The Risk Premium Channel and Long-term Growth

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SUMMARY

; We study a quantitative DSGE model linking a state of the art asset pricing framework à la Kung and Schmid (2015) with a constraint on leverage as in Gertler and Kiyotaki (2010). We show that a mere increase in the probability of rms being financially constrained leads to an increase in risk premia. Even for a small adverse shock to productivity a drop in asset valuation restrains firms from outside financing and by that induces a persistent low growth environment. In our framework a constraint on leverage induces countercyclical risk premia in equity markets even when it does not bind.

Research question: How does financial accelerator affect:

- Propagation of shocks: consumption (today/tomorrow), leverage
- Asset prices as nexus: (expected) returns, risk-free rate, joint dynamics
- Can we associate low growth rates with high premia?

Results: Build lean DSGE framework to analyse impact of financial friction on growth dynamics

- Induces countercyclical risk premia and procyclical yield of risk free asset
- low risk-free rate in downturn encourages agents to consume more invest less; higher risk premia help the firm to attract equity and deleverage
- Constraint on financial leverage not always binding (global solution)

DSGE MODEL

Endogenous economic growth model à la Kung and Schmid (2015) with recursive preferences as in Bansal and Yaron (2004) and stylized financial friction by Gertler and Karadi (2011)

Household

Endowed with recursive preferences Epstein and Zin (1989)

- **large family** (with full risk sharing)
  1. Workers
  2. Financial intermediaries
  3. Managers (final goods)
  4. Innovators (innovation goods)

→ **One pricing kernel**

$$\mathcal{M}_{t,t+1} \equiv \frac{\frac{\partial \mathcal{U}_t}{\partial C_{t+1}}}{\frac{\partial \mathcal{U}_t}{\partial C_t}} = \beta \left(\frac{C_{t+1}}{C_t}\right)^{-1/\psi} \left(\frac{\mathcal{U}_{t+1}}{\mathcal{R}_t}\right)^{\frac{1}{\psi}-\gamma},$$

where $\mathcal{R}_t(\mathcal{U}_{t+1}) = E_t\left[\mathcal{U}_{t+1}^{1-\gamma}\right]^{\frac{1}{1-\gamma}}$

- Disentangle elasticity of intertemporal substitution and risk aversion.
- Long-run growth prospects/intertemporal distribution of risk matters

Household

Intermediaries

- Introduce financial friction
- HH cannot invest directly in risky assets (physical/innovation)
- Intermediaries maximize expected value of their investment

$$\mathcal{J}^{FI} = \max E_t \sum_{i=0}^{\infty} \left[\left(p^b\right)^i \mathcal{M}_{t,t+1+i}\left(1-p^b\right) E_{j,t}\right],$$

where $\left(p^b\right)^i$ is the probability of remaining in the business for i periods

- Law of motion intermediaries' equity

$$E_{t+1} = p^b\left[\left(R^F_{t+1}-R^f_t\right)P^F_{t+1}S^F_t + \left(R^I_{t+1}-R^f_t\right)P^I_{t+1}S^I_t + R^f_t E_t\right] + \omega_b\left(P^F_{t+1}S^F_t + P^I_{t+1}S^I_t\right).$$

Household

Intermediaries II

→ Intermediaries will only invest as long as (participation constraint)

$$E_t\left[\mathcal{M}_{t,t+1+i}\left(R^k_{t+1+i}-R^f_{t+i}\right)\right] \geq 0 \qquad k \in \{F, I\}$$

→ Households will only lend money as long as (incentive constraint)

$$\mathcal{J}^{FI}_{j,t} \geq \omega_d\left(P^F_{j,t}S^F_{j,t} + P^I_{j,t}S^I_{j,t}\right).$$

- Euler equations account for shadow price

$$\lambda_t\omega_d = E_t\left[\tilde{\mathcal{M}}_{t,t+1}\left(R^k_{t,t+1}-R^f_t\right)\right]$$

