The recent Great Recession has emphasized the linkages between the financial system, banking regulation and real economy.

Basel Accords - setting the global standards for banking regulation.

Basel II (and the new Basel III): risk weights on loans are endogenous and may change throughout the cycle.

Problems with more volatile risk weights:
  - intensify a credit crunch.
  - may amplify an economic downturn (increased procyclicality).
"We are all macroprudentialists now" - Claudio Borio. What tools can mitigate procyclicality and foster financial stability?

- Countercyclical Bank Capital Buffers (Basel III proposal); Angelini et al. (2014), Christiensen et al. (2012), among others.
- Monetary Policy reacting to Financial Imbalances; Curdia and Woodford (2010), De Fiore and Tristani (2013), among others.
- Interaction between Monetary Policy and Countercyclical Regulation (N’Diaye (2009), Kannan et al. (2012) and Angeloni and Faia (2013)).
Policy oriented paper with microeconomic foundations, a borrowing cost channel, nominal price and wage rigidities.

- Endogenous risk of firm default.
- Default costs in the banking sector
- Role for bank capital, risk shocks and macroprudential policies.

Should central banks respond to price inflation in periods of financial distress?

- Our results cast doubt on existing inflation targeting practices by central banks following credit shocks.

Role of Macroprrudential Policy?

- Significant role for countercyclical regulation following both technology and credit shocks.
- Targeted approach allows standard monetary policy to focus on the demand channel
- Augmented Taylor rules can help alleviate wage deflation following credit shocks
The Model

- 5 type of agents: households, a final good firm, intermediate good firms, competitive commercial banks, and a central bank.

- Utility maximising Households consume, hold deposits, demand bank capital and supply differentiated labour to IG firms (via labour aggregator). Also own all firms and the commercial bank.

- Households - Consumption, Savings and Bank Capital Decision
  - Euler Equation,
    \[
    C_t^{-\frac{1}{\xi}} = \beta E_t R^D_t \frac{P_t}{P_{t+1}} C_{t+1}^{-\frac{1}{\xi}}
    \]
    (1)
  - Interest rate on bank capital - no arbitrage condition,
    \[
    R^V_t = \frac{R^D_t}{1 - \xi_t V}
    \]
    (2)
  - Households demand higher return on bank capital due to default costs \(\xi_{t-1}^V\) in the banking sector.
Intermediate Good Firms 1/2

- Similar to Agénor, Bratsiotis and Pfajfar (2014).
- IG firms use homogenous labour supplied by the labour aggregator to produce a distinct good,

\[ Y_{j,t} = Z_{j,t} N_t \quad \text{where,} \quad Z_{j,t} = A_t \epsilon_{j,t} \]  

(3)

- Each IG firm borrows from commercial bank to pay wages to households:

\[ L_{j,t} = W_t^R N_t \]

- Default occurs when the expected value of seizeable output is less than the amount that needs to be repaid to the bank,

\[ \chi_t Y_{j,t} < R_t^L L_{j,t}. \]  

(4)

with \( \chi_t \) representing the probability of banks recovering collateral.

- Defining \( \epsilon_{j,t}^{F,M} \) as the threshold value below which firms default, the above yields,

\[ \epsilon_{j,t}^{F,M} = \frac{1}{\chi_t A_t} R_t^L W_t^R \]  

(5)
Pricing of intermediate goods subject to Calvo (1983) nominal price rigidities. 1st stage: IG producer minimizes the expected cost of employing labour (taking its’ effective costs as given),

\[ mc_{j,t} = \left( \frac{R_t^L W_t^R}{Z_{j,t}} \right) \]

2nd stage: IG firms choose optimal prices - standard NKPC (in log-linear terms),

\[ \hat{\pi}_t^P = \beta E_t \hat{\pi}_{t+1}^P + \frac{(1 - \omega_p)(1 - \omega_p \beta)}{\omega_p} \hat{mc}_t \]

Marginal Cost and thus inflation depend on the loan rate behaviour, which in turn is determined by the policy rule, bank capital regulation, risk of default and banking sector losses - borrowing cost channel.
The bank raises funds through deposits and bank capital,

\[ L_t = D_t + V_t \]  \hspace{1cm} (8)

Bank’s break even condition from lending to IG firms. In default states, bank can either recover collateral \((Y_{j,t})\) with probability \(\chi_t\) or recover nothing at probability \((1 - \chi_t)\).

