How Can Expansive Monetary Policy Induce the Build-up of Asset Price Bubbles

Jakub Matějů

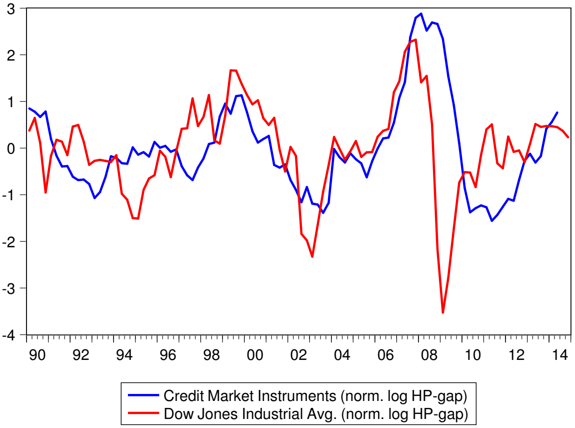


Figure: Asset prices leading the credit cycle

Agenda

Financial intermediation and asset overpricing

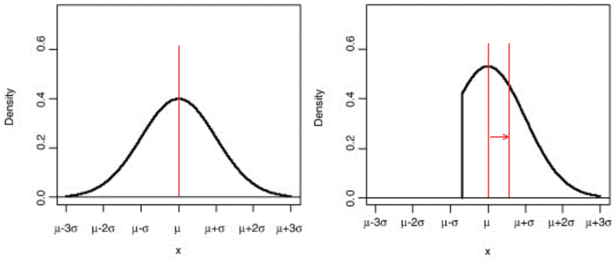
I start with a model where the demand for risky asset is increased by limited liability of leveraged investors. I show that because the investors can default on their obligations, the increased demand raises price of risky assets above the fundamental price (Allen & Gale, 2000).

General equilibrium and monetary policy simulations

Further I study the impact of monetary policy on the asset overpricing in a New-Keynesian small DSGE model with financial frictions based on the framework of Bernanke, Gertler & Gilchrist (1999). Allowing for the overpriced assets to be used as collateral, I examine the role of overpriced assets in credit supply and the implications for monetary policy.

Limited liability and risk shifting

- Under limited liability of investors, the truncation of their return distribution increases expected returns from holding risky assets
- This leads to a higher demand for risky assets and drives their price upwards



Financial intermediation: agents

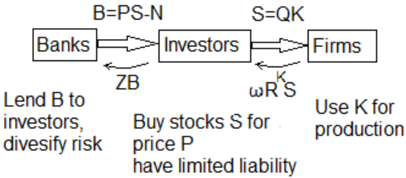


Figure: Agents in the contracting problem, flow of loans and repayments

Banks lend to investors, who enjoy limited liability and invest in risky assets on a stock market (firms' installed capital). Limited liability shifts the demand for risky shares and raises the stock price above fundamental value (defined as no-leverage price).
The idiosyncratic shocks ω are i.i.d. on $(0, \infty)$ with $E[\omega] = 1$.

Timing of financial intermediation contract

1. Banks lend B_{t+1} to investors for a flat rate Z_{t+1}, which compensates the bank for the ex-ante symmetric risk of investors' defaults.
2. Some ("creative") investors generate investment opportunities, acquiring a shares S_{t+1} for a cost $c(S_{t+1})$.
3. Stock market opens, where investors may sell and buy firm shares S_{t+1} for an endogenous price P_{t+1}.
4. The idiosyncratic risk ω is realized, the shares S_{t+1} yield ωR^K_{t+1} to an individual investor.
5. Investor either repays $Z_{t+1}B_{t+1}$ to the bank or defaults. In case of default, the bank pays fraction μ of the residual value as auditing costs and collects the remainder of the investment.