- with

$$\tilde{\mathcal{M}}_{t,t+1} = \mathcal{M}_{t,t+1}\left[(1-p^b) + p^b\hat{\mathcal{J}}^{FI}_{t+1}\right].$$

Final Goods I

- **Final good production:**
  - Cobb-Douglas technology

$$Y_t = \left(\left(K^k_t\right)^\alpha \left(N_t A_t\right)^{1-\alpha}\right)^{1-\omega_p} \left(G_t\right)^{\omega_p}$$

  - includes a bundle of patents:

$$G_t = \left(\int_0^{K^p_t} X_{i,t}{}^{\nu}\, \mathrm{d}i\right)^{\frac{1}{\nu}}.$$

- **Single source of uncertainty:**

$$log(A_{t+1}) = \rho_a log(A_t) + \sigma_a \varepsilon_{a,t+1},$$

with $\epsilon_{a,t+1} \overset{i.i.d.}{\sim} \mathcal{N}(0,1)$ and $\rho_a < 1$.

Final Goods II

Manager maximizes present value of dividends

- **Dividends**

$$D_t = Y_t - I^k_t - \int_0^{K^p_t} P^p_{i,t} X_{i,t} di - W_t.$$

- **LoM physical capital:**

$$K_{t+1} = (1-p^k)K_t + \phi\left(\frac{I_t}{K_t}\right)K_t,$$

- **Resulting return**

$$R^F_{t,t+1} = \frac{\frac{\partial F_{t+1}}{\partial K_{t+1}} + \frac{(1-p^k)+\Phi\left(\frac{I_{t+1}}{K_{t+1}}\right)}{\Phi'\left(\frac{I_{t+1}}{K_{t+1}}\right)} - \frac{I_{t+1}}{K_{t+1}}}{\Phi'\left(\frac{I_t}{K_t}\right)^{-1}}$$

Endogenous Growth I: Patents

Industrial innovation as in Romer (1990) and Comin and Gertler (2006)

- **Growth in patents drives TFP growth (μ)**
- **Monopolistic patented good sector**
  Producers internalize demand schedule from final good firms and act as price-setters.
- Firms financed/bought by intermediary
- **Return of investing in innovated goods**

$$R^I_{t,t+1} = \frac{(1-p^o)\,\mathcal{J}^p_{t+1}}{\mathcal{J}^p_t - \Pi^p_t}.$$

$\mathcal{J}^p_t$: Value of patent, Π^p_t: Profit of patent

KEY RESULTS

Calibration

Strategy: Remain standard

- **Preferences:**
  - Typical long-run risk calibration: Moderate risk aversion and intertemporal elasticity of substitution > 1.
- **Growth:**
  - Follows Kung and Schmid (2015) to match average growth rate, volatility of R&D, mark-ups, and patent data.
- **Financial sector:**
  - close to Gertler and Karadi (2011)
  - Three parameters
    - $p^b = 0.96$-Target: price-dividend ratio
    - $\omega_d = 0.48$-Target: leverage
    - $\omega_b = 0.0012$-Target: probability of being constraint
  - Weak accelerator: high ω_b; Strong accelerator: low ω_b

Macroeconomic Moments

Delivers basis for asset prices

Variable	Description	Data	Benchmark Model BM	Weak Accelerator WA	Strong Accelerator SA
Panel A	Means				
$E[\Delta y]$	GDP	1.89%	1.86%	1.85%	1.85%
$SS[\Delta y]$	GDP	–	1.59%	1.74%	1.63%
Panel B	Standard Deviations				
$\sigma[\Delta c]/\sigma[\Delta y]$	Ratio volatilities	0.53	0.53	1.01	0.50
$\sigma[\Delta i]/\sigma[\Delta y]$	Ratio volatilities	2.69	1.34	1.23	1.36
$\sigma[\Delta i^p]/\sigma[\Delta y]$	Ratio volatilities	2.14	1.59	0.88	1.59
$\sigma[\Delta c]$	Consumption	1.01%	1.03%	1.04%	0.98%
Panel C	Autocorrelations				
$\rho[\Delta c]$	Consumption	0.31	0.20	0.01	0.20
$\rho[\Delta y]$	Output	0.37	0.03	0.01	0.03