\[
\int_{\varepsilon_j,t}^{\bar{\varepsilon}_F} \left[ R^L_{t} L_{j,t} \right] f(\varepsilon_{j,t}) d\varepsilon_{j,t} + \int_{\varepsilon_j,t}^{\varepsilon_{F,M}} \left[ \chi_t Y_{j,t} \right] f(\varepsilon_{j,t}) d\varepsilon_{j,t} \\
= R^V_t V_t + R^D_t D_t + cV_t, \hspace{1cm} (9)
\]

where \(f(\varepsilon_{j,t})\) is the probability density function of \(\varepsilon_{j,t}\).
Using the bank’s balance sheet equation, the production function, the threshold condition, the break even condition reduces to,

\[
R_t^L = \left( \frac{V_t}{L_t} \right) (R_t^V + c) + (1 - \left( \frac{V_t}{L_t} \right)) R_t^D + \chi_t A_t \int_{\bar{F}}^{\bar{F}, M} \left[ \bar{F}, M - \bar{F} \right] f(\bar{F}, t) d\bar{F} + W_t^R
\]

The lending rate is related to the deposit (policy) rate, the finance premium and the bank capital-deposit rate spread (set as a proportion of the bank capital-loan ratio).

For probability of default, it is assumed that \( \varepsilon_t^F \) follows uniform distribution over the interval \( (\varepsilon^F, \bar{\varepsilon}^F) \). Thus:

\[
\Phi_t = \int_{\varepsilon^F}^{\varepsilon_t^F, M} f(\varepsilon_t^F) d\varepsilon_t^F = \frac{\varepsilon_t^F, M - \varepsilon^F}{\varepsilon^F - \bar{\varepsilon}^F}
\]
A fraction \((1 - \chi_t)\) of banks make a loss since they are unable to retrieve collateral in the default states.

Households, who invest in bank capital in all banks, know the aggregate level of firm default and can calculate aggregate losses in the banking sector - require a higher return for holding bank capital \((\xi^V_t)\).

Bank capital must cover for these losses:

\[
\xi^V_t V_t = (1 - \chi_t) \left[ \int_{\varepsilon_F}^{\varepsilon_{F,M}} \left[ \chi_t Y_{j,t} \right] f(\varepsilon_{j,t}) d\varepsilon_{j,t} \right],
\]

yielding the bank capital premium rate,

\[
\xi^V_t = (1 - \chi_t) \frac{L_t}{V_t} \left( \frac{\chi_t A_t}{W_t^R} \right) \left( \frac{\varepsilon_{F,M} + \varepsilon^F}{2} \right) \Phi_t \tag{12}
\]

Bank capital requirements (Basel II) can initially solve the market failure associated with losses in the banking sector - reduces loan rate volatility (Admati and Hellwig (2014), Barth et al (2004)). However, dominating effect - risk of default; bank capital default channel.
The bank must issue an amount of capital which covers a given percentage of loans for IG firms,

\[ V_t = \rho^D \vartheta_t \rho_t^C L_t \]  

(13)

Basel I The term \( \rho^D \in (0, 1) \) denotes the minimum capital adequacy requirements, also known as the Cooke Ratio (set by legislation),

Basel II-Under the IRB approach where the risk weight is related to the probability of default,

\[ \vartheta_t = \left( \frac{\Phi_t}{\Phi} \right)^q \]  

(14)

Basel III - capital adequacy ratio moves in response to deviations in loan to GDP ratio, viewed as a good measure for financial risk (BCBS 2011).

\[ \rho_t^C = \left( \frac{L_t / Y_t}{L/Y} \right)^{\theta_t^C} \]  

(15)
Using the characteristics of the uniform distribution, and equations (2), (11), (12), (13), (14) and (15). the lending rate equation (10) reduces to,

\[ R_t^L = R_t^D + \left[ \rho^D \left( \frac{\Phi_t}{\Phi} \right)^q \left( \frac{L_t/Y_t}{L/Y} \right)^{\theta^C} \right] (R_t^V - R_t^D + c) \tag{16}\]

The probability of default affects the lending rate through: the risk premium channel, bank capital default channel and risk weight channel - financial accelerator effect. Policy rule affects the loan rate through monetary policy cost channel. Countercyclical regulation under Basel III can attenuate accelerator effect.
The central bank targets the short term refinance rate ($R_{cb}^t$) according to the following Taylor-type policy rule,

$$R_{cb}^t = \left[ \left( R_{cb}^t \right) \left( \frac{\pi_t^p}{\pi^p, T} \right)^{\phi_{\pi}} \left( \frac{Y_t}{Y} \right)^{\phi_Y} \left( \frac{L_t / Y_t}{L / Y} \right)^{\phi_L} \right]^{1-\phi} \left( R_{cb}^{t-1} \right)^{\phi}$$

where $\phi \in (0, 1)$ is the degree of interest rate smoothing and $\phi_{\pi}, \phi_Y > 0$ coefficients measuring the relative weights on inflation and output deviations from steady state, respectively.

