The Eurace 2.0 model

SEPTEMBER 5, 2018

Marco Gross
Monetary and Capital Markets Department, IMF
Joint work with:

Sander van der Hoog and Dirk Kohlweyer:
ETACE, Bielefeld University, DE

Bjoern Hilberg:
European Central Bank, Frankfurt, DE

Disclaimer:

The views are those of the presenter and do not necessarily reflect those of the IMF.
We agree with:

“We need a theory that makes instability a normal result in our economy and gives us handles to control it.” (Minsky 1986)
We agree with:

“We need a theory that makes instability a normal result in our economy and gives us handles to control it.” (Minsky 1986)

We disagree with:

“Good models have to necessarily be artificial, abstract, and patently unreal.” (Lucas 1981)
We agree with:

“We need a theory that makes instability a normal result in our economy and gives us handles to control it.” (Minsky 1986)

We disagree with:

“Good models have to necessarily be artificial, abstract, and patently unreal.” (Lucas 1981)

We develop a Macro-Financial Agent-Based Model: not abstract, realistic, featuring endogenous cycles (instability), and a role for policy to influence the cycle.
Objective

Develop a model that helps policy makers answer questions such as:

1. Do capital- and borrower-based MPRU instruments help reduce financial and business cycle variance?
   - Comparative efficacy of instruments?
   - Trade-off between growth and stability (mean and variance)?
   - Transmission channels?
   - Actual quantitative, initial state-dependent impacts?

2. Static vs. dynamic use of tools
   - What macro-financial indicators to link to?
Why an ABM?

- Recourse to shocks in NK models very dis-satisfactory → not explaining cyclical sequence of booms and recessions.

- Critique about DSGE models very explicit (Blanchard 2016a/b, Stiglitz 2017, …)

- Rational expectations (Muth 1961): neat but extremely implausible.

- Bounded rationality more plausible (Simon 1955, Tversky & Kahnemann 1974): heuristics are economical and effective.

- Agent heterogeneity: distributional effects of policy.
OUTLINE

1. Literature perspective
2. Selected model features
3. Exemplary simulation results
4. Conclusions + Way forward
OUTLINE

1. Literature perspective
2. Selected model features
3. Exemplary simulation results
4. Conclusions + Way forward
**Procyclical bank lending**

- **Housing collateral**
  - Collateral Accelerator
  - Kiyotaki & Moore 1997
  - Bernanke et al. 1999
  - Almeida et al. 2006

- **Lending standards**
  - Mispricing Accelerator
  - Asea & Blomberg 1998
  - Ruckes 2004
  - Jiménez & Saurina 2006

- **Regulation / Policy**
  - Policy Accelerator
  - Blum & Hellwig 1995
  - Estrella 2004
  - Kashyap & Stein 2004
  - Angeloni & Faia 2013

- **Competition**
  - Implying ignorance w.r.t. mispricing and risk mismeasurement
  - Repullo 2004
  - Boyd & De Nicoló 2005
  - Martinez-Miera & Repullo 2010

- **Volatility does not measure risk**
  - Risk mismeasurement for accounting provisioning and capital requirements
  - Hayek 1960
  - Danielsson et al. 2012/2016
  - Brunnermeier & Sannikov 2014

- **Herd behavior**
  - Herding Accelerator
  - Day & Huang 1989
  - Scharfstein & Stein 1990
  - Becker 1991
  - Kirman 1993

- **Forgetfulness**
  - Memory-based bounded rationality and institutional memory hypothesis
  - Mullainathan 2002
  - Berger & Udell 2004
OUTLINE

1. Literature perspective
2. Selected model features
3. Exemplary simulation results
4. Conclusions + Way forward
# Integrated balance sheets

