POLICY STUDY 02|2021

German Economic Team

BELARUS

Semistructural framework for financial stability and macroprudential policy analysis

Jaromir Benes

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Outline of the presentation

1. Motivation
2. Key modelling choices
3. Visualization of model structure
4. Illustrative simulation experiments
5. Policy lessons

1. Motivation

Motivation for building a core financial stability and macroprudential policy framework

- Financial stability and macroprudential policy analysis (often) suffers from **fragmented** frameworks
  - Collections of very specific tools
  - High degree of disaggregation focused mostly on the short run
  - One-way interactions, limited endogeneity, limited consistency
- Needed a **broad-picture** support for systematic policy advise
  - Stylized and aggregative framework for depicting financial cycles
- Top-down semi-structural **model-based framework**
  - Medium-term relationships between key macro, financial, and policy variables
  - Endogenous feedback
- Not a substitute but a **complement**
  - A core-satellite structure most efficient operationally and conceptually

Primary use cases for a top-down framework

- Developing consistent stress scenarios
  - Macro-financial **consistency**
  - **Expectations**, consistency of assumptions evolving in time
  - Moving from static pools of exposures to **dynamic responses** of financial system
  - **Point in time** analysis: Direct, reverse, worst-case
- Inform macroprudential policy across the entire cycle
  - **Build-release** cycles
  - **Asymmetries** (nonlinearities) in macro-financial cycles
  - Cost-benefit analysis, policy **tradeoffs**
  - Macroprudential policy as a **robust** policy not optimal policy

What to keep in mind when building the framework

The framework should

- be designed primarily as a scenario analysis tool
- help the experts be very explicit about assumptions
- synthesize a range of different inputs from other tools, analytical work, judgmental assessment, and create a clear narrative
- facilitate communication, lead to better questions

The framework should not

- be designed as a forecasting model
- rely on formal statistical/predictive assumptions
- derive from very strict theoretical assumptions

2. Key modeling choices

Key modeling choices

2.1 Must-haves for financial stability and macroprudential policy models

2.2 Model building strategy: Theoretical versus empirical consistency

2.3 Macro-financial interactions

2.4 How to parametrize the model

2.1 Delineate the must-haves

- Basic **macroeconomic** consistency
- **Stock-flow** bank balance sheet consistency
- Endogenous asset **performance**
- **Integration** of credit risk, short rate risk, exchange rate risk
- Lending **conditions** based on risk
- Credit **creation** process
- Easy to incorporate **new standards** in financial reporting and MPP
  - Provisioning: Incurred loss versus expected loss (IFRS9)
  - Capital regulation: Basel III buffers (conservation, countercyclical, SIB)
- Costly **deleveraging**
- **Coordination** of monetary and macroprudential policy

2.2 Model building strategy: Semistructural aggregative methodology

- Create a **semistructural** framework to combine the benefits of three main modeling (equations building) methodologies
  - Dynamic stochastic general equilibrium models
  - Reduced-form empirical models
  - Agent based models
  - See next slide for more details
- Keep the semistructural framework highly **aggregative**
  - Support a big picture narrative
  - Deliver clear policy advice
  - Focus on aggregate financial cycles and business cycles
  - Disaggregation and analysis by portfolio segments/economic sectors best handled in satellite models

2.2 Comparison of basic modeling methodologies

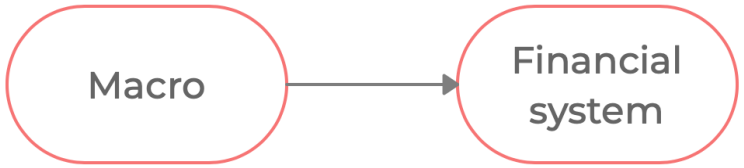
Methodology	Equations building	Main advantages	Main disadvantages
DSGEs	Derive equations for individual behavior from dynamic optimization assumptions	• Strong internal consistency • Explicit demand/supply • Endogenous expectations • More robust to policy changes	• Microfoundations driven by analytical tractability • Cross-equation restrictions too tight for data consistency • Difficult to incorporate real-world irrationality
Reduced-form empirical models	Estimate generic forms from data, imposing (a low number of) identifying restrictions	• Flexibility to capture data dynamics • Easy to resample to evaluate the effects of uncertainty	• Very limited or no capacity to support a clear narrative • Susceptible to false advice in times of policy changes
Agent based models	Specify individual heterogeneous behavior, aggregate across a very large number of agents	• Easy to run heterogeneity (critical in macroprudential) • Emergent properties (the whole different from the individuals) • Nonlinearities	• Ad-hoc foundations for individual behavior • An extremely large dimension of parameter/state space • Often difficult to support a clear narrative

2.2 What is semistructural?

- **Pragmatic** balance of theoretical and empirical consistency
- No **explicit** microfoundations, but enough internal consistency for a clear **narrative**
- Explicit notions of **supply and demand**
- **Unobserved** components
  - Long-run trends and medium-term cycles
  - Endogenous expectations including model-consistent component
- **Stock-flow** relationships, nonlinear response functions
- Flexibility to incorporate **real-world** complexities, e.g.
  - Nonprice lending conditions
  - Multiperiod interest rate fixation
  - Permanent movements in long-term ratio indicators
- High degree of **data consistency**, easy to create TTC and PIT scenarios

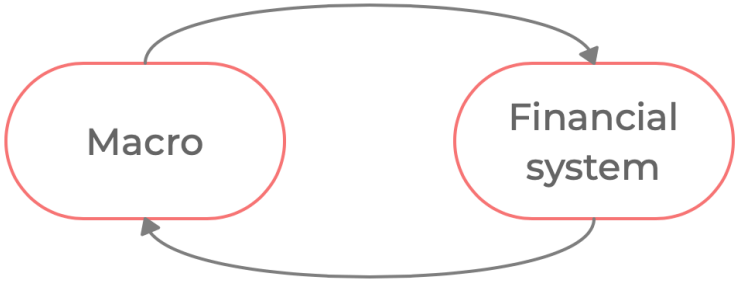
2.3 Endogenous macro-financial feedback

Traditional approach to financial stability and macroprudential policy analysis



- Macro scenarios are an exogenous input into the analysis of financial balance sheets
- No feedback from balance sheet stress to macro
- Easy to operate, difficult to use for systematic policy advice (including monetary-macroprudential coordination)

Frameworks based on two-way interactions



- Macro and financial system interact endogenously within a given scenario
- Macro and financial system respond endogenously to policy actions
- Difficult to develop/operate but essential for broad picture policy advice

2.4 Model parametrization

- Formal **estimation** methods are of very **limited** use in financial stability and macroprudential policy models (can cause more harm than good)
- **Nonlinearities** are the essential element for macroprudential policy analysis; to estimate simultaneous nonlinear reaction functions, we need a **much** large amount of data than for linear models
- Balance sheet **crises** are very infrequent/rare and distinct from each other; we have much smaller empirical base than for monetary or fiscal policy models
- Financial stability and macroprudential analysis is based on a large number of **unobserved** quantities (risks and risk perceptions, long-run sustainability trends, e.g. credit to GDP comfort level of CAR, etc.)
- **Stock-flow** relationships with trending data are extremely challenging in formal estimation
- Some critical **policy properties** are likely to be destroyed/damaged by mechanical/naïve estimation anticipation of long-run fundamentals, costly deleveraging)

