Jermann and Quadrini (2012)

ECON 70428: Advanced Macro: Financial Frictions

Eric Sims

University of Notre Dame

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Macroeconomic Effects of Financial Shocks

This paper incorporates a limited enforcement constraint into an otherwise canonical RBC model

Follows in the tradition of Kiyotaki and Moore (1997) and Iacoviello (2005)

Slight twist – borrowing constraint applies to an intraperiod working capital loan – firm basically has to borrow to finance all its expenditures prior to producing

This generates both an **investment wedge** but also a **labor wedge**

Differently than many of the other papers in the literature, the paper considers exogenous, stochastic disturbances to the amount firms can borrow – i.e. a **financial shock**

Principal Results

Financial shocks trigger positive co-movement among macroeconomic aggregates (precisely because they generate a labor wedge) and seem to account for a large fraction of observed fluctuations in output and other variables

Conditional on a productivity shock, the borrowing constraint plays a role very similar to Carlstrom and Fuerst (1997) – it generates **hump-shaped** responses of output and investment

I will focus on the RBC model; at the end, they append a medium-scale NK model with different bells and whistles and main conclusions hold up

Firm

A representative firm produces output according to:

$$y_t = z_t k_t^{\theta} n_t^{1-\theta}$$

Capital obeys the usual law of motion:

$$k_{t+1} = i_t + (1-\delta)k_t$$

Firm can issue debt, b_{t+1}, at price $1/R_t$ (i.e. these are discount bonds – you issue b_{t+1}/R_t in present and promise to pay back b_{t+1} in next period)

Tax Preference for Debt

Without much else, the capital structure of the firm – its split between equity and debt finance – is irrelevant (Modigliani-Miller)

Need something to ensure that firms issue debt

Tax preference: the real interest rate relevant for the household is $1 + r_t$

We have $R_t = 1 + r_t(1 - \tau)$

$\tau > 0$: firms issue bonds for **higher** price than household pays for them

This makes issuing debt attractive – roughly isomorphic to additional discounting

Working Capital Constraint

The firm needs to get an **intra-period loan**, l_t to finance all period t expenditures

Basic idea: you have to pay everyone before you produce

$$l_t = w_t n_t + i_t + \varphi(d_t) + b_t - \frac{b_{t+1}}{R_t}$$

Here $\varphi(d_t) = d_t + \kappa(d_t - d)^2$ is a dividend adjustment cost

You pay labor, pay for new physical capital, payoff existing intertemporal debt, b_t, issue new intertemporal debt, b_{t+1}/R_t, and pay dividends plus the adjustment cost

Have to borrow all of this – intraperiod so no interest rate

Flow of Funds and the Working Capital Loan

The firm's flow of funds (i.e. budget constraint) is:

$$b_t + w_t n_t + i_t + \varphi(d_t) = y_t + \frac{b_{t+1}}{R_t}$$

But then we can see:

$$l_t = y_t$$

Basically, you have to borrow to produce all revenue

Enforcement Constraint

The firm faces an enforcement constraint on its intraperiod working capital loan:

$$l_t \leq \xi_t \left(k_{t+1} - \frac{b_{t+1}}{1 + r_t} \right)$$

ξ_t is fraction of net assets lender can recover in default

Lender will not let borrower take on more than this so that the firm never wants to default in equilibrium

ξ_t is **stochastic** and interpreted as a financial shock

First Order Condition for Labor

Let μ_t be the multiplier on the borrowing constraint

Labor:

$$w_t = (1 - \mu_t \varphi'(d_t))(1 - \theta) z_t k_t^{\theta} n_t^{-\theta}$$

μ_t serve as a **labor wedge** distorting relationship between wage and marginal product

Tightening of constraint $\rightarrow \uparrow \mu_t \rightarrow$ direct reduction in labor demand

FOC for Bonds and Capital

Bonds, where $m_{t,t+1}$ is the stochastic discount factor

$$1 = \varphi'(d_t)\mu_t\xi_t \frac{R_t}{1+r_t} + \mathbb{E}_t\, m_{t,t+1} R_t \frac{\varphi'(d_t)}{\varphi'(d_{t+1})}$$

In frictionless world, $\mu_t = 0$, $\varphi'(\cdot) = 1$, and $R_t = 1 + r_t$: this would be standard

Capital:

$$1 = \mu_t\xi_t\varphi'(d_t) +$$
$$\mathbb{E}_t\, m_{t,t+1} \frac{\varphi'(d_t)}{\varphi'(d_{t+1})} \left[1 - \delta + (1 - \mu_{t+1}\varphi'(d_{t+1}))\theta z_{t+1} k_{t+1}^{\theta-1} n_{t+1}^{1-\theta}\right]$$

$\mu_{t+1} > 0$ is like a **investment wedge** in that it distorts the MPK in the standard asset pricing condition for capital