<table>
<thead>
<tr>
<th>Agent</th>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Households</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( h = 1 \ldots H )</td>
<td>( T^h ) tangible assets (real estate)</td>
<td>MORT mortgage loans</td>
</tr>
<tr>
<td></td>
<td>( M^h ) liquid assets (deposit at bank)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( S^f ) equity stake in firms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( S^b ) equity stake in banks</td>
<td></td>
</tr>
<tr>
<td></td>
<td>SBOND sovereign bonds</td>
<td></td>
</tr>
<tr>
<td><strong>Consumption goods</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( f_1 = 1 \ldots F_1 )</td>
<td>( T^{f_1} ) tangible assets (physical capital)</td>
<td>FLOAN loans</td>
</tr>
<tr>
<td></td>
<td>( M^{f_1} ) liquid assets (deposit at bank)</td>
<td>( \varepsilon^{f_1} ) equity</td>
</tr>
<tr>
<td><strong>Investment goods</strong></td>
<td><strong>firms</strong> ( (f_2 = 1 \ldots F_2) )</td>
<td><strong>firms</strong> ( (f_2 = 1 \ldots F_2) )</td>
</tr>
<tr>
<td></td>
<td>( T^{f_2} ) tangibles assets (physical capital)</td>
<td>( \varepsilon^{f_2} ) equity</td>
</tr>
<tr>
<td></td>
<td>( M^{f_2} ) liquid assets (deposit at bank)</td>
<td>( \varepsilon^{f_2} ) equity</td>
</tr>
<tr>
<td><strong>Banks</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( b = 1 \ldots B )</td>
<td>sum(MORT) mortgage loans</td>
<td>sum(M^h) deposits from households</td>
</tr>
<tr>
<td></td>
<td>sum(FLOAN) loans to consumption good firms</td>
<td>sum(M^{f_1}) deposits from cons. good firms</td>
</tr>
<tr>
<td></td>
<td>GLOAN loans to government</td>
<td>sum(M^{f_2}) deposits from investment good firms</td>
</tr>
<tr>
<td></td>
<td>SBOND sovereign bonds</td>
<td>M^G deposits from government</td>
</tr>
<tr>
<td></td>
<td>( M^b ) reserves (deposit at central bank)</td>
<td>BLOAN loan from central bank</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( P ) loan loss reserve</td>
</tr>
<tr>
<td></td>
<td></td>
<td>( \varepsilon^b ) equity</td>
</tr>
<tr>
<td><strong>Government</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( G )</td>
<td>( M^G ) liquid assets (deposit at bank)</td>
<td>GLOAN loans</td>
</tr>
<tr>
<td></td>
<td>SBOND sovereign bonds</td>
<td></td>
</tr>
<tr>
<td></td>
<td>( \varepsilon^G ) equity</td>
<td></td>
</tr>
<tr>
<td><strong>Central Bank</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>( CB )</td>
<td>( M^{CB} ) liquid assets</td>
<td>sum(M^G) liquid assets from banks (reserves)</td>
</tr>
<tr>
<td></td>
<td>SBOND sovereign bonds</td>
<td>( \varepsilon^{CB} ) equity</td>
</tr>
<tr>
<td></td>
<td>BLOAN loans to banks</td>
<td></td>
</tr>
</tbody>
</table>
... because changes in bank funding costs due to (policy-induced) changes in bank capital structure and bank-external conditions are important to properly capture the impact of MPRU policies.
Component 1/13: Bank funding cost module

\[ i_{b,h,t}^{\text{loans}} = WACF_{b,t} + \text{spread}_t (\text{borrower risk}) \]

\[ WACF_{b,t} = i_{t}^{\text{base}} + \text{spread}_t (\text{bank risk}) \]

\[ i_{t}^{\text{base}} = i_{t}^{\text{pol}} = f(\text{capacity util.}, \text{inflation gap}) \]

- **Fully structural**, function of borrower PDs and LGDs. For firms and mortgage loans separately. Borrower-specific spread.
- **Empirically micro-founded** bank panels for deposit rates, cost of debt and equity embedded in the ABM. Bank-specific.
- **Taylor rule**. Capacity utilization and inflation gap structurally endogenous in the ABM. Economy-wide base rate.
## Component 1/13: Bank funding cost module (ctd)

### Cost of deposits and debt
- Empirical bank (agent) panel model
- Controls for market price of risk and sovereign risk (ignored in ABM though)

\[
r_{bt}^D = \max\{\alpha_b^D + \beta^D R_{b,t-1} + \gamma^D R_{2,t-1}^2 + \delta^D RW_{b,t-1} + \eta^D r_t^{CBF}, 0\}
\]

