A Macroeconomic Framework for Quantifying Systemic Risk

Comments

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Model of financial intermediary capital and production/investment decision.

Serious attempt to quantify non-linear mechanism inherent in models of endogenous leverage (Brunnermeier and Sannikov, He and Krishnamurthy, Adrian and Boyarchenko)

Quantify the importance of GE feedback effects for macro-prudential policies such as stress-testing
Model:

- AK Production.
- Capital quality shocks.
- Investment-Q relationship.
- Housing in fixed supply.
Intermediaries:

- Net worth (reputation):
  \[
  \frac{d\varepsilon_t}{\varepsilon_t} = md\tilde{R}_t - \eta dt + d\psi_t
  \]

- Portfolio shares chosen to solve
  \[
  \max E_t \left[ d\tilde{R}_t \right] - \frac{m}{2} Var_t \left[ d\tilde{R}_t \right]
  \]
  subject to capital constraint
  \[
  (1 - \lambda) \left[ q_t K_t + p_t K_t \right] \leq \varepsilon_t
  \]

- CAPM – price of risk equal to marginal cost of bearing risk:
  \[
  \frac{\pi_t^k}{\sigma_t^k} = \frac{\pi_t^h}{\sigma_t^h} = m \left( \alpha_t^k \sigma_t^k + \alpha_t^h \sigma_t^h \right)
  \]
Without frictions asset prices and Sharpe ratios are constant:

\[
\frac{\pi^k}{\sigma^k} = \frac{\pi^h}{\sigma^h} = \frac{m}{1 - \lambda} \left( \frac{q}{q + p} \sigma^k + \frac{p}{q + p} \sigma^h \right)
\]

With frictions if \( \varepsilon_t \gg (1 - \lambda)W_t \) we get a similar result.

If \( \varepsilon_t < (1 - \lambda)W_t \) constraint binds, less equity financing and more leverage – expected returns must rise to compensate intermediaries for increased risk – asset prices fall and Sharpe ratios rise.

GE feedback – drop in asset prices implies lower intermediary net worth and further increase in Sharpe ratios.
Real effects:

- Investment falls – q-theory.
- $Y = AK$ so consumption increases.
- Land in fixed supply so land prices much more volatile than $q$.
Results:

- Calibration chosen to fit unconditional moments
- Model does well at explaining conditional moments – Sharpe ratios increase and investment falls when EBP is high.
  - Occasionally binding constraint implies non-linear dynamics owing to endogenous leverage – fear of a “sudden stop”.
- Financial crisis – 15% exogenous decline in capital leads to 70% drop in intermediary net worth and land prices.
Policy implications:

- Hidden leverage is bad.
- Stress tests must take GE effect into account.
- Macroprudential policy – \( m, \lambda, r \)?
Financial accelerator model with risk shock.

- Calibrate key parameters including strength of financial friction to fit impulse response of \([Y,C,I,\pi]\) to GZ excess bond premium obtained from VAR estimated with pre-crisis data.

Assess model’s ability to account for financial crisis.

Consider stabilization benefits of spread-augmented “robust rule” a la Orphanides-Williams:

\[
i_t = \rho i_{t-1} + (1 - \rho) [1.87\pi_t + 1.12\Delta y_t - 0.5s_t]
\]
**Financial Bond Premium (FBP)**

(Jan 1985–Dec 2010)

![Chart showing the Financial Bond Premium (FBP) from January 1985 to December 2010. The chart illustrates monthly percentage points over time, with shaded areas indicating significant periods.](chart.png)
MODEL RESPONSE TO A FINANCIAL SHOCK
Baseline vs. Spread-Augmented Monetary Policy Rule

NOTE: In deviations from the steady state.
**MODEL RESPONSE TO A FINANCIAL SHOCK**

**Baseline vs. Spread-Augmented Monetary Policy Rule**

**Prices**
- Baseline vs. Spread-augmented

**Net worth**

**Credit spread**

**Nominal interest rate**

**NOTE:** In deviations from the steady state.
MODEL SIMULATIONS VS. ACTUAL DATA

Real GDP

NOTE: All variables have been demeaned.
Model Simulations vs. Actual Data

Inflation

Quarterly

Actual
Baseline
Spread-augmented

Percentage points

NOTE: All variables have been demeaned.
Policy alternatives

- Inflation targeting:

\[ i_t = (1 - \rho)10[1.87\pi_t] + \rho i_{t-1} \]

- Output level (gap) rule

\[ i_t = (1 - \rho)[1.87\pi_t + 1.12y_t] + \rho i_{t-1} \]

- Spread augmented (Taylor: coefficient =1):

\[ i_t = (1 - \rho)[1.87\pi_t + 1.12\Delta y_t - s(t)] + \rho i_{t-1} \]
Monetary policy implications

- **Linear model:**
  - Augmenting “robust” output growth rules with financial variable (spread, leverage) substantially improves outcomes.
  - Rules with strong response to output gap also do very well – but what is output gap after financial crisis?

- **Non-linear model – volatility paradox comes into play:**
  - Stabilization policy will lead to higher leverage and increased probability of a crisis.
  - Need separate macro-prudential policy to limit leverage.

- **Commitment to an effective rule is very powerful in models where financial friction depends on asset prices – a promise to react mitigates the need to react.**