Table: Macroeconomic Moments

Asset Pricing Moments

... will affect the real economy

Variable	Description	Data	Benchmark Model BM	Weak Accelerator WA	Strong Accelerator SA
Panel A	Means				
$E[r^f]$	Risk-free rate	0.75%	1.35%	1.77%	1.36%
$E[r^A]$	Unlevered return	–	2.65%	2.78%	2.31%
$E[r^{lev}]$	Levered return	6.66%	3.99%	3.88%	3.60%
Panel B	Deterministic Steady States				
$SS[r^f]$	Risk-free rate	–	1.80%	1.91%	1.83%
$SS[r^A]$	Unlevered return	–	2.45%	2.74%	2.05%
$SS[r^{lev}]$	Levered return	–	3.16%	3.65%	2.39%
Panel C	Standard Deviations				
$\sigma[r^f]$	Risk-free rate	1.30%	0.26%	0.06%	0.24%
$\sigma[r^A]$	Unlevered return	–	1.79%	0.60%	1.81%
$\sigma[r^{lev}]$	Levered return	16.00%	3.67%	1.24%	4.35%

Table: Asset Pricing

Financial moments

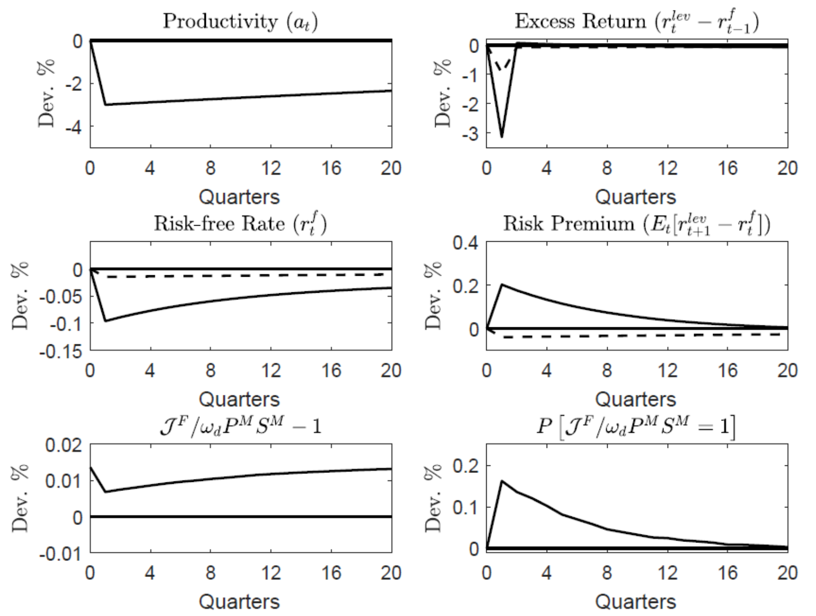
... before we have a look at the mechanism

Variable	Description	Data	Benchmark Model BM	Weak Accelerator WA	Strong Accelerator SA
Panel A	Means				
$E[\mathcal{J}^{FI}/\omega_d P^M S^M - 1]$	Excess firm value	–	0.89 %	0.00 %	3.77 %
$p[\mathcal{J}^{FI}/\omega_d P^M S^M = 1]$	Probability of const.	$> 1.00\%$	9.24 %	100.00 %	0.03 %
$E[B/E]$	Debt-equity ratio	1.16	1.06	1.09	1.41
$E[B/(E+B)]$	Debt-asset ratio	0.52	0.51	0.52	0.58
Panel B	Deterministic Steady States				
$SS[\mathcal{J}^{FI}/\omega_d P^M S^M]$	Excess firm value	–	1.00	1.00	1.00
$SS[B/E]$	Debt-to-equity ratio	–	1.10	1.09	1.53
$SS[B/(E+B)]$	Debt-to-asset ratio	–	0.52	0.52	0.60
Panel C	Standard Deviations				
$\sigma[B/E]$	Debt-to-equity ratio	32.63%	6.40%	0.12%	9.88%
$\sigma[B/(E+B)]$	Debt-to-asset ratio	20.91%	1.51%	0.03%	1.70%