Investor's problem

The break-even idiosyncratic productivity is defined by the default threshold:

$$Z_{t+1}B_{t+1} = \bar{\omega}R^K_{t+1}S_{t+1} \qquad B_{t+1} = P_tS_{t+1} - N_{t+1} \tag{1}$$

The limited-liable investor maximizes:

$$\max_{S_{t+1},\bar{\omega}} \left[\int_{\bar{\omega}}^{\infty} \omega R^K_{t+1}S_{t+1}dF(\omega) - (1 - F(\bar{\omega}))Z_{t+1}B_{t+1} \right] \tag{2}$$

subject to the participation constraint of the bank:

$$(1 - F(\bar{\omega}))Z_{t+1}B_{t+1} + (1 - \mu)\int_0^{\bar{\omega}} \omega R^K_{t+1}S_{t+1}dF(\omega) \geq R_{t+1}B_{t+1} \tag{3}$$

Contract returns to agents

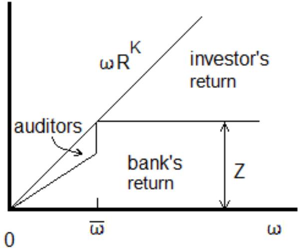


Figure: Contract returns distributed between bank, investor and auditing costs

Pricing of the risky asset

The demand function derived from the investors' problem leads to the pricing equation for the risky shares

$$P_t = \frac{1}{Z_{t+1}} \frac{\int_{\bar{\omega}}^{\infty} \omega R_{t+1}^K dF(\omega)}{(1 - F(\bar{\omega}))} \tag{4}$$

while the fundamental price can be defined as if the investors would finance the purchase with their own funds (no limited liability):

$$P_t^F = \frac{1}{R_{t+1}} \left(E[\omega] R_{t+1}^K \right) = \frac{R_{t+1}^K}{R_{t+1}} \tag{5}$$

In the paper I show that $P_t > P_t^F$.

Multiple-period assets

Now assume that the assets mature after more periods and can be used as collateral in the meantime. The prices of "new" and "old" assets become:

$$P_t^{old} = \frac{1}{Z_{t+1}} \frac{\int_{\bar{\omega}}^{\infty} \omega R_{t+1}^K dF(\omega)}{1 - F(\omega)} \tag{6}$$

$$P_t^{new} = \frac{P_{t+1}^{old}}{Z_{t+1}} = \frac{1}{Z_{t+1} Z_{t+2}} \frac{\int_{\bar{\omega}}^{\infty} \omega R_{t+2}^K dF(\omega)}{1 - F(\omega)} \tag{7}$$

It can be shown that investors wealth in this model exceeds the benchmark of BGG whenever growth of the asset market maintains sufficient momentum

$$\frac{P_t^{old} S_{t+1}^{old}}{P_{t-1}^{old} S_t^{old}} \lessgtr \frac{R_t}{1 - \mu F(\bar{\omega})} \tag{8}$$

The contracting problem is embedded in a standard New Keynesian general equilibrum framework including

- Supply side of risky asset market
- Investors' wealth accumulation and limited lifetime
- Households' utility consisting of final good consumption, real money holdings and labor
- Firms employing capital and both workers' and investors' labor
- Competitive labor market, capital adjustment costs
- Retailers' monopoly power and Calvo pricing
- Monetary and fiscal policies