2.4 Calibration and empirical validation

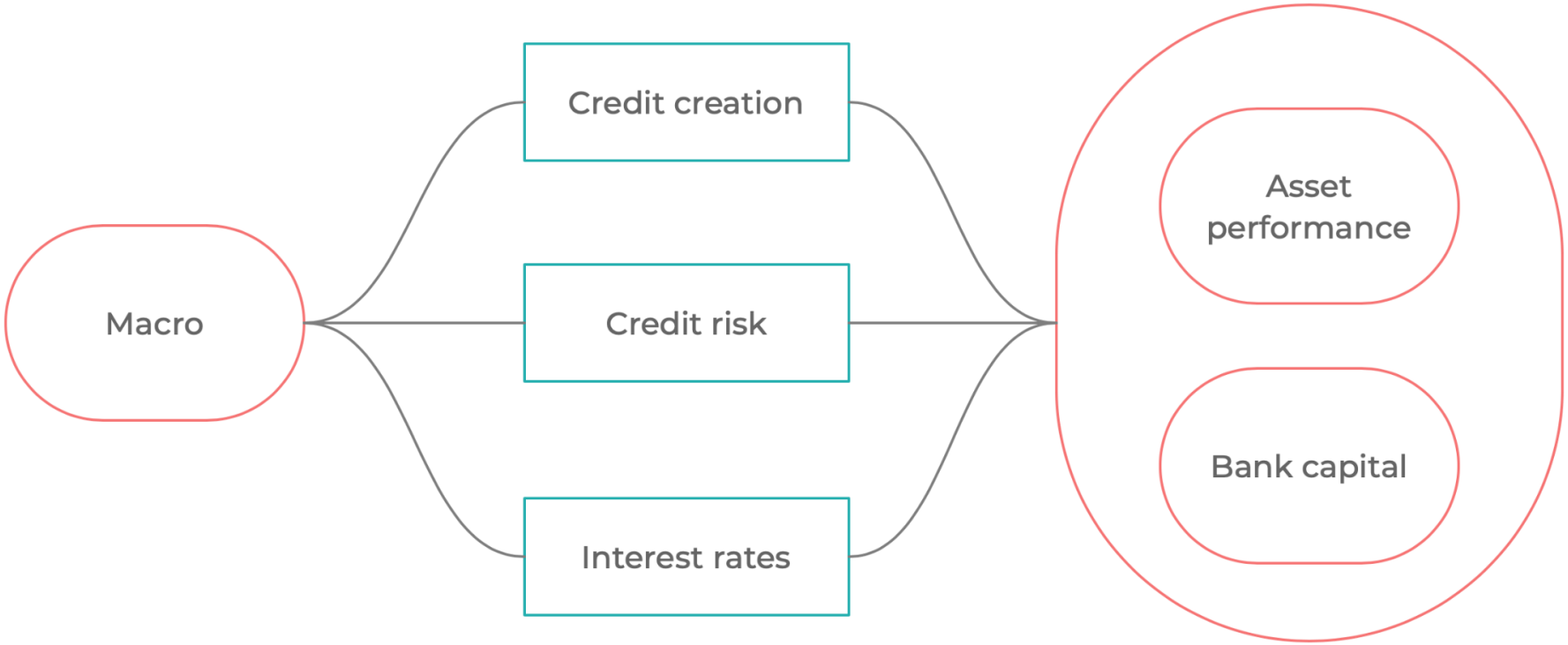
- Parametrize the model using **calibration** techniques
- Long-term **wash-rinse-repeat** process with large amounts of judgmental calls
- Set of simulation-based **smell checks** to constantly subject he most critical properties to testing, e.g.
  - Dynamic response of asset portfolios
  - Costly deleveraging
  - Cost of buffers in good times, benefits of buffers in bad times
  - Asymmetries in financial cycles
- Repeat **historical** projection exercises and counterfactuals
- Exercise great control over **long-term expectations** (macro fundamentals, credit risk, etc.) in calibration scenarios

3. Visualization of model structure

Main parts of the model framework

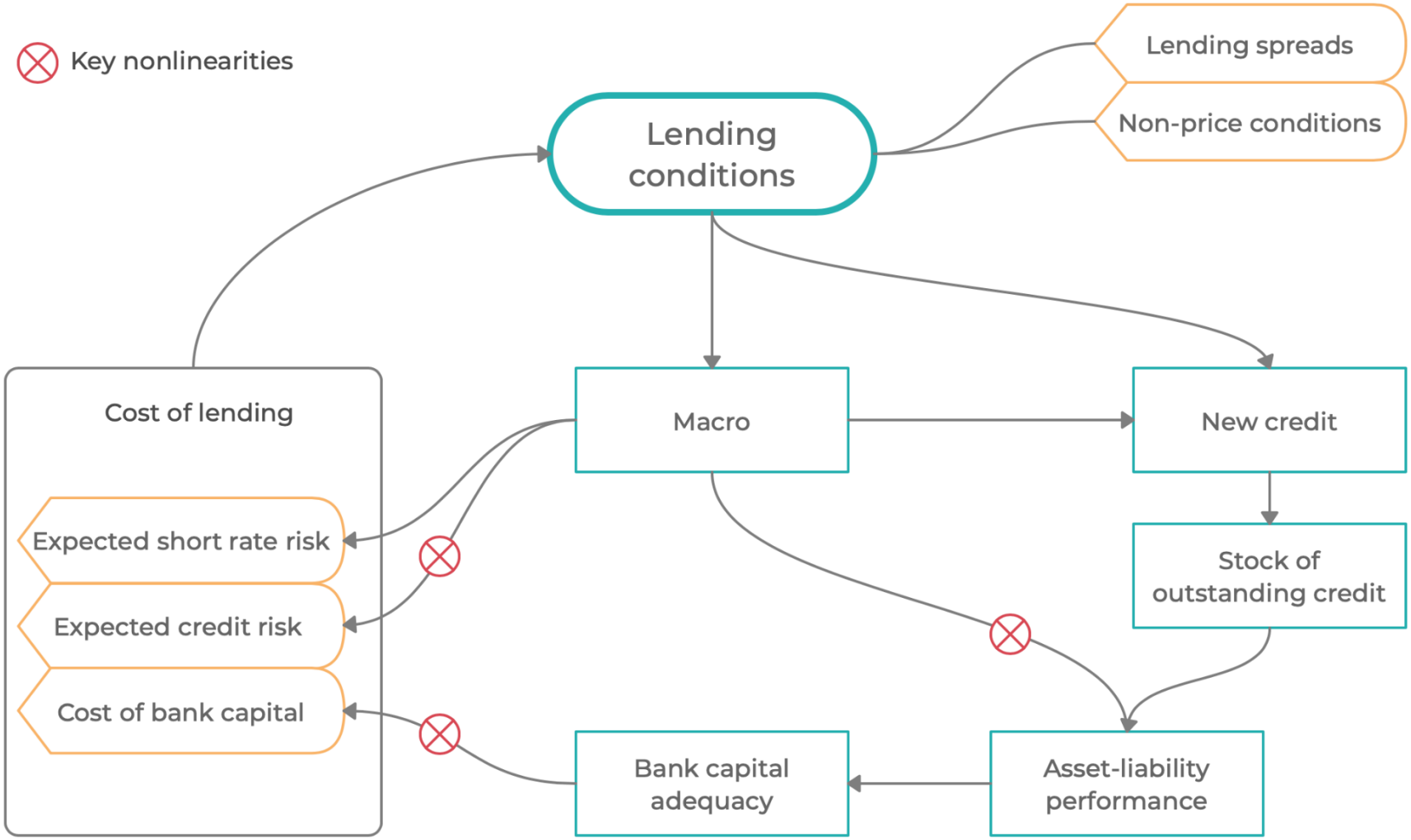
- Model framework consisting of individual modules grouped into *macro*, *bank balance sheets*, and *connecting modules*
- Core macro equations relatively standard (semi-structural gap model)
- Feedback between macro and financial system centered around lending conditions
- Stock-flow dynamics of bank loan porfolio
- Nonlinear loan portfolio loss rate function responding to macro conditions index
- Allowances and flows of provisions based on expected credit losses
- Lending conditions comprising lending spreads and nonprice conditions
- Bank capital cumulating from expected and unexpected profits and losses, and a nonlinear cost of bank capital function
- Credit creation process