Household

Can save via bonds, b_t, or shares of stock in firm, s_t

Its budget constraint is:

$$c_t + p_t s_{t+1} + \frac{b_{t+1}}{1 + r_t} = w_t n_t + b_t + s_t d_t + s_t p_t - T_t$$

Period utility is as follows:

$$u(c_t, n_t) = \ln c_t + \alpha \ln(1 - n_t)$$

Household FOC

These are standard:

$$\frac{\alpha}{1-n_t} = \frac{w_t}{c_t}$$

$$1 = \beta\,\mathbb{E}_t\,\frac{c_t}{c_{t+1}}(1+r_t)$$

$$p_t = \beta\,\mathbb{E}_t\,\frac{c_t}{c_{t+1}}(d_{t+1}+p_{t+1})$$

The last condition just prices shares – justifies firm using SDF, $\frac{\beta c_{t-1}}{c_t}$, to discount future dividends

Aggregation

Households hold the debt issued by the firm

Government is subsidizing firm debt via a lump sum tax on the household. Lump sum tax must satisfy:

$$T_t = b_{t+1}\left[\frac{1}{R_t} - \frac{1}{1+r_t}\right]$$

$1/R_t$ is what firms sell debt for; $1/(1+r_t)$ is what household buys debt for

$R_t < 1 + r_t$ if $\tau > 0$: so firm has to tax household to finance this subsidy

Resource constraint is standard:

$$y_t = c_t + i_t + \kappa(d_t - d)^2$$

Constraint Binds in Steady State

Since $\tau > 0$ means $R < 1 + r$, we have to have $\mu > 0$ in steady state (as well as in region around it)

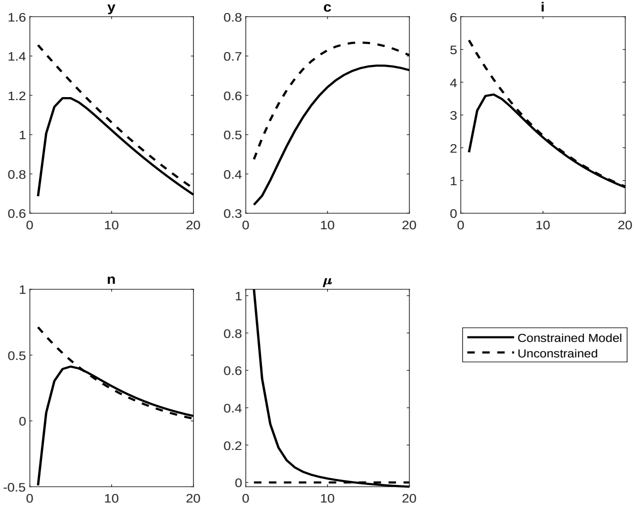
- $\tau > 0$ is like having extra discounting for the firm

Because of this, we can solve the model via linearization in the region of the steady state (where the constraint always binds)

Parameterization otherwise reasonably standard, with:

- $\xi = 0.1634$
- $\tau = 0.35$
- $\kappa = 0.146$

Productivity Shock



Discussion

The "unconstrained" model is a vanilla RBC model (dashed lines)

Borrowing constraint generates **hump-shaped** output and investment responses

- This is evocative of the hump-shaped responses to a productivity shock in Carlstrom and Fuerst (1997)

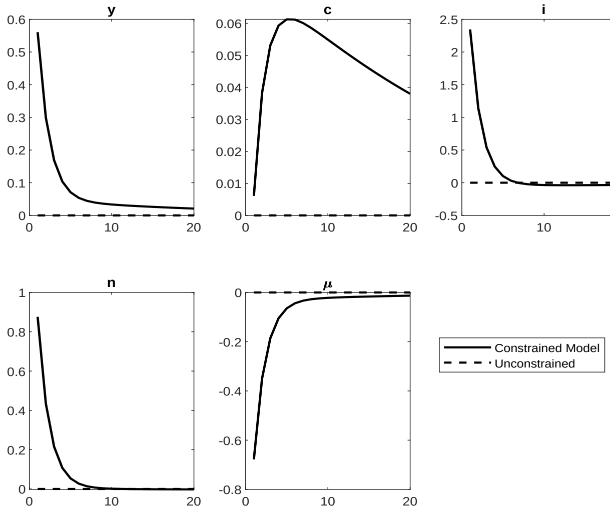
We can see this in the big increase in μ_t – constraint is tightening

Mechanism: firm would like to increase its production scale, but must borrow to do so and is limited by its net worth, $k_{t+1} - b_{t+1}/(1 + r_t)$, which evolves slowly

This generates a big labor wedge – labor input actually declines, so output and investment don't react by much on impact

After several quarters, we're basically on top of the RBC responses (constraint no longer tight)

Financial Shock, ξ_t



Discussion

A loosening of financial conditions (i.e. exogenous decline in ξ_t) is expansionary

Directly lets firm borrow more – gets it (temporarily) closer to the efficient scale

