Credit Frictions, Housing Prices and Optimal Monetary Policy Rules

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The recent rise in housing prices and household debt in most OECD countries had attracted the attention of policy makers and academics and raised concern as to its macroeconomic implications.

A positive correlation between housing prices, mortgage debt and consumption dynamics at business cycle frequencies has generated some interest in the business cycle literature. (Iacoviello (AER 05), Campbell and Hercowitz (05), Iacoviello and Neri (07), Christensen, Corrigan, Mendicino and Nishiyama (07), Finocchiaro and von Heideken (07)....)

$\Longrightarrow$ despite the important contribution assigned to household debt financing for business cycle dynamics, particularly to the wealth effect of housing prices, little attention has been paid to the optimal monetary policy prescriptions of models with collateralized debt and housing prices dynamics.

What we do

optimal design of monetary policy rules in a model with price stickiness and collateralized household's debt in nominal terms.

How

social- welfare and individual-welfare criteria

Anticipating the Results....

We highlights the existence of a trade-off between the minimization of the distortion generated by the existence of nominal price rigidities and nominal debt.

- **nominal price rigidities**: a strong inflation stabilization stance would reduce the cost of price dispersion

- **nominal debt**: uncertainty linked to the repayment of the debt generates unnecessary redistribution of wealth $\longrightarrow$ a nearly constant real interest rate would reduce the private risk generated by the nature of the debt contract $\longrightarrow$ higher volatility of inflation.

Our Contribution to the Literature on Asset Prices and Optimal Monetary Policy

- welfare consideration [Bernanke and Gertler (01), Cecchetti (00, 02),....Iacoviello (05)]

- explore the role of heterogeneity (borrowers and lenders) in characterizing optimal monetary policy [Faia and Monacelli (jedc 06), Monacelli (06)]

$\Longrightarrow$ Our results improve upon previous literature by contrasting the nominal rigidity emerging from household debt and from price rigidities and by exploring the role of housing prices dynamics in the optimal conduct of monetary policy.

Model Economy

- **nominal price rigidities**: quadratic adjustment cost on good market price setting adopted as a conventional source of monetary non-neutrality.

- **monopolistic competition in the good market**: allows for price setting above the marginal cost.

- **nominal debt**: distorsion in the form of unnecessary redistribution of wealth generate private risk.

Households

As in Iacoviello (2005) in order to generate a motive for credit flows we assume two types of agents $i = 1, 2$ that differ in terms of subjective discount factors $\beta_1 > \beta_2$ [Kyiotaki and Moore (JPE,1997)].

Households optimize

$$\max_{\{c_{it}, h_{it}, L_{it}\}} E \sum_{t=0}^{\infty} \beta_i^t U(c_{it}, h_{it}, L_{it}),$$

subject to a *budget constraint,*

$$c_{it} + q_t(h_{it} - h_{it-1}) + \frac{b_{it-1} R_{t-1}}{\pi_t} = b_{it} + w_t L_{it} + f_{it} - T_{it}, \qquad (1)$$

and a *borrowing constraint*,

$$b_{it} \leq \gamma_t E_t \frac{q_{t+1}\pi_{t+1}h_{it}}{R_t} \ . \tag{2}$$

Credit constraints arise because lenders cannot force borrowers to repay and houses are used as collateral for loans.

Limits on borrowing are introduced through the assumption that households cannot borrow more than a fraction of the next-period value of the housing stock.

The borrowing constraint is not derived endogenously but is consistent with standard lending criteria used in the mortgage and consumer loan markets.

Firms

The Intermediate Sector. continuum of firms indexed by $i \in [0, 1]$ that produce $y_t(i)$ units of each intermediate good i using $L_t(i)$ units of labor, according to the following constant-return-to-scale technology:

$$Z_t L_t(i) \geq y_t(i), \tag{3}$$

where Z_t is an aggregate productivity shock following an exogenous AR(1) stochastic process.