Model Simulations 1

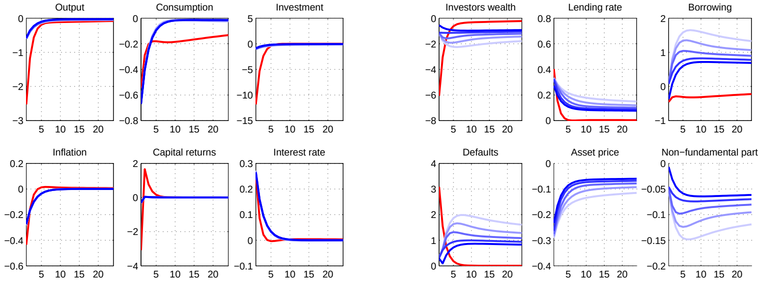


Figure: Impulse responses to a restrictive monetary policy shock

Model Simulations 2

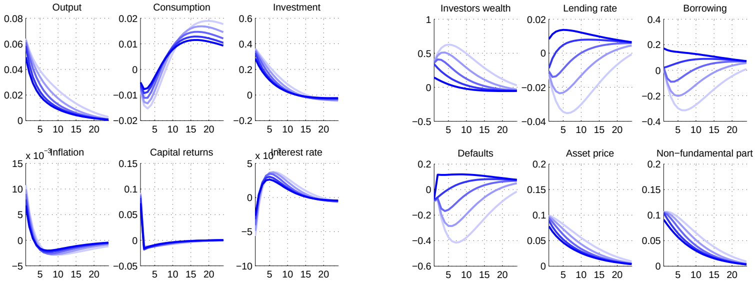


Figure: Impulse responses to a non-fundamental asset price shock

Should monetary policy react to asset prices? Probably not

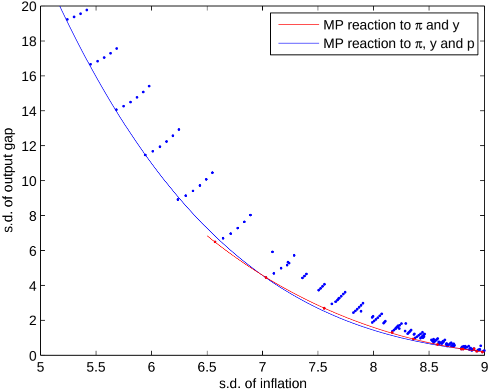


Figure: Combinations of s.d. of output gap and s.d. of inflation achieved under different parameters of the monetary policy rule

Concluding remarks

- GE model featuring the feedback loop between asset prices, collateral values, credit, investment, real activity and returns
- Risky assets may be priced above fundamentals if investors are limitedly liable
- Expansive monetary policy boosts both fundamental and non-fundamental component of asset prices
- But reaction of monetary policy to asset prices does not lead to lower volatilities of inflation and output
- Financial sector works as shock absorber, monetary policy may not be as effective as implied by BGG
- Non-fundamental asset price shocks have implications for both financial sector and real activity

Thank you.

Backup: asset overpricing

We need to show that

$$P = \frac{1}{Z}\frac{\int_{\bar{\omega}}^{\infty}\omega R^K dF(\omega)}{(1-F(\bar{\omega}))} \geq \frac{R^K}{R} = P^F \tag{9}$$

Now we define $\tilde{Z}$ such that

$$\tilde{P} = \frac{1}{\tilde{Z}}\frac{\int_{\bar{\omega}}^{\infty}\omega R^K dF(\omega)}{(1-F(\bar{\omega}))} = \frac{R^K}{R} = P^F \tag{10}$$

Now by showing that $\tilde{Z} > Z$ we will prove that $P > P^F$. Using that $\tilde{P} = P^F = \frac{R^K}{R}$:

$$\tilde{Z}(1-F(\bar{\omega})) = \frac{R}{R^K}\int_{\bar{\omega}}^{\infty}\omega R^K dF(\omega) \tag{11}$$

Eliminating R^K and multilplying with B:

$$\tilde{Z}B(1-F(\bar{\omega})) = RB\underbrace{\int_{\bar{\omega}}^{\infty}\omega dF(\omega)}_{>1} > RB \tag{12}$$

Now use the banks' participation constraint (3):

$$ZB(1-F(\bar{\omega})) = RB\underbrace{-(1-\mu)\int_{0}^{\bar{\omega}}\omega R^K S dF(\omega)}_{<0} < RB \tag{13}$$

therefore $\tilde{Z} > Z$ and $P > P^F$. Back to slide 9.

