Collateral Constraints, Banking Competition and Optimal Monetary Policy[1]

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[1] These slides reflect the views of the authors and do not necessarily reflect the views of Banco de España or Comisión Nacional del Mercado de Valores.

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- Less attention devoted to the analysis of optimal monetary policy under frictional financial markets

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- Interaction between both frictions potentially important:
  - degree of amplification due to collateral constraints depends on degree of banking competition
  - lending spreads depend on stringency of collateral constraint and expected evolution of asset prices

Theoretical framework

- Two consumer types: households (patient/savers) and entrepreneurs (impatient/borrowers)
- Banks intermediate all credit flows between households and entrepreneurs; monopolistic competition on the loans side
- Entrepreneurs subject to collateral constraints. Commercial real estate as collateralizable asset
- Real estate used for production (entrepreneurs) and housing services (households)

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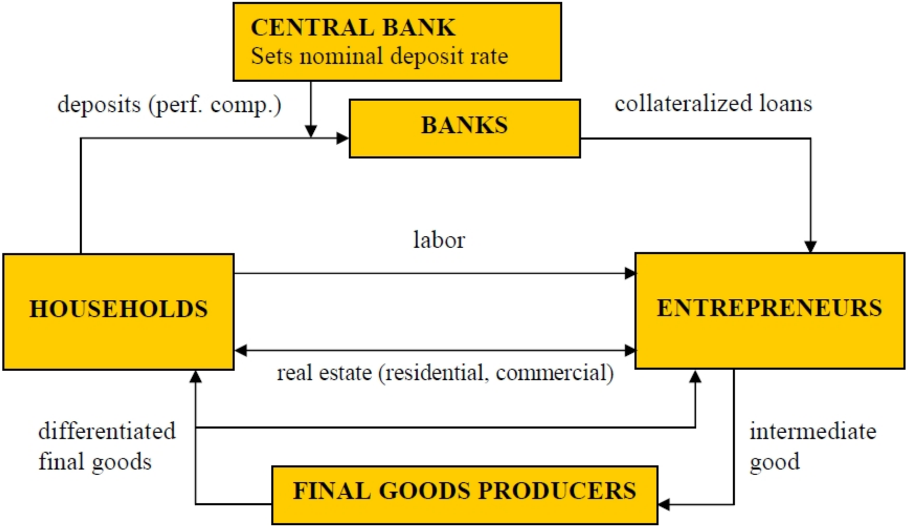
- Banking competition tends to *worsen* these trade-offs
  - fall in lending spreads $\Rightarrow$ increase in financial leveraging $\Rightarrow$ greater amplification

Literature review

- Curdia and Woodford (2008): banks intermediate credit flows, but...
  - lending spread is an ad-hoc function of loan volume (origination and monitoring costs)
  - no collateral constraints: asset prices do not matter
- Monacelli (2007): Ramsey optimal monetary policy under collateral constraints; savers lend directly to borrowers
- De Fiore, Teles and Tristani (2009): optimal monetary policy with nominal, predetermined debt
- De Fiore and Tristani (2009): optimal monetary policy under costly state verification à la Bernanke-Gertler.

Model structure



Households

Mass $\omega < 1$ of identical households. Each household maximizes

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\log c_t - \frac{\left(l_t^s\right)^{1+\varphi}}{1+\varphi} + \vartheta_t \log h_t \right)$$

subject to (ignoring lump-sum transfers)

$$w_t l_t^s + \frac{R_{t-1}^D d_{t-1}}{\pi_t} = c_t + p_t^h \left[\left(1 + \tau^h\right) h_t - h_{t-1} \right] + d_t ,$$

c_t: consumption, l_t^s: labor hours, h_t: residential property, p_t^h: real house price, d_t: real deposits, R_t^D: nominal deposit rate, π_t: gross inflation rate, τ^h: tax rate on housing purchases, $\log \vartheta_t \sim AR(1)$.