### Cost of central bank funding
- Empirical Taylor rule: function of inflation gap and capacity utilization

\[
r_{t}^{CBF} = \max\{r^* + \alpha_{\pi}(\pi_{t-1} - \pi^*) + \alpha_u u_{t-1}, 0\}
\]

### Weighted average cost of funding (WACF)

\[
I_t^b = \frac{12}{3} \times \sum_{s=1}^{3} \frac{I_t^{b,total}}{L_t^{s}}
\]

### Cost of equity
- Empirical bank (agent) panel model of cost of equity (CAPM-based)
- Define CAPM-based rate as dividend pay-out rate in the model

\[
r_{bt}^{Div} = \max\{\alpha_b^{Div,*} + \beta^{Div} R_{b,t-1} + \gamma^{Div} R_{2,t-1}^2 + \delta^{Div} RW_{b,t-1}, 0\}
\]
### CoF panel model: Empirical micro-foundation

\[
r_{bt}^{comp} = c + \alpha_b + \beta R_{bt} + \gamma R_{bt}^2 + \delta V_{bt} + \eta m_{st} + \psi \ln(tr_{x,t}) + \xi \ln(cds_{bt}^{sov}) + \epsilon_{bt}
\]

<table>
<thead>
<tr>
<th>Variable</th>
<th>Name</th>
<th>Description</th>
<th>Expected coefficient sign</th>
</tr>
</thead>
<tbody>
<tr>
<td>( r_{bt}^{comp} )</td>
<td>Cost of debt, deposits or capital</td>
<td>LHS variable, cost of funding components. CAPM-implied cost of capital.</td>
<td></td>
</tr>
<tr>
<td>( R_{bt} )</td>
<td>Capital ratio</td>
<td>Consolidate bank level, not risk weighted. Either CET1/TA or TE/TA.</td>
<td>- on linear term, + on squared term</td>
</tr>
<tr>
<td>( V_{bt} )</td>
<td>Asset volatility</td>
<td>Either aggregate risk weight (REA/TA) or asset volatility derived from Merton model.</td>
<td>+</td>
</tr>
<tr>
<td>( r_t )</td>
<td>Policy rate</td>
<td>ECB main refinancing rate</td>
<td>+</td>
</tr>
<tr>
<td>( m_{st} )</td>
<td>Money market spread</td>
<td>3-month Euribor minus policy rate</td>
<td>+</td>
</tr>
<tr>
<td>( tr_{x,t} )</td>
<td>iTraxx Financials</td>
<td>iTraxx Senior Financial to control for market price of risk</td>
<td>+</td>
</tr>
<tr>
<td>( cds_{t} )</td>
<td>Sovereign CDS</td>
<td>5Y sovereign CDS to control for presence of implicit / explicit guarantees</td>
<td>+</td>
</tr>
</tbody>
</table>
CoF panel model: Empirical micro-foundation

\[ r_{bt}^{comp} = c + \alpha_b + \beta R_{bt} + \gamma R_{bt}^2 + \delta V_{bt} + \eta r_t + \theta m s_t + \psi \ln(trx_t) + \xi \ln(cds_{bt}^{sov}) + \epsilon_{bt} \]

While this eq. does not as such capture the reverse relationship (funding cost \(\rightarrow\) solvency), this reverse relation is captured in a fully structural manner in the ABM. That is, the impact of changing funding costs implies a change in interest expenses (incl. dividends) which feed directly through to changes in bank capital.

[it’s this reverse relation that is captured in an econometric simultaneous eq. system for example in Schmitz et al. (2017) and Aldasoro and Park (2018)]
We use the combined cost of deposits and debt for steering deposit expenses of banks in the ABM since the model does not contain money market / wholesale funding sources (on purpose).
Component 2/13: Mortgage loan market – Why?

... because borrower-based measures (LTV/DSTI/LTI/DTI caps) operate on new loan business, hence new loan origination feature is needed.

And: Mortgage credit matters a lot from an economic perspective (Claessens et al. 2010, Schularick & Taylor 2012, Jorda et al. 2013, Jorda et al. 2016, etc.).
Component 2/13: Mortgage loan market

Mortgage loan application process

Joint draw for DSTI, LTV, M
Multivariate distribution based on HFCS (with caps or without); debt service implied since income of household is given.