We see this in the large decline in μ_t

Eases both the labor and investment wedges

In the unconstrained model, ξ_t is irrelevant

The Importance of Dividend Adjustment Cost

The constraint will bind in the steady state even without a dividend adjustment cost – $\tau > 0$ is sufficient to make the constraint bind in steady state and κ is irrelevant for the steady state

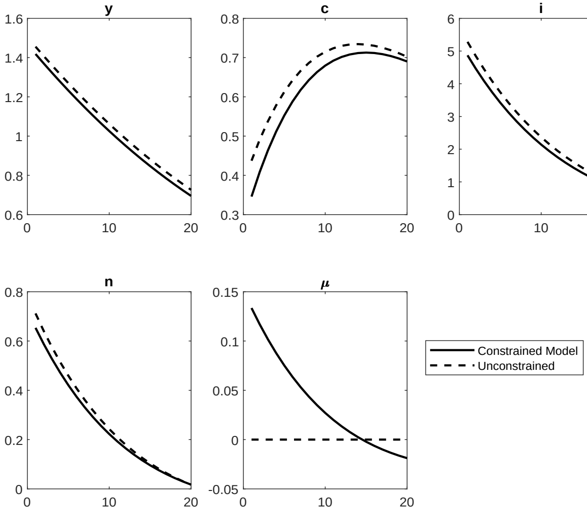
But $\kappa > 0$ is important for the model to be materially different from RBC model in terms of dynamic responses to shocks

Why?

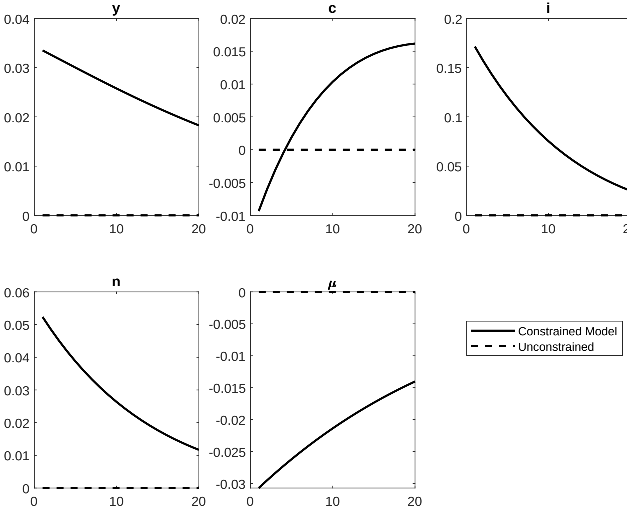
If $\kappa = 0$, firm can basically raise or lower its dividend payouts in such a way as to more or less keep the extent of the borrowing constraint binding fixed

This means cyclical dynamics are very close to standard RBC model, even though steady state is distorted

Productivity Shock, $\kappa = 0$



Financial Shock, ξ_t, $\kappa = 0$



Implications for Equity Value of Firm

In standard model, financial shock actually **lowers** the ratio of the firm's share price to its book value, $k_{t+1} - b_{t+1}$

To "fix" this, one can add an investment adjustment cost, which basically gets q_t (relative price of capital) to fluctuate

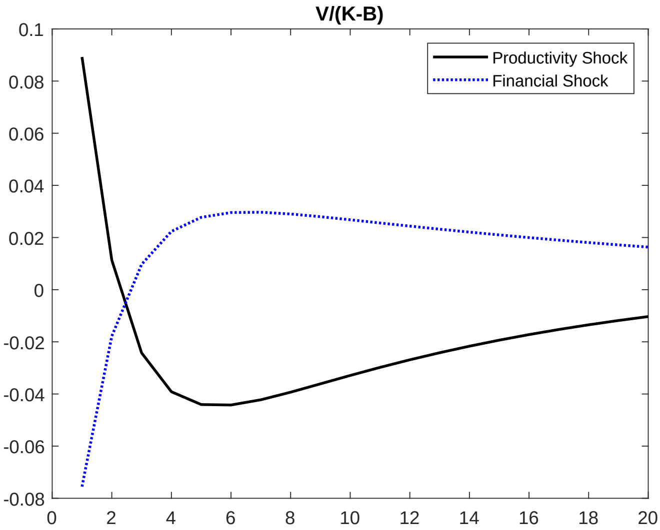
Adjustment cost specification is a bit weird:

$$k_{t+1} = k_{t+1} = \left[\frac{\varrho_1 \left(\frac{i_t}{k_t} \right)^{1-\nu}}{1-\nu} + \varrho_2 \right] k_t + (1-\delta) k_t$$

Need to be careful parameterizing this:

- $\frac{\varrho_1 \delta^{1-\nu}}{1-\nu} + \varrho_2 = \delta$
- $\varrho_1 \delta^{-\nu} = 1$ (so $\partial k_{t+1} / \partial i_t = 1$ in steady state)

Equity Valuation Responses: Base Model



Equity Valuation Responses: Investment Adjustment Cost