Main modules of the framework



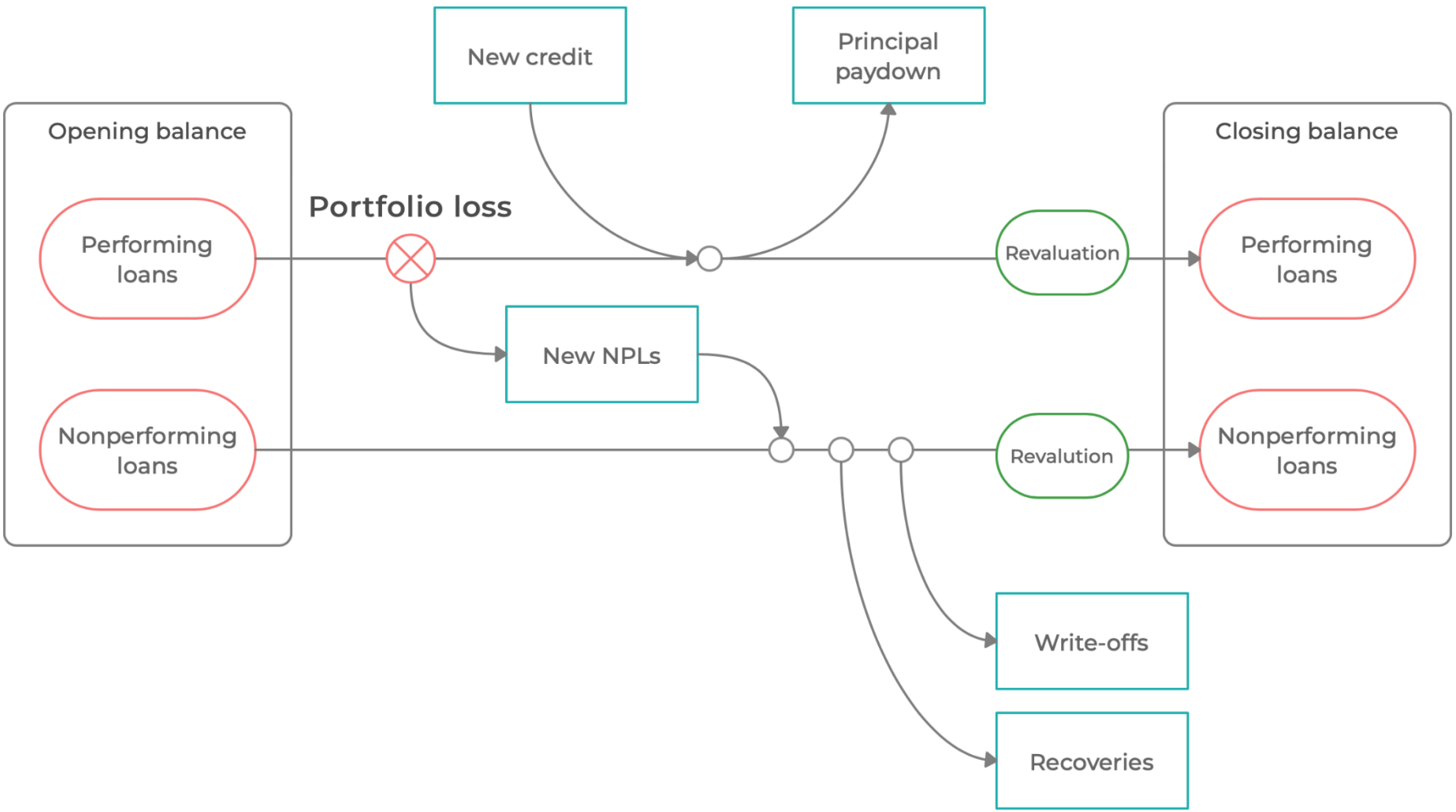
Source: OGResearch methodology

Main elements of macro-financial feedback



Source: OGResearch methodology

Gross loan dynamics (Multiple portfolio segments)



Source: OGResearch methodology

Roles of portfolio loss rates in feedback mechanisms

Actual loss rates

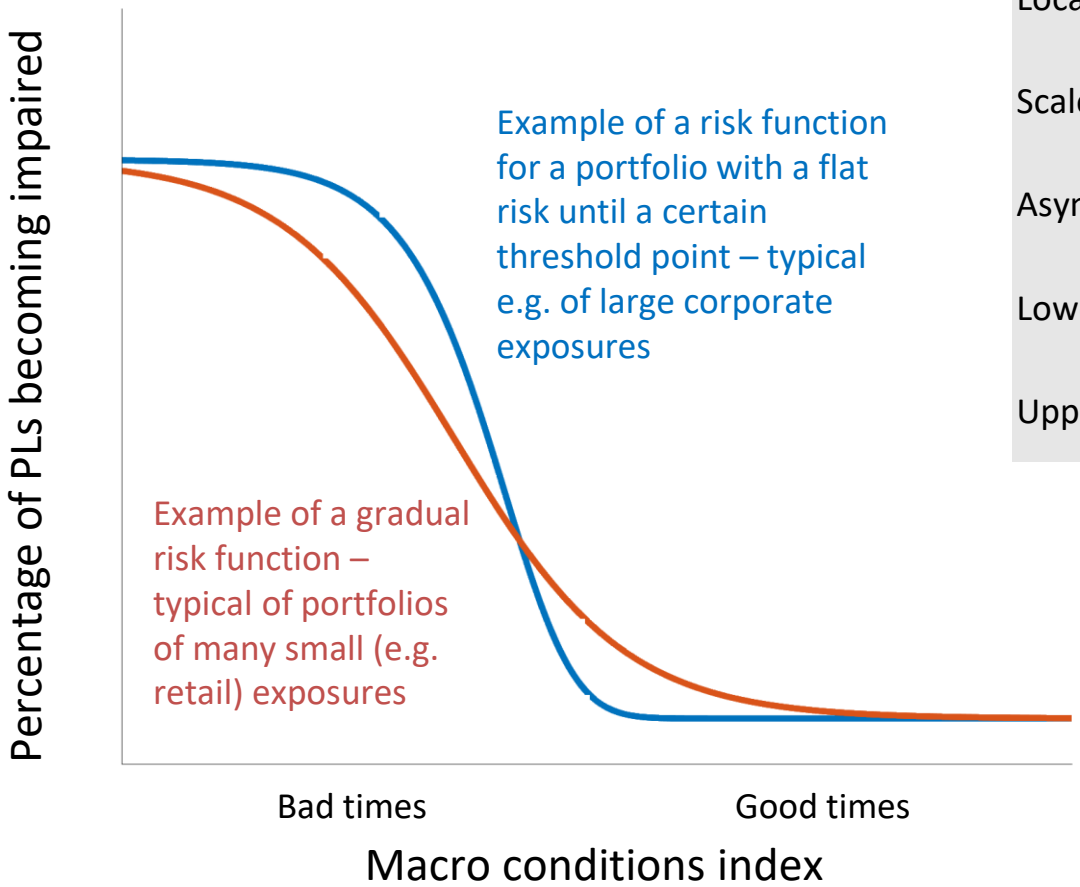
- Determine **actual inflows** from performing loans into nonperforming loans
- Cause shocks to bank capital if actual losses have not been previously provisioned properly

Expected future loss rates

- Expected losses incorporated in new **lending conditions** (lending spreads, nonprice conditions) for new loans and new adjustable rates
- Expected losses determine the level of **allowances** (provisions) created
- Affect both macro and bank profitability/bank capital

Nonlinearity #1: Portfolio loss rate function

Illustrative **qualitative** chart of the portfolio loss rate function



Five-parameter generalized logistic function

Location

Scale (dispersion)