The Final-Good-Producing Firms. Perfectly competitive firms produce a final good, y_t, using $y_t(i)$ units of each type of intermediate good i (with $i \in (0, 1)$) and adopting a constant return to scale, diminishing marginal product, and constant-elasticity-of-substitution technology:

$$y_t \leq \left[\int_0^1 y_t(i)^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}}$$

Fiscal Authority

The government consumes a fraction G of the final good and runs a balanced-budget deficit financed with lump-sum taxes: $G_t = T_t$.

Total taxes T_t are the sum of total taxes on both types of households $T_t = (1-n)T_{1t} + nT_{2t}$.

We assume that $G_t = \tau_t Y_t$, where $\log(1-\tau_t)$ follows an exogenous stationary Markov process.

$\Longrightarrow$ no need for unexpected inflation as lump sum tax

Quantitative Exercise

We assume a separable utility function, as follows:

$$U(c_{it}, h_{it}, L_{it}) = \frac{c_{it}^{1-\varphi_c}}{1-\varphi_c} + \nu_{h,t} \ln h_{it} - \nu_L \frac{L_{it}^{1+\varphi_L}}{1+\varphi_L} \ , \tag{4}$$

The structural shocks of the model $\Lambda_t = [\gamma_t, \nu_{h,t}, 1-\tau_t, Z_t]$ follow an autoregressive process:

$$\ln(\Lambda_t) = \rho_\Lambda \ln(\Lambda_{t-1}) + \varepsilon_{\Lambda t}, \quad \varepsilon_{\Lambda t} \backsim^{iid} N(0, \sigma_{\varepsilon_\Lambda}), \ \ 0 < \rho_\Lambda < 1 \ . \tag{5}$$

Table 2. Model parameters

Preferences		
$\beta_1 = 0.99$	$\varphi_c = 1.6$	$\nu_h = 0.018$
$\beta_2 = 0.95$	$\varphi_L = 0.1$	$\nu_L = 1$
Technology	**BOC**	
$\theta = 8$	$\gamma = 0.85$	
$\phi_p = 81.5$	$n = 0.5$	
Shocks		
$\rho_Z = 0.880$	$\sigma_Z = 0.0041$	
$\rho_G = 0.0917$	$\sigma_G = 0.0065$	
$\rho\gamma = 0.300$	$\sigma_\gamma = 0.0020$	
$\rho_j = 0.9622$	$\sigma_j = 0.0155$	

Computation

We provide a normative assessment of monetary policy in the constrained class of simple interest-rate feedback rules

$$R_t = \Theta(X) \ .$$

- Simplicity requires X to include easily observable macroeconomic indicators

$$X = \left[R_{t-1}, \frac{\pi_{t-j}}{\pi_{ss}}, \frac{y_{t-j}}{y_{ss}}, \frac{q_{t-j}}{q_{ss}}, \frac{b_{t-j}}{b_{ss}} \right] \ .$$

with j={-1,0,1}.

- For the rule to be operational, we require that it delivers local uniqueness in the rational expectations equilibrium.

Welfare Measure

We postulate that the monetary policy objective function can be summarized in a social welfare function that assigns social weights to the welfare of the individual agents

$$V_0 \equiv E_0 \left[\sum_{i=1}^{2} \eta_i \sum_{j=0}^{\infty} \beta_i^j U(c_{i,t+j}, h_{i,t+j}, L_{i,t+j}) \right],$$

- η_1=n(1-β_1) and η_2=(1-n)(1-β_2) such that, given a constant consumption stream, the two agents achieve the same level of utility.

- we start evaluating welfare conditional on the initial state being the non-stochastic steady state

$\Longrightarrow$The interest rate rule's configuration of parameters, satisfying the determinacy requirements and yielding the highest welfare gives the optimal implementable rule.