Entrepreneurs

Mass $1-\omega$ of identical entrepreneurs. Each entrepreneur maximizes

$$E_0 \sum_{t=0}^{\infty} (\beta^e)^t \left(\log c_t^e - \alpha d_t^i\right),$$

$\beta^e < \beta$, subject to

$$b_t + (1-\tau^e)\left(p_t^I y_t - w_t l_t^d\right) = c_t^e + p_t^h (h_t^e - h_{t-1}^e) + \frac{R_{t-1}^L b_{t-1}}{\pi_t},$$

$$y_t = a_t \left(l_t^d\right)^{1-\nu} \left(h_{t-1}^e\right)^{\nu},$$

$$b_t \leq m_t E_t \frac{\pi_{t+1}}{R_t^L} p_{t+1}^h h_t^e,$$

d_t^i: distance to bank i, α: utility cost per unit distance, c_t^e: consumption, b_t: real debt, l_t^d: labor demand, R_t^L: nominal loan rate, h_t^e: commercial property, y_t: output, p_t^I: real price of intermediate good, τ^e: tax rate on entrepreneur profits, $\log a_t \sim AR(1)$, m_t: pledgeability ratio.

Entrepreneurs (2)

FOCs wrt to c_t^e and h_t^e,

$$\frac{1}{c_t^e} = \beta^e R_t^L E_t \left\{ \frac{1}{c_{t+1}^e \pi_{t+1}} \right\} + \xi_t,$$

$$\frac{p_t^h}{c_t^e} = E_t \frac{\beta^e}{c_{t+1}^e} \left\{ (1-\tau^e)\, p_{t+1}^l \nu \frac{y_{t+1}}{h_t^e} + p_{t+1}^h \right\} + \xi_t m_t E_t \frac{\pi_{t+1}}{R_t^L} p_{t+1}^h,$$

ξ_t: Lagrange multiplier on collateral constraint.
Assuming $\beta / \beta^e > R_{ss}^L / R_{ss}^D$, collateral constraint holds in SS and its neighborhood $\Rightarrow$ entrepreneur consumes a constant fraction of her *real net worth*,

$$c_t^e = (1-\beta^e) \left[(1-\tau^e)\, p_t^l \nu y_t + p_t^h h_{t-1}^e - \frac{R_{t-1}^L b_{t-1}}{\pi_t} \right]$$

Banks

Bank $i \in \{1, 2, .., n\}$ chooses $\{R_t^L(i)\}_{t=0}^{\infty}$ to maximize

$$E_0 \sum_{t=0}^{\infty} \left(\beta^t \frac{c_0}{c_t} \right) \frac{\Omega_t^i}{P_t}$$

subject to

$$\Omega_t(i) = \left(R_t^L(i) - R_t^D \right) B_{t-1}(i),$$

$$\frac{B_t(i)}{P_t} = b_t(i) \tilde{b}_t(i)$$

and the expressions for intensive business margin, $b_t(i)$, and extensive business margin or *market share*, $\tilde{b}_t(i)$. FOC,

$$R_t^L(i) = R_t^D + \frac{1}{\left(-\frac{\partial b_t(i)}{\partial R_t^L(i)} \right) \tilde{b}_t(i) + \left(-\frac{\partial \tilde{b}_t(i)}{\partial R_t^L(i)} \right) b_t(i)}.$$

Banks (2)

In a symmetric equilibrium ($R_t^L(i) = R_t^L$ for all i),

$$R_t^L - R_t^D = \frac{R_t^D - m_t E_t\left(\pi_{t+1} p_{t+1}^h / p_t^h\right)}{\eta m_t E_t\left(\pi_{t+1} p_{t+1}^h / p_t^h\right) - R_t^D} R_t^D,$$

$$\eta \equiv 1 + \frac{n}{\alpha} \frac{\beta^e}{1 - \beta^e}.$$

Spreads are:

- decreasing in pledgeability ratio, m_t, and expected inflation in property prices, $E_t\left(\pi_{t+1} p_{t+1}^h / p_t^h\right)$. (From borrowing constraint, $m_t E_t\left(\pi_{t+1} p_{t+1}^h / p_t^h\right) = b_t / \left(p_t^h h_t^e\right)$: *loan-to-value ratio*)
- increasing in deposit/policy rate, R_t^D.
- decreasing in number of banks (n) and increasing in utility cost (α).