Interest rate setting
Bank sets spread over own funding cost to reflect borrower-specific risk (lifetime PD and LGD) to cover EL and earn positive spread on average.

Imply principal loan amount and repayment schedule
Given maturity M, borrower interest rate and debt service, principal is implied. Imply lifetime schedule.

Imply max value of house
Given a draw of an LTV and implied L, value of house is implied.

HH own funds
Required residual own funds suffice or not, for contract to be signed or not.
Component 2/13: Mortgage loan market

Loan pricing

Set loan rate \((i_t)\) such that expected life-time loss of a loan is covered, for the bank to earn at least its funding cost \((f_t)\) plus a self-set profit margin \((\mu_t)\) on top.

\[
(1 + f_t + \mu_t)^m = (1 + i_t^h)^m (1 - PD_{t,t+m}^h) (1 - LGD_t) PD_{t,t+m}^h
\]

\[
\Rightarrow i_t^h = \left( \frac{(1 + f_t + \mu_t)^m - (1 - LGD_t) PD_{t,t+m}^h}{(1 - PD_{t,t+m}^h)} \right)^{\frac{1}{m}} - 1
\]
Component 3/13: Housing market

- HHs have inherent motive to own a house
- Purchase possible only with mortgages
- Approach housing market if mortgage contract is feasible and debt service no more expensive than current rent (conditional on current quality)
- Double-auction market
- Buy-To-Let (BTL) gene for pre-defined subset of HHs: aim to own additional housing units to rent out
- Secondary housing market only: no new construction
- Rental and house price index in the model: for policy to link to them
Component 3/13: Housing market

Involving voluntary and involuntary transitions.

[Diagram showing transitions between home-seeking, tenant, owner roles with options for starting or stopping rental contracts, buying or defaulting on mortgage or selling property]
**Component 4/13: Buy-to-Let investors**

*Adaptive price expectation rules*

Two conditions to hold for attempt to buy OP (to rent out)

- **Capital gain objective**
  \[ E_t(V_{t+H}) > \gamma_1 V_t \]
  \[ E_t(V_{t+H}) = \exp \left( \ln(V_t) + H \times q_t \right) \]
  \[ q_t = \frac{1}{S} \sum_{s=1}^{S} \ln \left( \frac{P_{t-s}}{P_{t-s-1}} \right) \]

- **Rental yield objective**
  \[ \sum_{h=1}^{H} \frac{E_t(RI_{t+h})}{A_{t+h}} > \gamma_2 \]
  \[ E_t(RI_{t+H}) = \exp \left( \ln(RI_t) + H \times q_t \right) \]
  \[ q_t = \frac{1}{S} \sum_{s=1}^{S} \ln \left( \frac{CPI_{t-s}}{CPI_{t-s-1}} \right) \]

Condition to hold for attempt to sell

- **Avoid capital loss**
  \[ E_t(V_{t+H}) < V_t \]
Component 5/13: Banks’ loan loss reserve management

Expected loss (EL) a function of point-in-time PDs, LGDs, and EAD, for firms and HH mortgages in the ABM.

IFRS9 philosophy in a simplified manner: Expected loss instead of incurred loss for LLR built up for performing loans.

Event line built into the model:
Remaining components 6-13

6. Risk weighted asset dynamics: IRB REA formulas embedded
7. Seizure of housing collateral by banks and re-sale in secondary market
8. Solvency-based bank defaults
9. Balance sheet initialization for households with household survey data and banks
10. Household consumption and savings rules, including household assets
11. Consumption goods firms: production planning, capital/labor management, vintage choice, pricing
12. Capital goods firms: development of vintages, pricing
13. Sovereign: tax rules and unemployment benefits
OUTLINE

1. Literature perspective
2. Selected model features
3. Exemplary simulation results
4. Conclusions + Way forward
Baseline: Endogenous cycles

(a) GDP growth YoY
(b) Price inflation YoY
(c) Unemployment rate
(d) Policy rate

(e) Banks' E/A ratio
(f) Firm credit growth YoY
(g) House price inflation
(h) NPL ratios
Countercyclical pricing
Model outcome vs. empirical data
LTV cap at 70%
Switch off OP business

Reduction in business and financial cycle variance.
OUTLINE

1. Literature perspective

2. Selected model features

3. Exemplary simulation results

4. Conclusions + Way forward
Conclusions

Model with self-evolving endogenous leverage, business and financial cycles, without recourse to exogenous (off-model) shocks.