Asymmetry

Lower bound

Upper bound

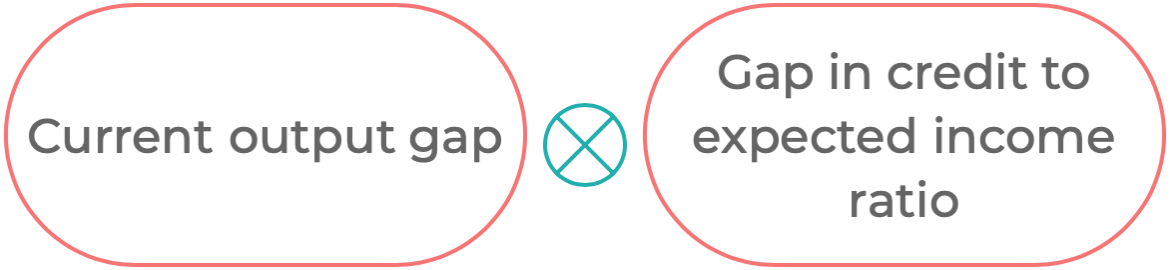
Source: OGResearch methodology

Loan portfolio segmentation

- Keep the framework **aggregative**: big picture
- A **small number** of loan portfolio segments
- Capture differences in **portfolio loss** rate risk function
- **Examples** of segmentation
  - Unsecured consumer + Mortgage + Nonfinancial corporate
  - Local currency denomination + Foreign currency denomination

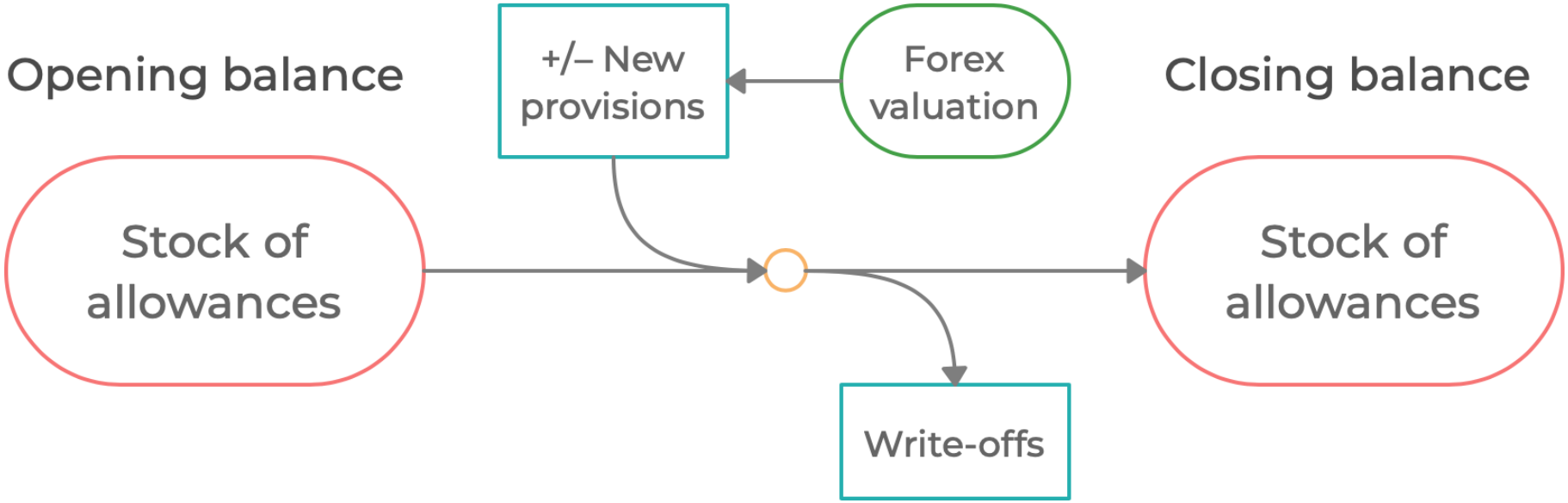
Design of macro conditions indicator

- Combine two notions in the overall macro conditions indicator: current conditions and longer-term vulnerability level



- Current output gap: indicator of current ability of borrowers to repay their contractual obligations
- Gap in credit to expected (discounted) income ratio: indicator of longer-term vulnerabilities on borrower balance sheets

Allowances for expected credit losses



Source: OGResearch methodology

Allowances for expected credit losses

- Two provisioning systems:
  - Backward-looking based on recognized performance of the loan portfolio
  - Forward-looking based on expected credit losses (ECLs) over a future horizon
- Backward-looking systems
  - Estimated of downturn risk parameters used
- Forward-looking systems (IFRS9)
  - *ACL* = PV of contractual cash – PV of expected cash
  - Forward-looking information (scenarios) used

Allowances for expected credit losses

- Two possible definitions of allowances for credit losses (ACLs):
  - Backward-looking based on actual performance of the loan portfolio
  - Forward-looking based on expected credit losses (ECLs) over a future horizon
- Stock of ACLs determined by the value of ECLs each period

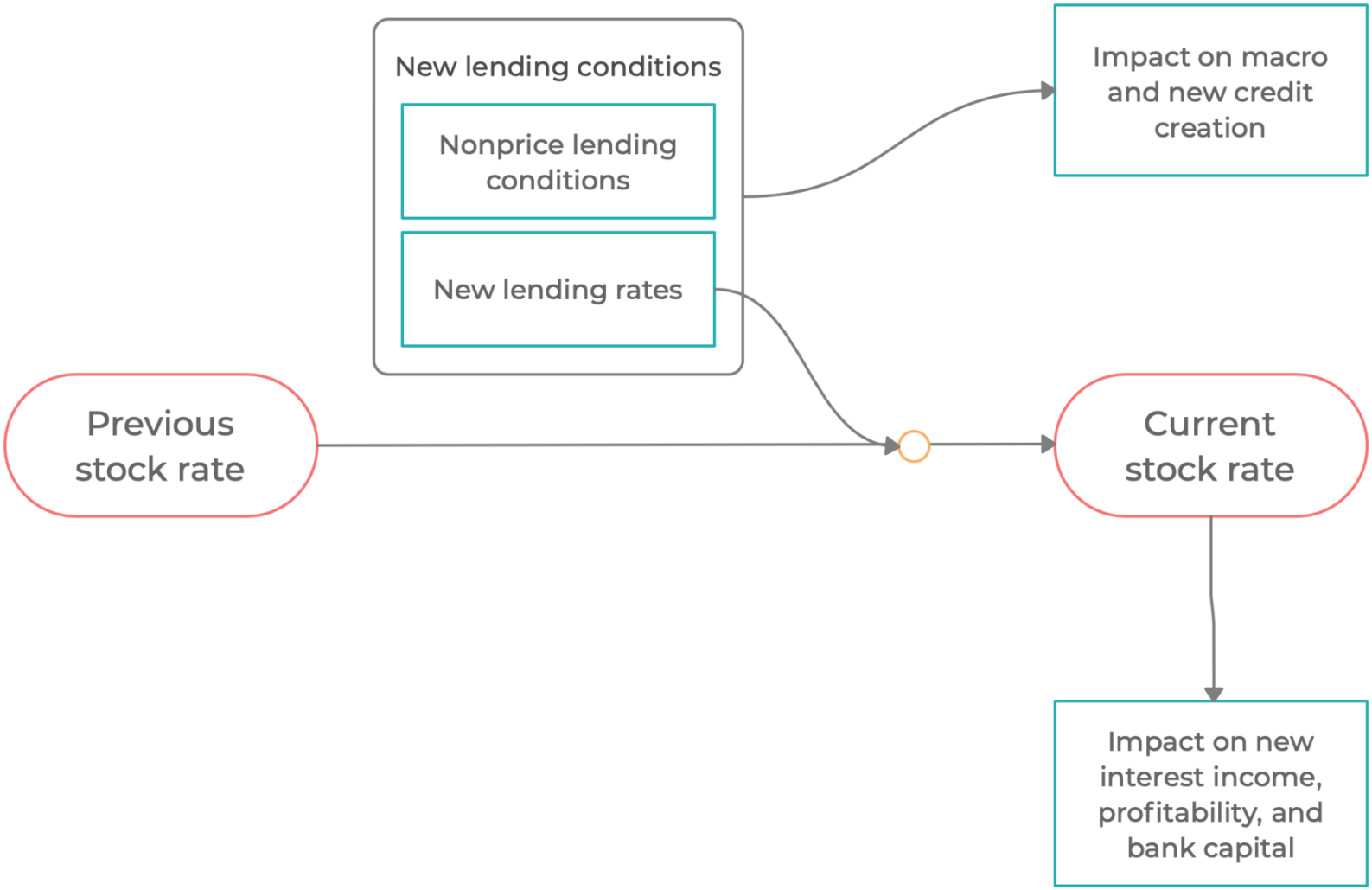
  ACL = Present values of contractual cash – Present value of expected cash
- Two important parameters introduced by IFRS9 methodology
  - Time value of money
  - Time horizon for expected losses
- Time value of money: discounting by the contractual lending rate
- Time horizon: 12-month horizon (stage-1 and stage-2 assets under IASB[1]) vs lifetime (stage-3 under IASB, all assets under FASB[2])
- Flow of provisions (positive or negative) follows residually from the dynamics of the stock of ACLs