Table: Financial Moments

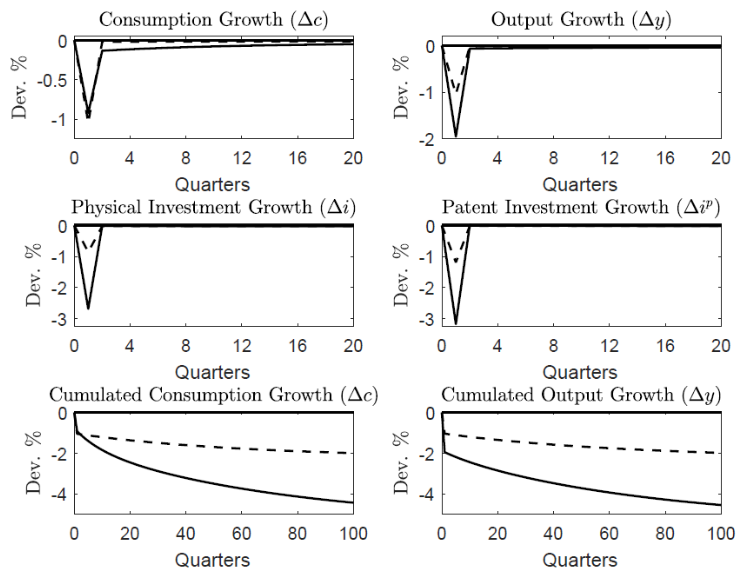
Impulse Response Functions

Asset Pricing ...



Impulse Response Functions

Macro ...



FINDINGS AND CONCLUSION

Summary

GE...different explainations

- **Higher consumption growth with uncertainty**
  - Households can only adjust savings through lending
  - Demand for risk-free asset increases
  - Risk-free rate drops
- **Leverage constraint makes investment more volatilie & consumption less volatile**
  - Asset value drops in downturn
  - outside funding decreases
- **Levered return similar**
  - Strong accelerator lower
  - For weak accelerator premia driven by shadow price

Mechanism in a nutshell

Asset pricing as a nexus ...

- **Risk premia increase even without active constraint:**

$$E_t\left[R_{t+1} - R^f_t\right] = \underbrace{-R^f_t cov_t\left(\tilde{\mathcal{M}}_{t,t+1} R_{t,t+1}\right)}_{\mathrm{I}} + \underbrace{\lambda_t\omega_d}_{\mathrm{II}}$$

agents anticipate negative effects of leverage constraint

→ amplify negative effect as leverage increases

- **What does the increase in the equity premium mean?**
  - probability of being financially constraint increases when leverage is high
  - the firm has to pay a higher premium to attract equity capital/organic growth without outside financing
- **What role does the risk-free rate play?**
  - Risk-free rate drops as riskless assets become scarce
  - agents withdraw external funding
  - → higher consumption today + low growth tomorrow

Conclusion

Summary and Take-away

- **Build lean DSGE framework to analyze impact of financial friction on growth dynamics**
- **Induces countercyclical risk premia and procyclical yield of riskfree asset**
  - low risk-free rate in downturn encourages agents to consume more invest less
  - higher risk premia help the firm to attract equity and deleverage
- **Constraint on financial leverage not always binding → global solution**

Sounds interesting?

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