Capital-based MRPU policy able to compress cycle under two conditions:

1. Banks to hold voluntary excess buffers above regulatory minima.
2. Assumptions underlying MM theorem to not hold.
Conclusions

Borrower-based policy has a more direct bearing. LTV caps work primarily through reducing borrowers’ LGDs (DSTIs more through PDs).

Model without strategic default structures, as meant to capture European structure. Otherwise, LTVs may have stronger bearing on PDs as well.

Point-in-time risk measures that banks use to price risk, to provision and compute RWs not forward-looking enough

→ Mispricing Accelerator / Variance does not measure risk
→ IFRS9 promising in principle (but…)
→ Countercyclical regulation to counter pro-cyclical effects of passive risk-based regulation
Way forward

Two steps toward finalizing the model structure:

1. **Implement target capital ratio mechanism for banks**: to render capital-based MPRU more potent. Define break-even capital ratios (self-estimated) as targets (approx. 10-12%).

2. **Make labor market a bit more inflexible**: to increase correlation of firm PDs with the cycle.

Then: Estimate the model (a project in itself)

Then: Outcome of counterfactual policy simulations can be interpreted also quantitatively.
Background Slides
Agents in the Eurace 2.0 model

- Banks
- Consumption goods firms
- Central Bank
- Investment goods firms
- Government
- Households
**Component 1/13: Bank funding cost module (ctd)**

**Trade-off theory of capital structure**

- **Kraus and Litzenberger 1973 and Myers 1984**: banks choose debt amounts vs. residual net worth in a way to balance costs and benefits → trade-off between tax benefit and bankruptcy costs

- Marginal benefit of more debt (due to tax benefits) vanishes with higher levels of debt (more risk); effect of higher risk will dominate at some pt.
Component 1/13: Bank funding cost module (ctd)

Trade-off theory of capital structure

- Kraus and Litzenberger 1973 and Myers 1984: banks choose debt amounts vs. residual net worth in a way to balance costs and benefits $\rightarrow$ trade-off between tax benefit and bankruptcy costs
- Marginal benefit of more debt (due to tax benefits) vanishes with higher levels of debt (more risk); effect of higher risk will dominate at some pt.

We link to this theory: not via use of capital structure measures on LHS (as all literature in this field it seems) but through lense of cost of funding!
Component 2/13: Mortgage loan market (ctd)

Nonlinear repayment schedule: constant annuity, fixed rate contracts

Principal implied by interest rate \((i)\) and duration \((M)\):

\[
L_{0}^{b,h} = \frac{12A^{h}}{i^{b,h}} \left( \left( 1 + \frac{i^{b,h}}{12} \right)^{M} - 1 \right) \left( 1 + \frac{i^{b,h}}{12} \right)^{M}
\]

Principal outstanding each period:

\[
L_{s}^{b,h} = L_{0}^{b,h} (1 + \frac{i^{b,h}}{12})^{s} - \frac{12A^{h}}{i^{b,h}} \left( \left( 1 + \frac{i^{b,h}}{12} \right)^{s} - 1 \right), \forall s = 0, ..., M
\]

Monthly interest payment flows:

\[
a_{s}^{b,I} = \frac{i^{b,h}}{12} \times L_{s}^{b,h}, \forall s = 1, ..., M
\]

Monthly repayment flows:

\[
a_{s}^{b,P} = A^{h} - a_{s}^{b,I}, \forall s = 1, ..., M
\]

Example: Duration 20 years. Monthly annuity EUR 1,000. Annual effective interest rate 3%. Principal loan amount at EUR 180,311.
Component 3/13: Housing market

1. Collect bids/asks
2. Determine highest bid $B^*$
3. Determine highest ask $A^* \leq B^*$
4. Match $A^* \leftrightarrow B^*$
5. Remove $A^*, B^*$

Repeat until all bids processed or unable to find $A^* \leq B^*$
Housing/Rental Market Mechanism (ctd)
Housing/Rental Market Mechanism (ctd)

- **Bids/Buyers**:
  - The highest bid is $B^*$.
  - The highest quality with $A^* < B^*$.