[1] International Accounting Standards Board
[2] Financial Accounting Standards Board

Allowances and lending spreads

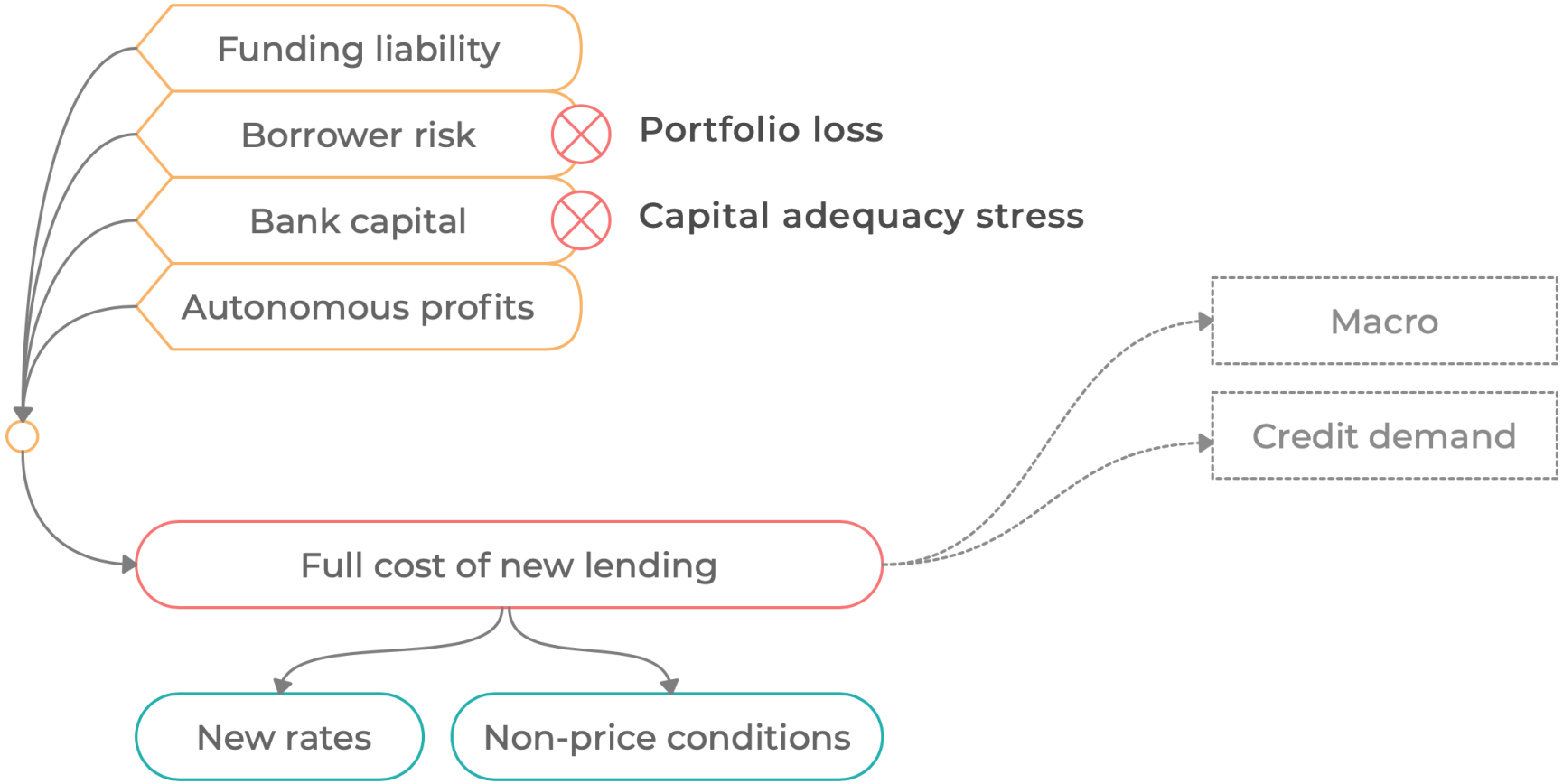
- In a fully optimal and rational world
  - the lending spreads would cover the expected credit losses fully
  - the allowances would not need to be mandated on bank balance sheets
- The assumption falls far from the reality
  - Mismeasurement of expected credit losses
  - Strategic behavior of banks tilted towards myopia
  - Lending policies respond to expected credit risk by both the lending spreads and the nonprice lending conditions
- Important financial stability dimension in the concept of allowances
  - Front-load the creation of (costly) allowances to “good times” when the cost remains low
  - Release the allowances in “bad times” when the relief is needed the most