Final goods producers

Buy intermediate good at real price p_t^I, transform it one-for-one into differentiated final goods $\Rightarrow$ p_t^I = retailers' *real marginal cost*. Demand curve of each retailer $j \in [0,1]$,

$$y_t^f(j) = \left(P_t(j)/P_t\right)^{-\varepsilon} y_t^f,$$

ε: elasticity of subst. across varieties, y_t^f: aggregate demand of final goods. Set prices à la Calvo (1983). Optimal price decision $\tilde{P}_t$,

$$E_t \sum_{T=t}^{\infty} (\beta\theta)^{T-t} \frac{c_t}{c_T} \left\{ (1+\tau) \frac{\tilde{P}_t}{P_T} - \frac{\varepsilon}{\varepsilon - 1} p_T^I \right\} P_T^{\varepsilon} y_T^f = 0,$$

θ: Calvo parameter, τ: subsidy rate for retailers. Law of motion of price level,

$$P_t = \left[\theta P_{t-1}^{1-\varepsilon} + (1-\theta) \tilde{P}_t^{1-\varepsilon}\right]^{1/(1-\varepsilon)}.$$

Market clearing

All variables in per capita terms. Equilibrium in intermediate good market,

$$(1-\omega)\, y_t = \Delta_t y_t^f,$$

$\Delta_t \equiv \int_0^1 \left(P_t(j)/P_t\right)^{-\varepsilon} dj$: price dispersion in final goods.
Equilibrium in final goods markets,

$$y_t^f = \omega c_t + (1-\omega)\, c_t^e.$$

Equilibrium in labor market,

$$\omega l_t^s = (1-\omega)\, l_t^d.$$

Equilibrium in real estate market,

$$\bar{h} = \omega h_t + (1-\omega)\, h_t^e.$$

Efficient equilibrium

Useful normative benchmark. Social planner solution characterized by

1. perfect risk sharing: $c_t = c_t^e$
2. constant labor hours: $l_t^s = l^{s,*}$
3. distribution of real estate driven *only* by preference shocks:

$$\frac{h_t^e}{h_t} = \frac{\beta \nu}{(1 - \omega)\, \vartheta_t}$$

Optimal monetary policy

Linear-quadratic approach (Rotemberg & Woodford, 1997, Benigno & Woodford, 2008):

- Quadratic approximation of welfare criterion
- Linear approximation of equilibrium conditions

Clarifies stabilization goals and trade-offs among goals

Quadratic loss function

Assuming an efficient steady-state (implemented by τ, τ^e, τ^h), aggregate welfare can be approximated up to second order by

$$\sum_{t=0}^{\infty} \beta^t \left[\lambda_\pi \hat{\pi}_t^2 + \lambda_y \left(\hat{y}_t - \hat{y}_t^* \right)^2 + \lambda_c \left(\hat{c}_t - \hat{c}_t^e \right)^2 + \lambda_h \left(\hat{h}_t - \hat{h}_t^* \right)^2 \right],$$

where

$$\lambda_\pi \equiv \frac{\varepsilon\theta}{(1-\theta)(1-\beta\theta)}, \; \lambda_y \equiv \frac{1+\varphi}{1-\nu}, \; \lambda_c \equiv \omega(1-\omega), \; \lambda_h \equiv \omega\vartheta \frac{\omega\vartheta + \beta\nu}{\beta\nu}$$

$$\hat{y}_t^* \equiv \hat{a}_t + \nu \hat{h}_{t-1}^e \qquad \hat{h}_t^* \equiv \frac{\beta\nu}{\omega\vartheta + \beta\nu} \hat{\vartheta}_t^h$$

Hats: log-deviations from SS

Quadratic loss function (2)

Four stabilization goals for monetary policy:

