropriately the institutional perimeter for the tests

Identify all relevant channels of risk propagation

Include all material risks and buffers

Make use of the investors’ viewpoint in the ST design

Focus on tail risks

Beware of the “black swan”

Communication: Speak smarter, not just louder

**Principle: Appropriate perimeter**

- **Size**
  Firms with a large share in assets, deposits

- **Interconnectedness**
  Connection to other firms via a substantial web of transactions

  Focus on *systemic institutions* (bank and nonbank) whose failure can impact the whole financial system, including all relevant *activities* (e.g. cross-border, SPVs)

- **Complexity**
  Firms that would require time and high costs to resolve

- **Substitutability**
  Firms providing services that are widely used but hard to replace

---

**Principle: Appropriate perimeter**

- Know your system: major players, business models, transactions, key counterparties

- Identify systemically important institutions to cover in the tests, including relevant nonbanks and financial market infrastructures.

- Gain a basic understanding of the structure of financial conglomerates, and cover any banking or non-banking activities that may have a major impact in a stress scenario.
Principle: Appropriate perimeter

- banks (large and small) only: 22%
- banks and insurance companies: 19%
- banks, insurance, other: 5%
- large banks only: 54%

Source: IMF staff, Survey of country stress testing practices, 2012

Principle: All material risks & buffers

Firms faces various risks (many missed in pre-crisis stress tests)
- Credit quality
- Value of marketable securities
- Cross-border exposures
- Funding risk
- Counterparty risk

Resilience also depends on buffers and business and policy reactions
- Health of a financial institution
- Existing capital
- Liquidity buffers
- Changes in risk-weighted-assets
- Earnings during test period
Risks included in tests

<table>
<thead>
<tr>
<th>Risk Category</th>
<th>% of Jurisdictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Credit risk (incl. downgrade risk, counterparty risk)</td>
<td>100</td>
</tr>
<tr>
<td>Market risk (incl. exchange rate, equity, derivatives, real estate price risks)</td>
<td>88</td>
</tr>
<tr>
<td>Funding liquidity risk</td>
<td>71</td>
</tr>
<tr>
<td>Interest rate risk (banking book)</td>
<td>71</td>
</tr>
<tr>
<td>Sovereign risk</td>
<td>58</td>
</tr>
<tr>
<td>Market liquidity risk</td>
<td>38</td>
</tr>
<tr>
<td>Operational risk</td>
<td>25</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
</tr>
</tbody>
</table>

Source: IMF staff, Survey of country stress testing practices, 2012

---

**Principle: All material risks & buffers**

- Before undertaking ST, understand key activities, markets, exposures, and counterparties

- Be as comprehensive as possible in including potential sources of risk in ST: think the unthinkable

- Assess and project buffers during the test period conservatively
### Test period

<table>
<thead>
<tr>
<th>Test Period</th>
<th>% of Jurisdictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Two years</td>
<td>35</td>
</tr>
<tr>
<td>One year</td>
<td>24</td>
</tr>
<tr>
<td>Instantaneous</td>
<td>9</td>
</tr>
<tr>
<td>Five years</td>
<td>6</td>
</tr>
<tr>
<td>Other</td>
<td>26</td>
</tr>
</tbody>
</table>

Source: IMF staff, Survey of country stress testing practices, 2012

### Principle: Focus on tail risks

#### Lessons from the crisis
- In principle: low probability shocks ("extreme but plausible")
- In practice: shocks in pre-crisis tests were often too mild

#### How extreme is “extreme but plausible”?
- Typically based on history
  - but "extreme" shocks calibrated during a benign period may be very mild
  - and what if there is no history at all?
- Small shocks may cause severe impact
  - non-linear reactions, correlated shocks, correlated default of multiple financial institutions
Principle: Focus on tail risks

- Pursue truly tail event scenarios
- Use different approaches to historical data (standard deviation, worst-ever, worst-in-a-decade, etc.)...
- Use a variety of approaches to determine “extreme but plausible”
- … or cross-country experiences
- Complement base test with alternative, newer approaches accounting for simultaneous distress in multiple institutions
- Adopt methods that capture correlations between shocks

In practice, most central bank ST: based on own history
- historical worst, multiples of the worst, standard deviations, percentiles, worse than historical worst

- Some target specific likelihood: 1-5 %

- 70 % consider scenario with joint movement of multiple risk factors
  - macrofinancial scenarios (macro vars + asset price assumptions)
  - distressing credit and market risk parameters

Source: IMF staff, Survey of country stress testing practices, 2012
Principle: Speak smarter, not just louder

Benefits:
- Policy transparency
- More realistic risk pricing and market discipline
- Public awareness of risks
- Boost market confidence

Challenges:
- Potential confusion if multiple tests
- Excessive attention by investors to stress tests
- Attempts to “game” the tests
- Confidence undermined if tests seen as unreliable

ST principles: summary

In-depth knowledge of the system is a pre-condition for effective stress tests (principles 1-3)

Stress tests need to focus on tail risks and be informed by market expectations; communication of results needs to meet these expectations (principles 4-6)

Stress tests do not predict the future; they need to be used in conjunction with other tools (principle 7).
Combining ST with other perspectives

- It is soft!
- It may be too big to fail!
- It is very flexible!
- It clearly has bad assets!
- Its foundations are firm!

Contact Information

Gaston Gelos
International Monetary Fund
Phone +1-202 623 7946
Fax +1-202 589 7946
E-mail ggelos@imf.org
www.imf.org
Hands-on example: credit risk

• Simplified example based on the FSAP tests in smaller/less complex systems

• Fictional data similar to those in the FSAP
Hands-on example: credit risk

<table>
<thead>
<tr>
<th>Initial Balance Sheet</th>
<th>Bank SB1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing loans</td>
<td>#1</td>
</tr>
<tr>
<td>NPLs</td>
<td>#2</td>
</tr>
<tr>
<td>Provisions held</td>
<td>#3</td>
</tr>
<tr>
<td>Regulatory capital</td>
<td>#4</td>
</tr>
<tr>
<td>RWA</td>
<td>#5</td>
</tr>
<tr>
<td>CAR (pre-shock)</td>
<td>#6 = #4 / #5</td>
</tr>
<tr>
<td>NPLs (gross) to total (net) loans</td>
<td>#7 = #2 / (#1 + #2 - #3)</td>
</tr>
</tbody>
</table>

- Shock: 5% of performing loans become NPLs (0.05*1099=55)
- Out of that increase, assume bank provisions 40% (0.4 * 55 = 22)
- Capital then decreases by 22!
### Hands-on example: credit risk

<table>
<thead>
<tr>
<th>Stressed Balance Sheet</th>
<th>Bank SB1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performing loans#1</td>
<td>0.95*10^9</td>
</tr>
<tr>
<td>NPLs#2</td>
<td>1014 + 0.05*10^9</td>
</tr>
<tr>
<td>Provisions held#3</td>
<td>521 + 0.4<em>0.05</em>10^9</td>
</tr>
<tr>
<td>Regulatory capital#4</td>
<td>59 = 81 - 0.4<em>0.05</em>10^9</td>
</tr>
<tr>
<td>RWA#5</td>
<td>1030</td>
</tr>
<tr>
<td>CAR (pre-shock)#6 = #4 / #5</td>
<td>5.7%</td>
</tr>
<tr>
<td>NPLs (gross) to total (net) loans#7 = #2 / (#1 + #2 - #3)</td>
<td>68%</td>
</tr>
</tbody>
</table>