New lending rates and stock lending rates



Source: OGResearch methodology

New lending conditions

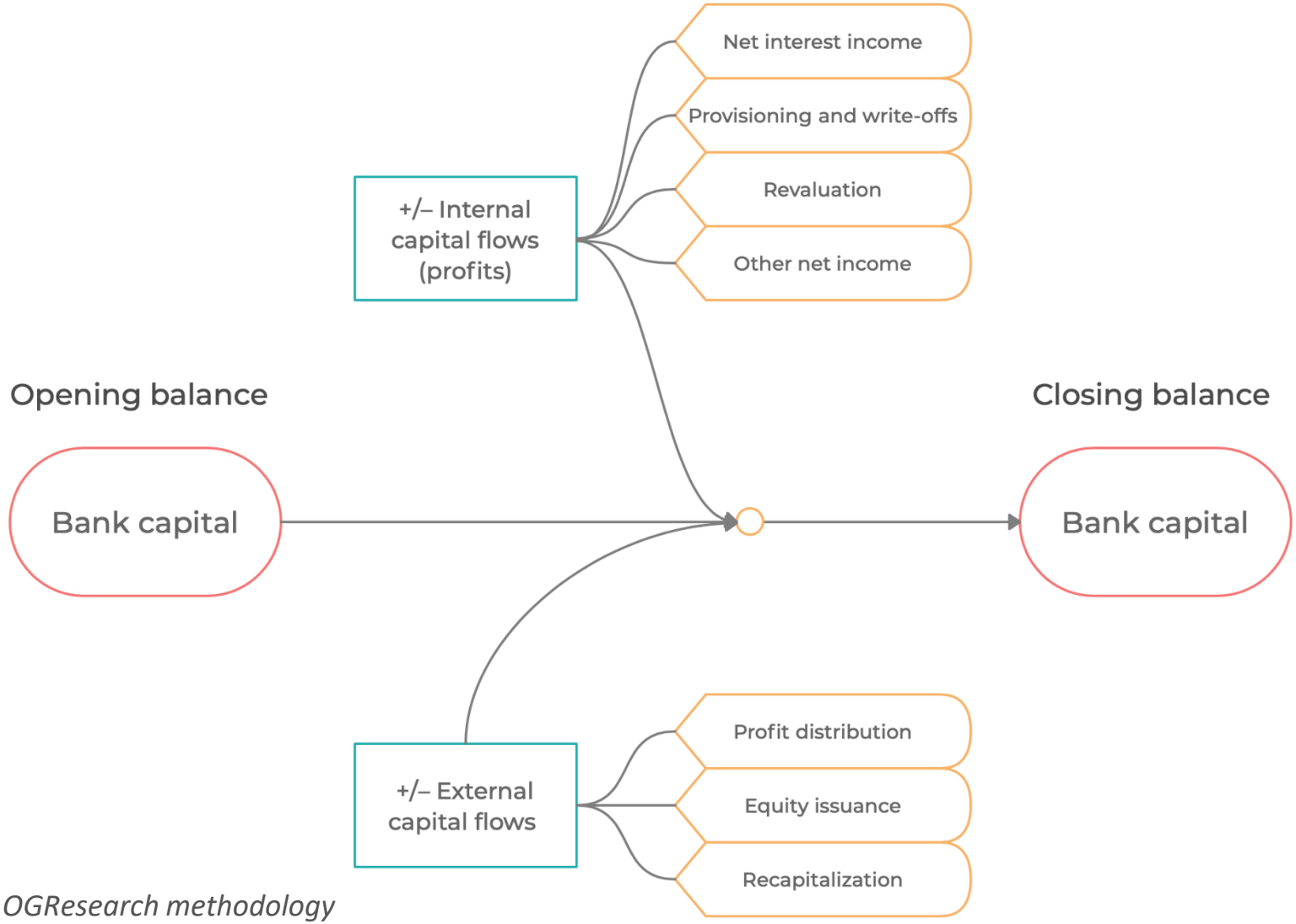


Source: OGResearch methodology

New lending conditions

- Lending conditions comprise
  - directly measurable lending spreads
  - nonprice lending conditions, including direct credit volume rationing
- Banks set the lending conditions to equilibrate credit demand and supply so to cover the marginal cost of creating credit
  - Cost of funding liability: current and future expected short rates (depending on the lending rate fixation period)
  - Borrower credit risk: expected credit losses over a future horizon
  - Cost of bank capital: current and future expected distance of regulatory capital from its regulatory minimum
  - Autonomous profit margins: exogenous components to compensate overall return on bank capital