1. Inflation ($\Rightarrow$ inefficient price dispersion)
2. Output gap ($\Rightarrow$ inefficient fluctuations in labor hours)
3. *Consumption gap*: inefficient risk-sharing between constrained and unconstrained consumers
4. *Housing gap*: distortion in the distribution of the real estate stock (residential vs. commercial)

(1) and (2) are standard in the New Keynesian model
(3) and (4) are due to collateral constraints

Policy trade-offs

Log-linearized entrepreneur consumption,

$$\frac{\hat{c}^e_t}{1-\beta^e} = \frac{\nu\left(\hat{p}^l_t + \hat{y}_t\right)}{1-\omega} - m\hat{m}_{t-1} + \frac{p^h_{ss} h^e_{ss}}{c^e_{ss}}\left[\hat{p}^h_t - mE_{t-1}p^h_t + (1-m)\,\hat{h}^e_{t-1} + \hat{\pi}_t - E_{t-1}\hat{\pi}_t\right].$$

Endogenous determinants: entrepreneur profits $(\hat{p}^l_t + \hat{y}_t)$, inflation surprises $(\hat{\pi}_t - E_{t-1}\hat{\pi}_t)$, and real estate prices. Entrepreneur profits can be expressed as,

$$\hat{p}^l_t + \hat{y}_t = \left(\frac{1+\varphi}{1-\nu} + 1\right)\left(\hat{y}_t - \hat{y}^*_t\right) + (1-\omega)\left(\hat{c}^e_t - \hat{c}_t\right) + \hat{y}^*_t.$$

$\Rightarrow$ Closing consumption gap requires inefficient fluctuations in inflation and output (along with manipulation of real estate prices).

Calibration

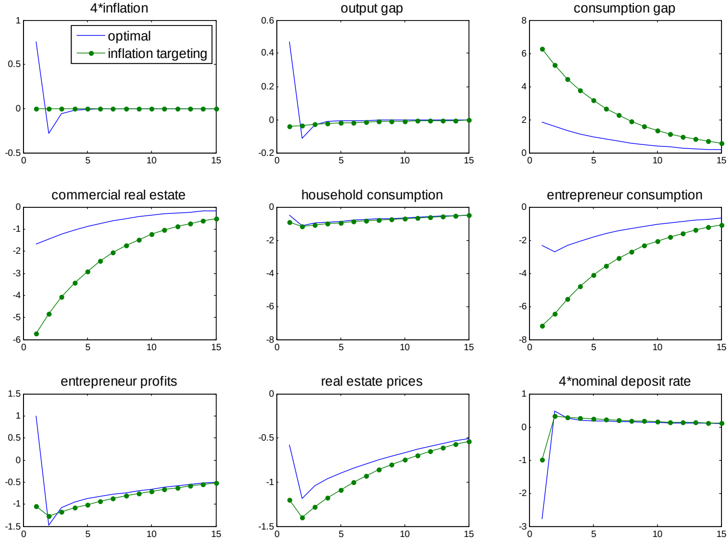
	Value	Target	Description
β	0.993	$R^D_{ss}/\pi_{ss} = 1.03$	household discount factor
β^e	0.95	standard	entrepreneur discount factor
ν	0.05	$p^h_{ss}h^e_{ss}/(4y_{ss}) = 0.62$	elasticity of output wrt real estate
n, α	10, 6.32	$4(R^L_{ss} - R^D_{ss}) = 2.5\%$	number of banks, distance cost
ω	0.979	$\tau^e = 0$	household share of population
m	0.85	standard	pledgeability ratio
ϑ	0.11	$p^h_{ss}h_{ss}/(4y_{ss}) = 1.40$	relative weight on housing utility
φ	2	$1/\varphi = 0.5$	(inverse of) labor supply elasticity
ε	6	$(1+\tau)/p^l_{ss} = 1.20$	intratemporal elasticity of subst.
θ	0.67	$1/(1-\theta) = 3$ qrts.	Calvo parameter
τ^h	0.012	efficient SS	tax rate on house purchases

Normalized weights: $(\lambda_\pi, \lambda_y, \lambda_c, \lambda_h) = (0.909, 0.081, 0.001, 0.009)$.