- **Asks/Sellers**:
  - The arrow indicates the highest bid $B^*$.
Housing/Rental Market Mechanism (ctd)

Asks/Sellers

Bids/Buyers

highest quality with $A^* < B^*$

highest bid $B^*$
Housing/Rental Market Mechanism (ctd)

- **Asks/Sellers**
- **Bids/Buyers**

Highest quality with \( A^* < B^* \)

Highest bid \( B^* \)

Out
Housing/Rental Market Mechanism (ctd)

\[ Q \]

Asks/
Sellers

Bids/
Buyers

highest quality with \( A^* < B^* \)

highest bid \( B^* \)
Housing/Rental Market Mechanism (ctd)
Self-evolving business and financial cycles: A narrative

**Boom:** credit available, collateral values rising due to rising demand (through credit), optimism, adaptive/extrapolative expectations, PDs and LGDs falling because of use of PIT measures, LLR of banks too small (not reflecting risk), hedge finance for firms: profits cover annuity

**Nearby turning point:** leverage reaches its limits, some firms have entered speculative finance (interest still covered by profits but principal not), Ponzi finance, small disturbances (endogenous) may cause first firms/HHs to default

**At/after turning point:** firms go bankrupt, HHs get unemployed, HHs default on their mortgages, banks face losses (underprovisioned at this time because of too low PDs/LGDs before), value of collateral falls due to excess supply and lack of demand in the housing market, loan interest rate spreads rise since still based on variance-model philosophy just as during boom

**Nearby trough of recession and forward:** share of NPLs beyond the peak now coming down (write-offs), bank BS more healthy, NPLs no drag on credit creation potential anymore, PDs and LGDs meanwhile down because default wave abades, credit spreads down, positive supply impulse, more demand, all up again
**Eurace vs. Eurace 2.0 model**

**Eurace project: model development, final in Nov. 2009**
- EU Commission project: Consortium of experts from universities in Italy, France, Germany, UK.

**Applications with the model since 2009**
- Policy applications since then: Focus largely on fiscal policy and regional/labor market policies.

**Eurace 2.0**
- Significant additional development, adding:
  1. A properly designed banking system
  2. Mortgage credit to households
  3. Housing and rental market

**Eurace 2.0 policy applications**
- Primary focus: Capital- and borrower-based macroprudential (MPRU) policy assessment.
  - Interplay of MPRU with monetary policy.
Eurace vs. Eurace 2.0 model

Eurace project: model development, final in Nov. 2009

EU Commission project: Consortium of experts from universities in Italy, France, Germany, UK.

Applications with the model since 2009

Policy applications since then: Focus largely on fiscal policy and regional/labor market policies.

Current / almost final

Eurace 2.0

Significant additional development, adding:
1. A properly designed banking system
2. Mortgage credit to households
3. Housing and rental market

Eurace 2.0 policy applications

Primary focus: Capital- and borrower-based macroprudential (MPRU) policy assessment.

Interplay of MPRU with monetary policy.
**Eurace vs. Eurace 2.0 model**

**Eurace project:** model development, final in Nov. 2009

- EU Commission project: Consortium of experts from universities in Italy, France, Germany, UK.

**Applications with the model since 2009**

- Policy applications since then: Focus largely on fiscal policy and regional/labor market policies.

**Eurace 2.0**

- Significant additional development, adding:
  1. A properly designed banking system
  2. Mortgage credit to households
  3. Housing and rental market

**Eurace 2.0 policy applications**

- Primary focus: Capital- and borrower-based macroprudential (MPRU) policy assessment.
- Interplay of MPRU with monetary policy.

**Near future**
Number of macroprudential measures taken in the EU in 2014-16

(Number of measures by measure type (left panel) and by Member State (right panel))

Frequency of use of measures pertaining to intermediate objectives

(Data labels show number of measures)

Transmission channels for capital-based macroprudential policy instruments

Source: adopted from CGFS 2012.
Transmission channels for borrower-based macroprudential policy instruments

Source: adopted from CGFS 2012.
Effect of counter-cyclical buffers over the cycle

- Assess whether use of a measure implies **cost or benefit in short term**, depending on stage in business cycle
- Assess whether **long-run net benefit** is positive/negative