Social Welfare Based Optimal Simple Rule

Table 3.a. Social welfare-based optimal rule

$\hat{R}_t = \alpha_R \hat{R}_{t-1} + (1-\alpha_R)\alpha_\pi \hat{\pi}_t + (1-\alpha_R)\alpha_y \hat{y}_t + (1-\alpha_R)\alpha_q \hat{q}_t$			
$\alpha_\pi = 6.76$	$\alpha_q = -0.05$	Welfare cost (deterministic S.S.)	-0.000833

Welfare loss in terms of consumption as percentage of the steady state consumption level (multiplied by 10^2.)

The model requires a *negative* response to variations in housing prices and an *active* response to inflation

Table 3.b. Welfare costs of ad-hoc rules

Inflation stabilization	-0.001161
α_π= 6.76, α_q= 0	-0.000885
α_π= 1.5, α_y= 0.5	-0.001113
α_π= 1.5, α_q= -0.05, α_R= 0.9	-0.001045
α_π= 6.76, α_q= 0.05	-0.001114
α_π= 6.76, α_q= -0.05, α_y= 0.5	-0.002007

- a strong anti-inflationary stance is not optimal.

- targeting the lagged interest rate is welfare reducing.

- optimality of a mute response to output.

Heterogeneity and Welfare

-**nominal debt**: monetary policy can reduce the unnecessary redistribution generated by the existence of nominal contract, stabilizing the real interest rate and thus allowing agents to share risks optimally.

- **price stickiness**: monetary policy reducing variations in inflation can decrease the cost of price dispersion.

Borrowers: direct effect of nominal debt distortion, indirect effect of price rigidities

Lenders: directly effected by both distortions

Table 4. Welfare costs for lenders and borrowers

$$\hat{R}_t = \alpha_R \hat{R}_{t-1} + (1-\alpha_R)\alpha_\pi \hat{\pi}_t + (1-\alpha_R)\alpha_y \hat{y}_t + (1-\alpha_R)\alpha_q \hat{q}_t$$

	Lenders	Borrowers
$\alpha_\pi = 6.79$, $\alpha_q = -0.05$	-0.3429	0.02187
inflation stabilization	-0.3427	0.02186
Optimal rule for...		
lenders: $\alpha_\pi = 17$, $\alpha_q = 0$	-0.3428	
borrowers: $\alpha_\pi = 1.01$, $\alpha_q = -0.06$		11.7229

- lenders are better off when the central bank is very aggressive with respect to inflation

- borrowers prefer a policy that weakly responds to inflation.

Trade-off between the welfare of the two groups of agents with respect to inflation stabilization.