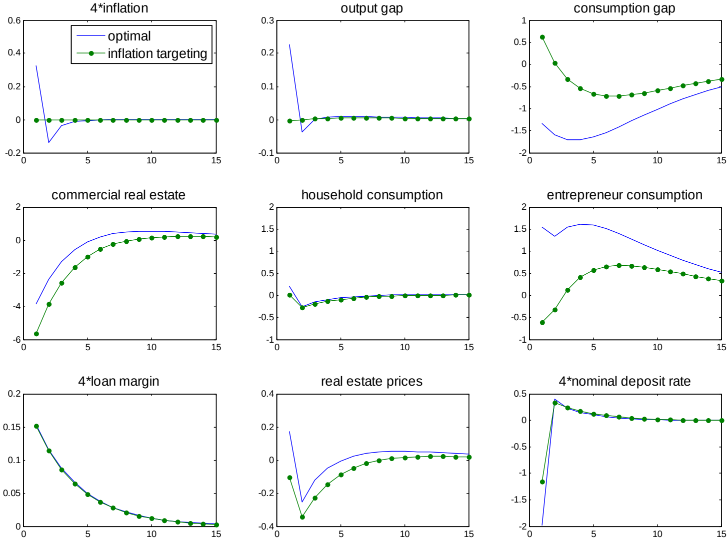
Compare the economy's response to shocks under

- **Strict inflation targeting**: $\hat{\pi}_t = 0$
- **Optimal monetary policy**: minimize $\sum_{t=0}^{\infty} \beta^t L_t$ subject to log-linear constraints

1% negative productivity shock



1% negative shock to pledgeability ratio (*credit crunch*)



Welfare analysis

Compute volatility of stabilization goals and average welfare losses under:

- Inflation targeting
- Output gap targeting: $\hat{y}_t = \hat{y}_t^*$
- Optimal monetary policy
- Optimal simple rule,

$$\hat{\pi}_t + \zeta \left(\hat{p}_t^h - \hat{p}_{t-1}^h + E_t \hat{p}_{t+1}^h - \hat{p}_t^h \right) = 0.$$

Choose ζ that minimizes $E\left(L_t\right)$.

Welfare analysis: productivity shocks (std=1%)

Policy rule	$4\hat{\pi}_t$	$\hat{y}_t - \hat{y}_t^*$	$\hat{c}_t - \hat{c}_t^e$	$\hat{h}_t - \hat{h}_t^*$	Welfare loss
inflation targeting	0	0.08	11.67	4.73	0.11
output gap targeting	0.85	0	9.79	3.97	0.09
optimal policy	0.81	0.49	3.49	1.41	0.03
simple targeting rule*	0.95	0.31	5.17	2.10	0.04

Note: standard deviations in %, welfare loss as a % of steady-state consumption

* optimal weight: $\zeta = 0.212$

Welfare analysis: credit-crunch shocks (std=1%)

Policy rule	$4\hat{\pi}_t$	$\hat{y}_t - \hat{y}_t^*$	$\hat{c}_t - \hat{c}_t^e$	$\hat{h}_t - \hat{h}_t^*$	Welfare loss
inflation targeting	0	0.01	2.19	3.37	0.04
output gap targeting	0.31	0	2.08	3.45	0.05
optimal policy	0.36	0.23	4.94	2.21	0.03
simple targeting rule*	0.31	0.11	2.85	2.98	0.04

Note: standard deviations in %, welfare loss as a % of steady-state consumption

* optimal weight: $\zeta = 0.262$

The effects of banking competition

- We want to isolate the effects of banking competition on monetary policy trade-offs.
- We repeat our exercises under the assumption of perfect banking competition ($\alpha = 0$, or $n \to \infty$).
  $\Rightarrow$ Loan rate R^L_{ss} falls from baseline to $R^D_{ss} = 1/\beta$.