New term in Macroprudential Taylor Rule: $\left( \frac{L_t / Y_t}{L / Y} \right)^{\phi_L}$; "lean against the wind" type of monetary policy, central bank reacting to deviations in credit to GDP ratio.
Calibration

- Most parameters within the range of Christiano et al. (2005) and Smets and Wouters (2007).
- Specific parameters unique to this model: probability of bank recovering collateral $\chi = 0.97$; bank capital adequacy ratio, $\rho^D = 0.08$ (consistent with the Basel Accords); elasticity of risk weight with respect to probability of default, $q = 0.05$ (Covas and Fujita 2010).
- For illustration at first: Basel III countercyclical parameter $\theta^C = 10$, weight on loan to output ratio Taylor Rule $\phi_{L/Y} = 0.06$. 
Simulations

- Examinations of 3 different regimes:
  - Basel II + Standard TR ($\theta^C = 0, \phi_L = 0$, solid blue)
  - Basel III + Standard TR ($\theta^C = 10, \phi_L = 0$, dashed red)
  - Basel III + Augmented TR ($\theta^C = 0, \phi_L = 0.06$, dotted black)
Adverse Financial Shock

Note: Interest rates, inflation rate, the probability of default and the bank capital-loan ratio are measured in percentage point deviations from steady state. The rest of the variables are measured in terms of percentage deviations.
Adverse Supply Shock

Note: Interest rates, inflation rate, the probability of default and the bank capital-loan ratio are measured in percentage point deviations from steady state. The rest of the variables are measured in terms of percentage deviations.
Discussion

- Countercyclical rule may be a more effective tool in stabilizing the financial variables and inflation (via borrowing cost channel).
- Output can be further stabilized using a policy rate tool reacting modestly also to deviations in the loan-output ratio.
- However, a rise in output increases inflationary pressures (standard demand channel); Trade off between output and inflation with a borrowing cost channel.
- What should be the role of financial regulation and monetary policy?
Aim: Minimize a central bank loss function

\[ \text{Loss}_t = \frac{\lambda_p}{k_p} \text{var}(\hat{\pi}_t^P) + (\zeta^{-1} + \gamma) \text{var}(\hat{Y}_t^g) + \frac{\lambda_w}{k_w} \text{var}(\hat{\pi}_t^W) \]

subject to policy rules \((\phi_\pi, \phi_Y, \phi_L\) and \(\theta^C\)).

<table>
<thead>
<tr>
<th>Optimal Policy</th>
<th>(\phi_\pi)</th>
<th>(\phi_Y)</th>
<th>(\phi_L)</th>
<th>(\theta^C)</th>
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With a more standard loss function

\[ \text{Loss}_t = \frac{\lambda_p}{k_p} \text{var}(\hat{\pi}_t^P) + (\zeta^{-1} + \gamma) \text{var}(\hat{Y}_t^g) \]

<table>
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<th>(\phi_Y)</th>
<th>(\phi_L)</th>
<th>(\theta^C)</th>
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</table>
Monetary Policy, Macroprudential Policy and Welfare

Relationship Between $\phi_{\pi}$, $\theta^C$ and Decomposition of Welfare Losses - Credit Shocks

Total Losses

Price Inflation Losses

Output Gap Losses

Wage Inflation Losses
Relationship Between $\phi_{\pi}$, $\phi_L$ and Decomposition of Welfare Losses - Credit Shocks

Total Losses

Price Inflation Losses

Output Gap Losses

Wage Inflation Losses
Relationship Between $\phi_\pi$, $\theta^C$ and Decomposition of Welfare Losses - Supply Shocks

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Monetary Policy, Macroprudential Policy and Welfare

Relationship Between $\phi_\pi$, $\phi_L$ and Decomposition of Welfare Losses - Supply Shocks

Total Losses

Price Inflation Losses

Output Gap Losses

Wage Inflation Losses

Roy Zilberman (Lancaster University)
Probability of default impacts the loan rate through multiple channels: bank capital default channel, risk premium channel and risk weight channel. Also provides an acceleration mechanism in the model. CCR moderates accelerator effect.

Borrowing cost channel links between the financial sector and real economy and is affected by credit frictions, regulatory requirements and monetary policy.

Credit Shocks: CCR can achieve the anti-inflation target of MP. In this state, central banks should react mainly to GDP and financial indicators and less to price inflation. Standard Inflation Targeting TR - welfare detrimental.

Supply Shocks: CCR can restore the traditional hawkish stance of monetary policy, which in combination yield the lowest welfare losses. No role for a "lean against the credit cycle" monetary policy.