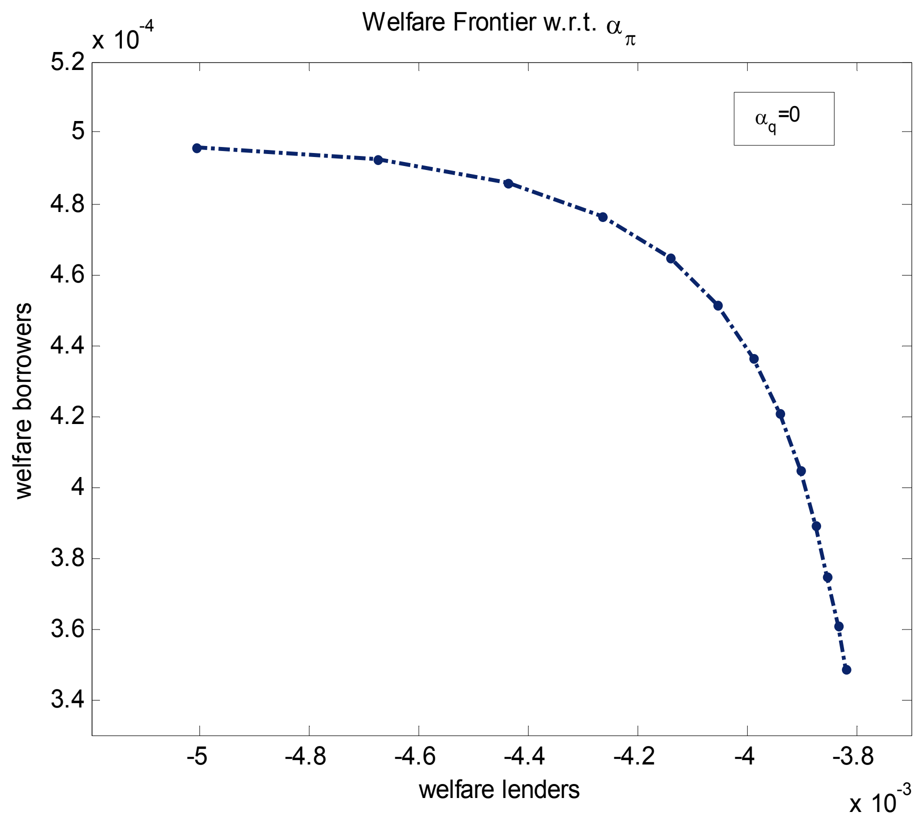

Figure 4.b Welfare Frontier w.r.t. weight on inflation, $\alpha_\pi \in [1.01,17]$ and $\alpha_{q=0}$

welfare frontier: a monetary policy outcome is on the frontier if there is no alternative feasible outcome in which either of the two individuals is at least as well off and the other is strictly better off.

Borrower's Optimal Rule

Main distortion that affect borrowers' welfare = private risk generated by the uncertain repayment of the debt $\Longrightarrow$ a nearly constant real interest rate would reduce the volatility of consumption and improve welfare.

A stable real rate $\Longrightarrow$ lower volatility of housing prices

$$q_t = E_t \sum_{j=0}^{\infty} \beta_1^j \frac{u_{c1,t+1}}{u_{c1,t}} \frac{u_{h1,t+j}}{u_{c1,t+1}}, \tag{6}$$

and thus debt.

volatility

$\hat{R}_t = \alpha_R \hat{R}_{t-1} + (1-\alpha_R)\alpha_\pi \hat{\pi}_t + (1-\alpha_R)\alpha_y \hat{y}_t + (1-\alpha_R)\alpha_q \hat{q}_t$

	$\alpha_\pi = 6.79$, $\alpha_q = -0.05$	$\alpha_\pi = 17$, $\alpha_q = 0$	$\alpha_\pi = 1.01$, $\alpha_q = -0.06$
$\sigma(\pi)$	0.0678	0.0251	1.5482
$\sigma(rr)$	0.3848	0.3865	0.1966
$\sigma(q)$	6.3564	6.3756	5.670
$\sigma(b)$	5.7196	5.7156	5.40

Weak response to inflation $\Longrightarrow$ reduced volatility of real interest rate, housing prices and indebtedness

BUT... $\Longrightarrow$ higher inflation volatility

Level effect and stabilization effect

	$\alpha_\pi = 6.79$, $\alpha_q = -0.05$	Inflation stabilization	$\alpha_\pi = 17$, $\alpha_q = 0$	$\alpha_\pi = 1.01$, $\alpha_q = -0.06$
Lenders				
$\sigma(c_1)$	2.13	2.16	2.15	*1.03*
$\mu(c_1)$, $\times 10^{-6}$	-1.2053	0.12005	-0.466	-79.801
Borrowers				
$\sigma(c_2)$	2.22	2.27	2.26	*0.72*
$\mu(c_2)$, $\times 10^{-6}$	-2.0901	-0.00285	-1.0123	-102.05

- stabilizing the real rate, monetary policy reduces the private risk generated by the uncertain return of the nominal asset $\Longrightarrow$ reduces the volatility of consumption for both borrowers and lenders

From one side the central bank should stabilize inflation to increase lender's welfare, from the other it should stabilize the real rate to increase borrower's welfare.