Effects of banking competition: productivity shocks

Banking regime	$4\hat{\pi}_t$	$\hat{y}_t - \hat{y}_t^*$	$\hat{c}_t - \hat{c}_t^e$	$\hat{h}_t - \hat{h}_t^*$	Welfare loss
Inflation targeting					
baseline calibration	0	0.08	11.67	4.73	0.11
perfect competition	0	0.10	14.24	5.74	0.16
Output gap targeting					
baseline calibration	0.85	0	9.79	3.97	0.09
perfect competition	1.22	0	11.44	4.61	0.14
Optimal policy					
baseline calibration	0.81	0.49	3.49	1.41	0.03
perfect competition	0.90	0.54	3.27	1.32	0.04
Simple targeting rule*					
baseline calibration	0.95	0.31	5.17	2.10	0.04
perfect competition	1.12	0.35	5.33	2.15	0.05

Note: standard deviations in %, welfare loss as a % of steady-state consumption

* optimal weight: 0.212 (baseline) and 0.251 (perfect comp.)

Banking competition and financial leveraging

- Let $LR_t \equiv p_t^h h_t^e / \left(p_t^h h_t^e - b_t\right)$ be entrepreneurs' *leverage ratio*. In the steady state,

$$LR_{ss} = \frac{1}{1 - b_{ss} / \left(p_{ss}^h h_{ss}^e\right)} = \frac{1}{1 - m / R_{ss}^L}.$$

Stronger banking competition ($\downarrow R_{ss}^L$) raises financial leveraging.

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  Stronger banking competition ($\downarrow R_{ss}^L$) raises financial leveraging.

- Entrepreneur consumption,

$$\begin{aligned} \frac{\hat{c}_t^e}{1-\beta^e} &= \frac{\nu \left(\hat{p}_t^l + \hat{y}_t\right)}{1-\omega} - m\hat{m}_{t-1} \\ &\quad + LR_{ss}\left[\hat{p}_t^h - mE_{t-1}p_t^h + (1-m)\,\hat{h}_{t-1}^e + \hat{\pi}_t - E_{t-1}\hat{\pi}_t\right]. \end{aligned}$$

  The increase in LR_{ss} amplifies the effect of asset prices on the consumption and housing gaps.

Effects of banking competition: credit-crunch shocks

Banking regime	$4\hat{\pi}_t$	$\hat{y}_t - \hat{y}_t^*$	$\hat{c}_t - \hat{c}_t^e$	$\hat{h}_t - \hat{h}_t^*$	Welfare loss
Inflation targeting					
baseline calibration	0	0.01	2.19	3.37	0.04
perfect competition	0	0.02	2.63	3.33	0.04
Output gap targeting					
baseline calibration	0.31	0	2.08	3.45	0.05
perfect competition	0.42	0	2.41	3.45	0.05
Optimal policy					
baseline calibration	0.36	0.23	4.94	2.21	0.03
perfect competition	0.28	0.18	5.38	2.42	0.03
Simple targeting rule*					
baseline calibration	0.31	0.11	2.85	2.98	0.04
perfect competition	0.27	0.10	3.37	3.00	0.04

Note: standard deviations in %, welfare loss as a % of steady-state consumption

* optimal weight: 0.262 (baseline) and 0.226 (perfect comp.)

Effects of banking competition: summary

- Welfare loss increases conditional on productivity shocks, especially for suboptimal policy rules
- Virtually no effect conditional on credit crunch shocks:
    - amplifying role of counter-cyclical lending spreads disappears under perfect competition

Conclusions

- Optimal monetary policy analysis in a New Keynesian model with financial frictions (collateral constraints + imperfect banking competition)
- Optimal policy involves a trade-off between (1) inflation, (2) output-gap, (3) consumption risk sharing and (4) efficient distribution of real estate.
  - Case *against* strict inflation targeting
- Simple rule targeting a weighted average of inflation and asset price fluctuations performs relatively well
- Severity of trade-offs *increases* as the banking sector becomes *more* competitive (i.e. as lending spreads fall)
  - especially for suboptimal policy rules and conditional on productivity shocks