Households

$$E_t \sum_{k=0}^{\infty} \beta^k \left[\ln(C_{t+k}) + \zeta \ln \left(\frac{M_{t+k}}{P_{t+k}} \right) + \xi \ln(1 - H_{t+k}) \right] \tag{14}$$

s.t. budget constraint

$$C_t = W_t H_t - T_t + \Pi_t + R_t D_t - D_{t+1} + \frac{(M_{t-1} - M_t)}{P_t} \tag{15}$$

the FOCs constitute the Euler equation, labor supply and money demand:

$$\frac{1}{C_t} = E_t\{\beta \frac{1}{C_{t+1}} R_{t+1}\} \tag{16}$$

$$\frac{W_t}{C_t} = \xi \frac{1}{1 - H_t} \tag{17}$$

$$\frac{M_t}{P_t} = \zeta C_t \left(\frac{R^n_{t+1} - 1}{R^n_{t+1}} \right) \tag{18}$$

Firms and investment

$$Y_t = A_t K_t^{\alpha} L_t^{1-\alpha} \tag{19}$$

where labor consists of workers' labor H_t and investors' labor H_t^e (consider venture capital):

$$L_t = H_t^{\Omega} (H_t^e)^{1-\Omega} \tag{20}$$

There are installment costs to newly purchased capital:

$$K_{t+1} = \Phi\left(\frac{I_t}{K_t}\right) - (1-\delta)K_t \tag{21}$$

And capital is paid its marginal product plus the change in capital price times the relative price of wholesale goods

$$E[R_{t+1}^K] = E\left[\frac{\frac{1}{X_{t+1}}\frac{\alpha Y_{t+1}}{K_{t+1}} + Q_{t+1}(1-\delta)}{Q_t}\right] \tag{22}$$

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Workers and Investors

Workers and investors' wages are competitive:

$$W_t = (1-\alpha)\Omega \frac{1}{X_t}\frac{Y_t}{H_t} \tag{23}$$

$$W_t^e = (1-\alpha)(1-\Omega)\frac{1}{X_t}\frac{Y_t}{H_t^e} \tag{24}$$

And the investors' wealth accumulates according to

$$N_{t+1} = \gamma V_t + W_t^e \tag{25}$$

where the value of the firm V_t evolves

$$V_t = R_t^K Q_{t-1}K_t - \left(R_t + \frac{\mu \int_0^{\bar{\omega}} dF(\omega) R_t^K Q_{t-1}K_t}{Q_{t-1}K_t - N_{t-1}} \right) (Q_{t-1}K_t - N_{t-1}) \tag{26}$$

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Retailers and Calvo pricing

- Monopolistically competitive retailers costlessly differentiate their product and sell it to consumers, facing the Dixit-Stiglitz demand curves

$$Y_t(z) = \left(\frac{P_t(z)}{P_t}\right)^{\epsilon} \tag{27}$$

where ϵ is the elasticity of substitution.

- Each period, only a fraction θ of retailers changes prices

$$P_t = [\theta P_{t-1}^{1-\epsilon} + (1-\theta)(P_t^{\star})^{1-\epsilon}]^{\frac{1}{1-\epsilon}} \tag{28}$$

(Calvo pricing), which leads to a New Keynesian Phillips curve.

$$\pi_t = \beta E_t\{\pi_{t+1}\} - \kappa x_t \tag{29}$$

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Monetary and Fiscal Policies

- Government budget is balanced

$$G_t = \frac{M_t - M_{t-1}}{P_t} + T_t \tag{30}$$

- Monetary policy follows inflation targeting rule

$$R^n_{t+1} = (R^n_t)^\rho \, \Pi_t^\psi \varepsilon^{R^n}_{t+1} \tag{31}$$

where ε^{rn}_t is an autoregressive monetary policy shock. For the purpose of monetary policy efficiency evaluation, the rule was extended such that

$$R^n_{t+1} = (R^n_t)^\rho \, \Pi_t^{\psi^\pi} Y_t^{\psi^y} P_t^{\psi^p} \varepsilon^{R^n}_{t+1} \tag{32}$$

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