$\rightarrow$Even in a sticky prices environment, the existence of credit flows in the economy, undermine the robustness of inflation stability as the optimal monetary policy prescription, unless the central bank is willing to neglect borrowers'welfare.

Price Stickiness and Social Welfare

Price stickiness	Optimal rule	Welfare loss
$\theta = 0$	$\alpha_\pi = 1.01$ $\alpha_q = -0.71$	0.079461
$\theta = 10$	$\alpha_\pi = 3.78$ $\alpha_q = -0.07$	-0.000807
$\theta = 50$	$\alpha_\pi = 5.21$ $\alpha_q = -0.05$	-0.000874
$\theta = 81.5$	$\alpha_\pi = 6.79$ $\alpha_q = -0.05$	-0.000833
$\theta = 100$	$\alpha_\pi = 7.44$ $\alpha_q = -0.05$	-0.000816

$\Longrightarrow$ In the absence of price stickiness monetary policy allowing for deviation from inflation stability increases social welfare

Housing Prices and Monetary Policy

- An interest rate response opposite to variations in housing prices implies an even lower volatility of housing prices and debt.

- An increase in housing prices that leads to a reduction in the nominal interest rate would limit the distortion on the equilibrium credit flows from

the existence of collateral constraints.

Table 6. Unconditional moments: $\mathbf{n = 0.5}$, $\phi_p = 81.5$

	α_π= 6.79, α_q= −0.05	α_π= 17, α_q= 0	α_π= 1.01, α_q= 0	α_π= 1.01, α_q= −0.06
$\sigma(\pi)$	0.0678	0.0251	1.520	1.5482
$\sigma(rr)$	0.3848	0.3865	0.1966	0.1966
$\sigma(q)$	6.3564	6.3756	5.670	*5.5964*
$\sigma(R)$	0.4605	0.4227	1.540	1.5636
$\sigma(b_2)$	5.7196	5.7156	5.40	*5.3464*

Negative response to housing prices $\Longrightarrow$lower volatility of housing prices and

indebtedness.

ex: positive productivity shock: $\downarrow$marginal cost $\Longrightarrow\downarrow$inflation $\Longrightarrow\uparrow$consumption

borrowers smooth the effect on consumption by $\uparrow$ housing investment $\Longrightarrow$ $\uparrow$q$\Longrightarrow\uparrow$ b$\Longrightarrow\uparrow\uparrow$housing investment.

- Due to the existence of limits to credit, borrowers'investment dynamics are distorted below the frictionless level.

- Borrowers wish the central bank to lower the interest rate in order to reduce the effects of financing constraints and spur housing investment.

The same mechanism holds in response to a positive shock to the loan to value ratio and housing preferences and a negative government spending shock.

Asimmetry and Monetary Policy

- In contrast with the standard representative agent model, the second-order approximation of our baseline economy delivers asymmetric dynamics. Household debt, housing prices, inflation, and the real interest rate display a more pronounced response to positive shocks.

- Monetary policy amplifies the reaction to positive shocks and dampens the effect of negative shocks on borrowers' consumption.

Lenders: willing to pospone consumption to the future depending on the real rate of return.

Borrowers: prefer to anticipate future consumption to the present.

$\Longrightarrow$ monetary policy, through its effects on reale rate can relax credit frictions, at the cost of asymmetric business cycle dynamics

Government Spending Shock

- Government Speding Shock = income shock

Since impatient agents care more for present consumption, optimal monetary spurs today's effect of the shock on borrowers consumption and the next period effect on lenders consumption. As a result lenders' consumption follows an increasing path in the first two periods and then declines. So, the real interest rates increases first and then drasticly decreases.

$\Longrightarrow$ borrowers can borrow more and increase their consumption even when $+$ government spending shock (- income shock) – $\uparrow$ real interest rate increases after both shock $\Longrightarrow$ asymmetric effect of shocks!