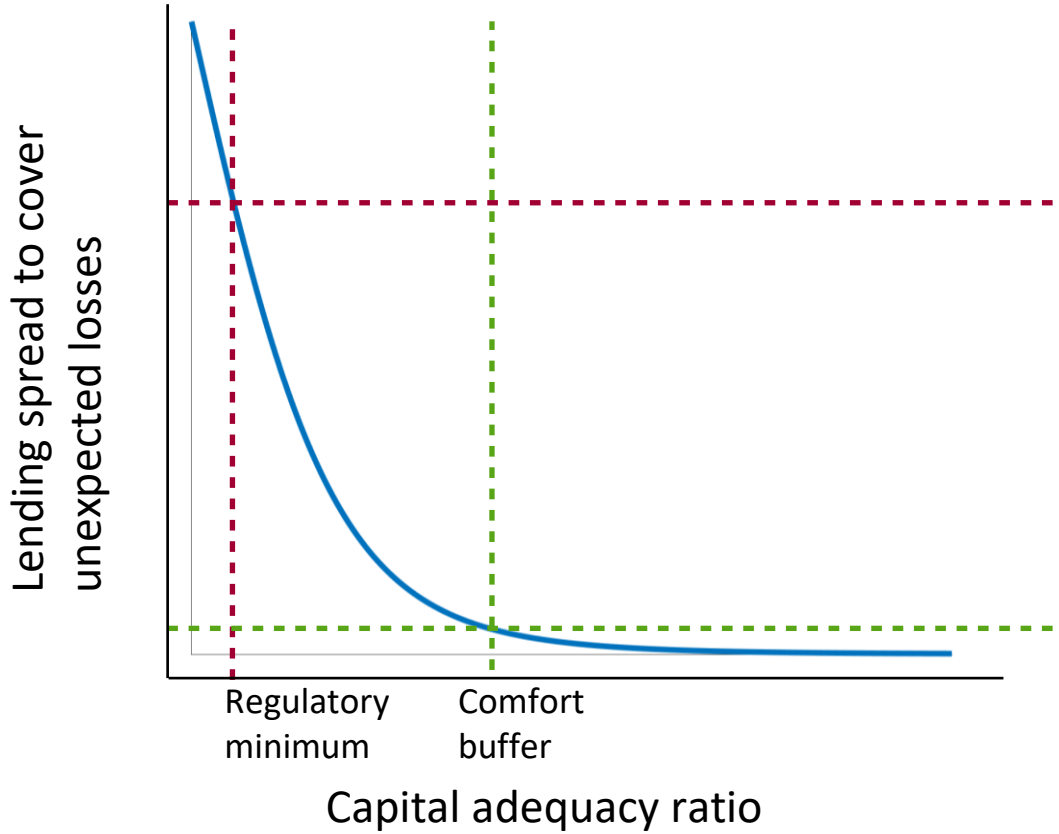
Bank capital and unexpected losses



Source: OGResearch methodology

Nonlinearity #2: Bank capital and unexpected losses

Illustrative **qualitative** chart of the bank capital cost function

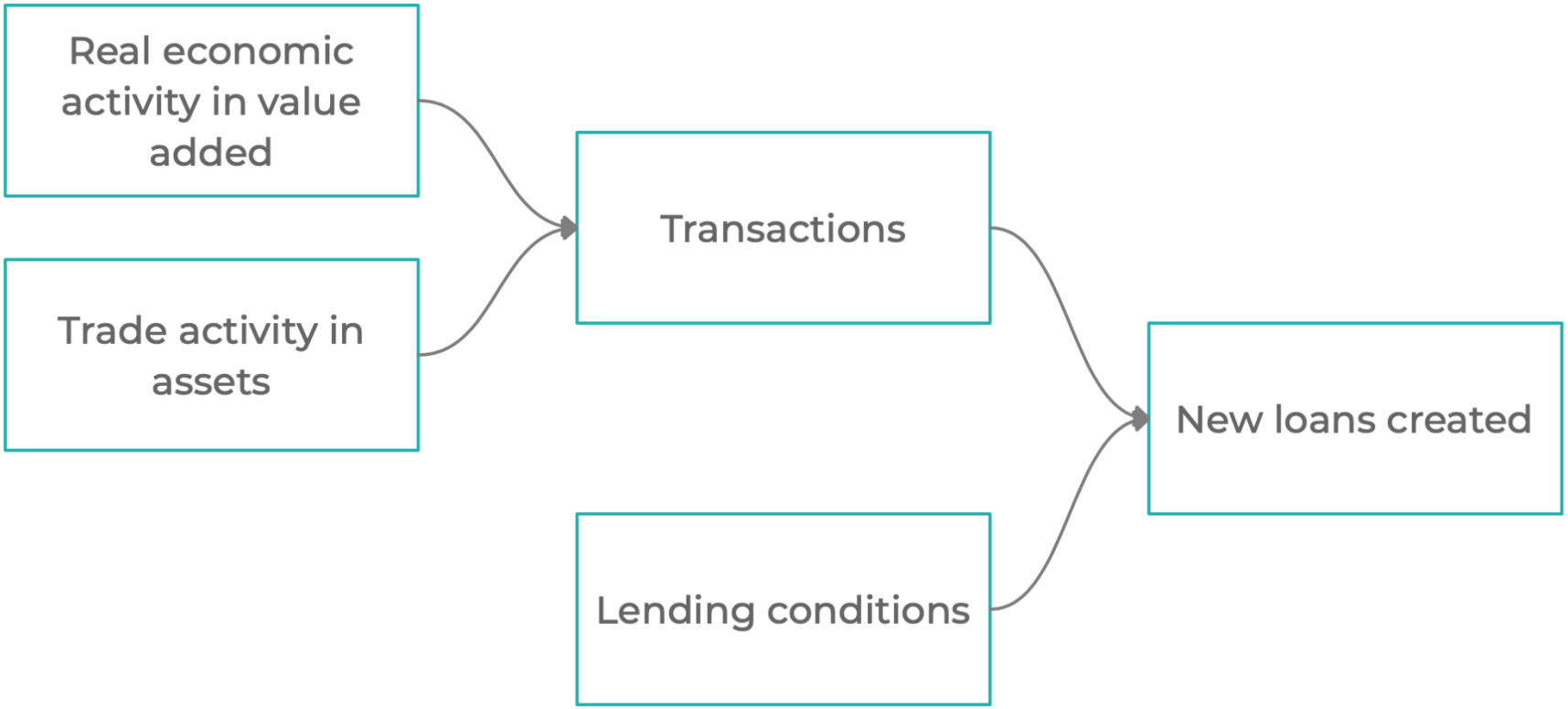


CAR approaching regulatory minimum: Banks reluctant to expand leverage, increase lending spreads and nonprice conditions to slow down credit creation process; slope of the bank capital cost steeper

Normal times: Slope of the cost of bank capital function is relatively small, not affecting lending conditions significantly

Source: OGResearch methodology

Credit creation process



Source: OGResearch methodology

Macroprudential policy

- Capital regulation instruments
  - Conservation buffers
  - Countercyclical buffers
  - Other capital buffers
  - Build-release cycles in capital buffers difficult to model as a reaction function; judgmental/discretionary analysis always needed
- Quantitative caps and inequality constraints (occasionally binding)
  - Loan to value ratio caps
  - Debt service to income ratio caps
  - Caps work may work as built-in stabilizers and don't need a policy reaction function to be activated
- Modeling quantitative caps through a shadow price
  - When binding, quantitative caps increase the underlying shadow price of credit to the point where demand is effectively discouraged from exceeding the caps

Modifications in standard macro equations

- Potential output with hysteresis
  - Path dependence on actual output
  - Generates a real cost of deep financial crises
- Output gap (aggregate demand) with lending conditions
  - Conceptual breakdown into a real short rate gap and lending conditions gap
- Definition of future expected income
  - Discounted sum of future expected output
  - Used as an indicator of future expected repayment capacity of borrowers
  - Used as an indicator of the fundamental component in asset prices
- Country premium in the forex market inclusive of lending conditions
  - Lending conditions used as a proxy of the risks to the country's real economic activity