Sensitivity Analysis

Transition Dynamics

- changing the initial conditions from the steady state to the mean of the distribution of the state vector under a simple Taylor rule or under the evaluated

policy doesn't significantly alter the monetary policy outcome.

Table 7. Social welfare-based optimal rule

	Optimal rules	Ad hoc rules	
	$\alpha_\pi = 6.79$ $\alpha_q = -0.05$	$\alpha_\pi = 7.27$ $\alpha_q = -0.06$	$\alpha_\pi = 6.79$ $\alpha_q = -0.06$
Social welfare cost (deterministic S.S.)	-0.000833	-0.000834	-0.000834
	$\alpha_\pi = 6.79$ $\alpha_q = -0.08$	$\alpha_\pi = 7.27$ $\alpha_q = -0.08$	$\alpha_\pi = 6.79$ $\alpha_q = -0.07$
Social welfare cost (stochastic mean)	0.004389	0.004388	0.004386
	$\alpha_\pi = 6.20$ $\alpha_q = -0.05$	$\alpha_\pi = 5.21$ $\alpha_q = -0.06$	$\alpha_\pi = 6.20$ $\alpha_q = -0.06$
Social welfare cost (stochastic mean, Taylor)	0.001652	0.001650	0.001648

Model's Parametrization: n; θ

- the more costly it is to change prices, the stronger the response to inflation and the lower the weight on housing price.

- the higher the borrowers'share the lower the reaction to inflation

Table 8. Social welfare-based optimal rule w.r.t. degree of price stickiness

$$\hat{R}_t = \alpha_R \hat{R}_{t-1} + (1-\alpha_R)\alpha_\pi \hat{\pi}_t + (1-\alpha_R)\alpha_y \hat{y}_t + (1-\alpha_R)\alpha_q \hat{q}_t$$

Price stickiness	Optimal rule	Welfare loss
$\theta = 0$	$\alpha_\pi = 1.01$ $\alpha_q = -0.71$	0.079461
$\theta = 10$	$\alpha_\pi = 3.78$ $\alpha_q = -0.07$	-0.000807
$\theta = 50$	$\alpha_\pi = 5.21$ $\alpha_q = -0.05$	-0.000874
$\theta = 81.5$	$\alpha_\pi = 6.79$ $\alpha_q = -0.05$	-0.000833
$\theta = 100$	$\alpha_\pi = 7.44$ $\alpha_q = -0.05$	-0.000816

Table 9. Social welfare-based optimal rule w.r.t. share of borrowers in the economy

$$\hat{R}_t = \alpha_R \hat{R}_{t-1} + (1-\alpha_R)\alpha_\pi \hat{\pi}_t + (1-\alpha_R)\alpha_y \hat{y}_t + (1-\alpha_R)\alpha_q \hat{q}_t$$

Borrowers' share	Optimal rule	Welfare loss
$n = 0$	$\alpha_\pi = 17$ $\alpha_q = 0$	0.079461
$n = 0.001$	$\alpha_\pi = 16.82$ $\alpha_q = -0.06$	-0.000807
$n = 0.20$	$\alpha_\pi =$ $\alpha_q = -0.05$	-0.000713
$n = 0.50$	$\alpha_\pi = 6.79$ $\alpha_q = -0.05$	-0.000833
$n = 0.80$	$\alpha_\pi = 1.62$ $\alpha_q = -0.02$	-0.000816

Conclusions

- We examine optimal the conduct of monetary policy in an economy with **collateralized debt** and **sticky prices**

-In the absence of price stickiness monetary policy allowing for deviation from inflation stability, improves **risk sharing** and increases social welfare.

- The distortions generated by the existence of nominal household debt and price stickiness generate a **trade-off** for monetary policy – strong inflation stabilization vs real interest rate stabilization (higher inflation volatility)

- As a result, a strong anti-inflationary stance is not optimal.

- Furthermore, we document that a monetary policy can aim at relaxing credit frictions at the cost of **asymmetric** business cycle dynamics and higher inflation volatility.