4. Illustrative simulations

Illustrative simulations

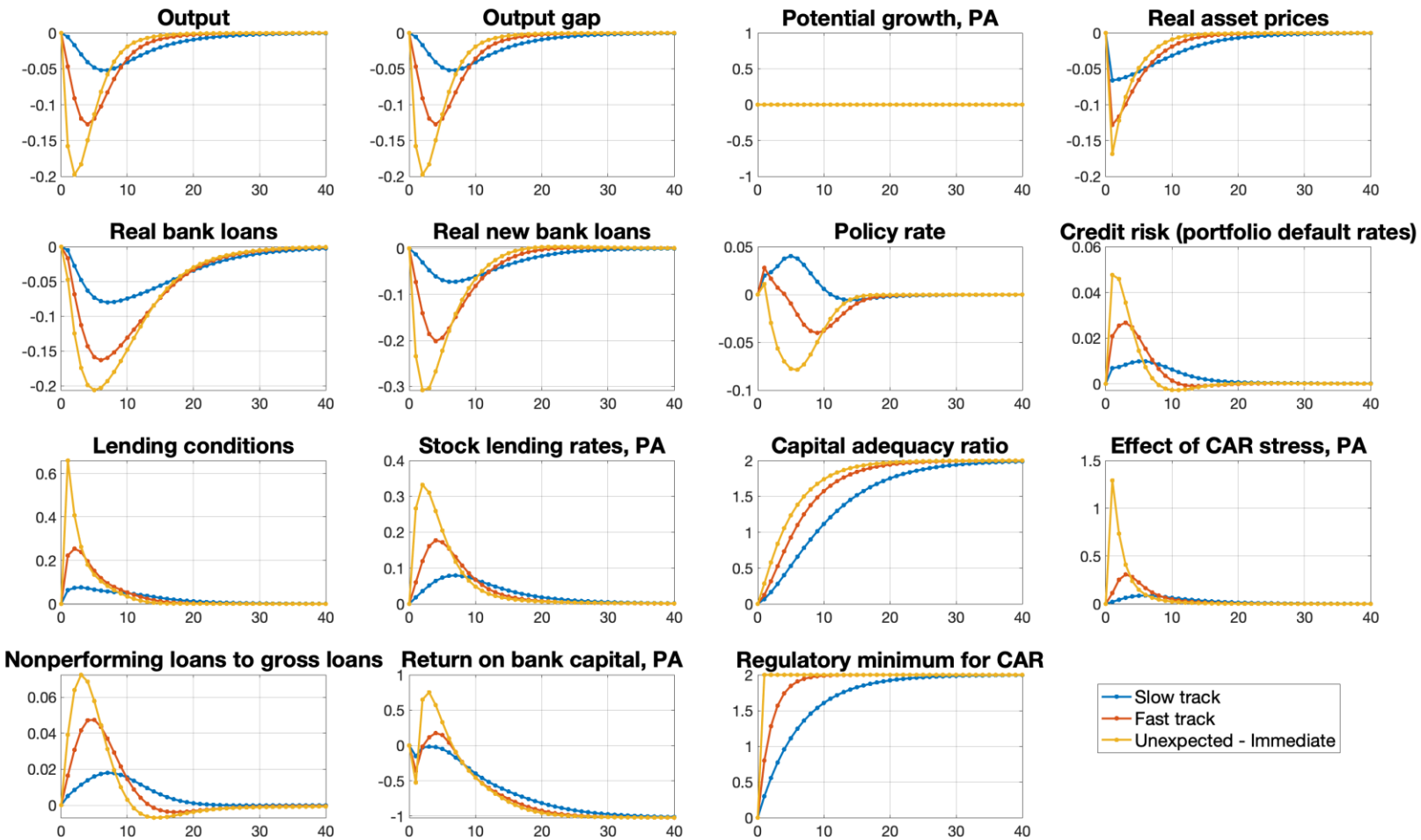
Creating conservation buffers

- Different speed of implementation
- Different initial condition

Boom-bust credit cycle

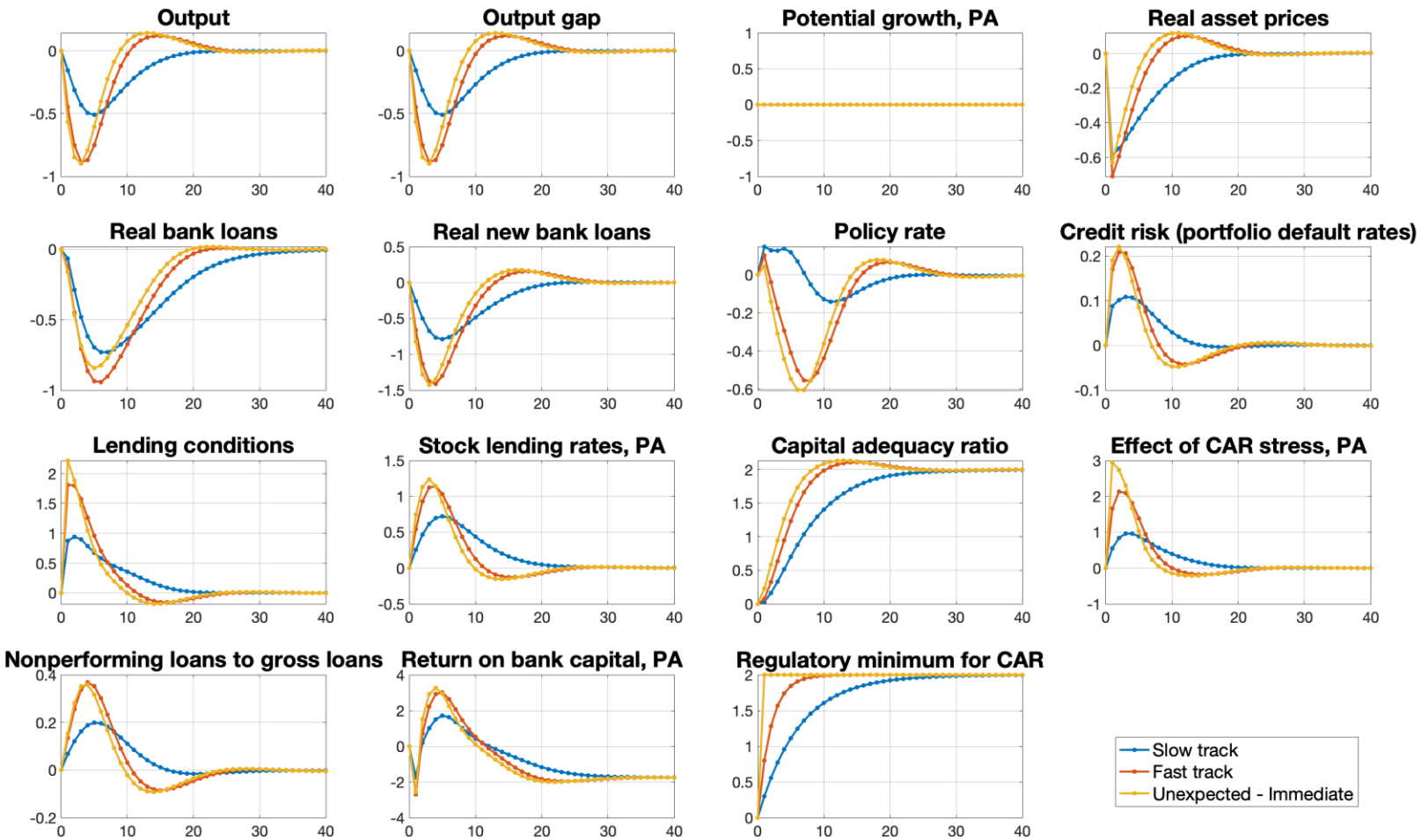
- Create overly optimistic scenario of potential growth
- After a while, get everything revised down
- Use countercyclical buffers

Conservation buffers – High excess capital



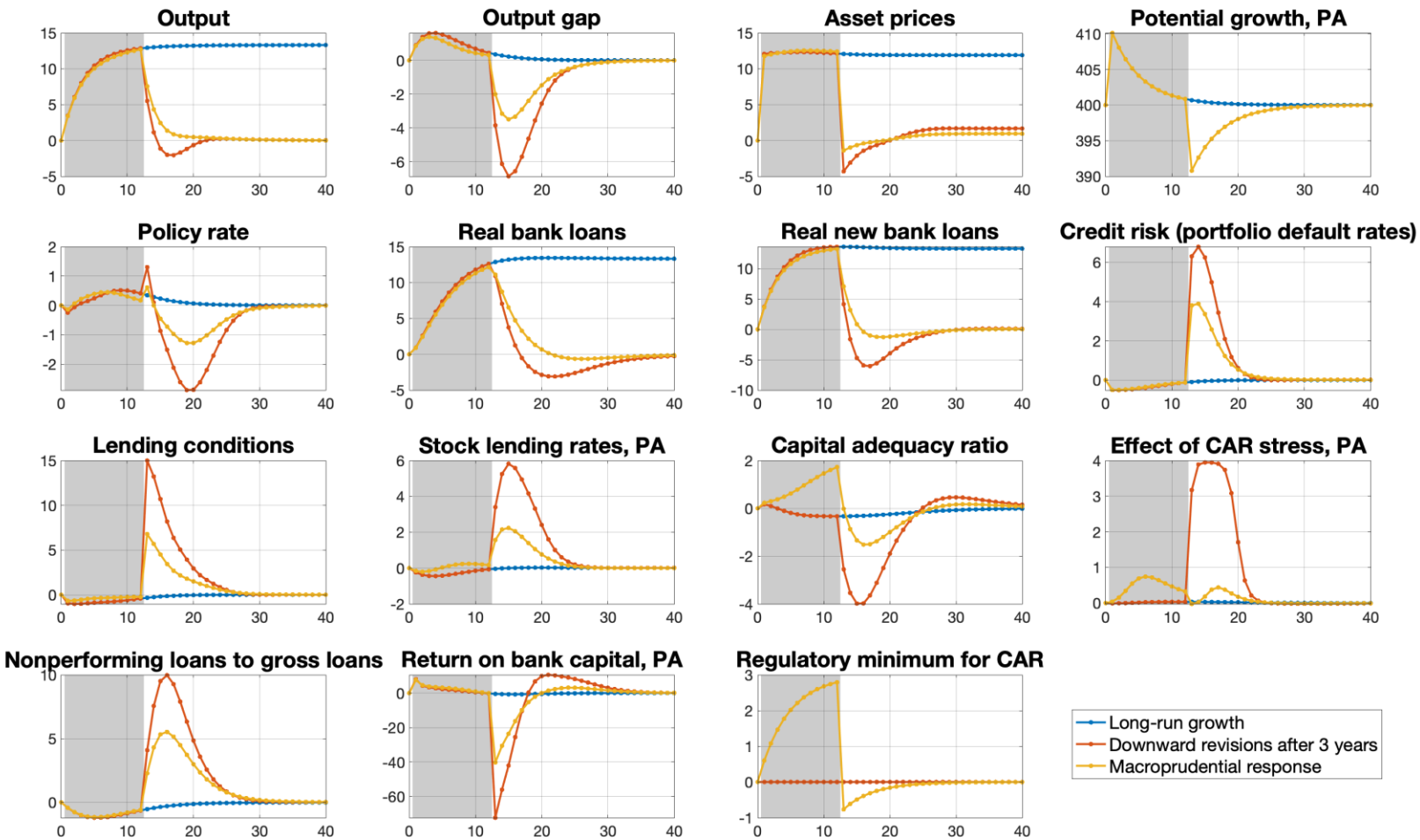
Source: Author's own calculations

Conservation buffers – Low excess capital



Source: Author's own calculations

Credit boom-bust cycle and FSMP policy



Source: Author's own calculations

5. Policy lessons

Policy lessons

- Systematic financial stability and macroprudential policy analysis need a broad-picture framework focused on basic policy trade-offs and cost-benefit analysis across financial cycles
- **Nonlinearities** are essential and indispensable
  - Transmission mechanisms change dramatically under large balance sheet stress
  - Nonlinearities distort greatly the quantification of costs and benefits of macropru policies
- Macroprudential policy should be viewed as a **robust** control problem, not optimal control problem
  - Do not fine tune cyclical behavior
  - Build sufficient buffers in good times (when it‘s cheap) and release the buffers in bad times when needed
- Unlike in monetary policy, good mechanical **reaction functions** are impossible to design in macroprudential policy
  - Extremely model-specific and scenario-specific

About the German Economic Team

Financed by the Federal Ministry for Economic Affairs and Energy, the German Economic Team (GET) advises the governments of Ukraine, Belarus, Moldova, Kosovo, Armenia, Georgia and Uzbekistan on economic policy matters. Berlin Economics has been commissioned with the implementation of the consultancy.

CONTACT

Dmitry Chervyakov, Project Manager Belarus
chervyakov@berlin-economics.com

German Economic Team
c/o BE Berlin Economics GmbH
Schillerstraße 59
10627 Berlin

Tel: +49 30 / 20 61 34 64 0
info@german-economic-team.com
www.german-economic-team.com

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