Borrowing Cost of US firms

- Interest rate at which US firms borrow has two features: (i) countercyclical; (ii) an inverted leading indicator: low rate forecasts future booms.
- Feature (ii) is a long-standing puzzle (King-Watson, 1996).
- 1-sector RBC model at odds with (i) and (ii);

Proposition (Analytical Global Sunspot Equilibria)

There exist global sunspot equilibria such that the dynamics of the land stock allocated to borrower follows

\[ L_{t+1} = [1 + Q(1 - \beta R_t)]L_t \]

for all \( t \geq 0 \), given \( L_0 > 0 \), where \( Q = \beta/(1 - \beta) \), \( R_t = \beta^{-1}(1 + \varepsilon_t) \) and sunspot innovation \( \varepsilon_t \) is an i.i.d. random variable with zero mean.

Variable v.s. Predetermined-rate

- In the variable-rate economy, the real interest \( R_{t+1} \) applied to period \( t \) loan \( B_{t+1}^t \) will be realized in period \( t + 1 \).
- In the predeterninated-rate economy the rate applied to \( B_{t+1}^t \) is \( R_t \), predetermined and known in \( t \).

Intuition for Indeterminacy with Variable-rate

- Under variable interest rate, credit demand and supply are: \( B_{t+1}^t = \beta Q L_{t+1} \), \( B^l_{t+1} = Q \beta L_t - \beta' X_t L_t \), where \( X_t \equiv 1 + Q(1 - \beta R_t) \).

- Bottom line: sunspot equilibria under variable interest rate because of aggregate credit-demand externality.
- Pecuniary externality does not generate sunspot equilibria.

A Model with Analytical Solution

- A risk-neutral representative lender consumes non-nondurable goods \( C_t \) and durable land \( L_t \)

\[
\max \{C_t, L_{t+1}, B^t_{t+1}\} \quad \mathbb{E} \sum_{t=0}^{\infty} \frac{1}{(1 + \delta)^t} \beta^t \{C_t + \psi L_t\}
\]

s.t. \( C_t + Q(L_{t+1} - L_t) + B^t_{t+1} \leq R_t B^l_t \)

- A representative producer faces linear technology

\[ Y_t = L_t \] and borrowing constraint:

\[
\max \{C_t, L_{t+1}, B^t_{t+1}\} \quad \mathbb{E} \sum_{t=0}^{\infty} \frac{1}{(1 + \delta)^t} \beta^t \log C_t
\]

s.t. \( C_t + Q(L_{t+1} - L_t) + R_t B^l_t \leq B^t_{t+1} + L_t \)

\[ \mathbb{E} \theta\varepsilon_t Q_{t+1} L_{t+1} \leq \theta \mathbb{E} Q_{t+1} L_{t+1} \]

A Quantitative Model

- We introduce variable-rate loans in Liu-Wang-Zha (2013), a model with additional features on top of Pintus-Wen (2013): consumption habits, investment adjustment costs, productivity growth.

- Shocks:
  - discount rate, land demand, labor supply;
  - production technology (transitory and permanent);
  - investment technology (transitory and permanent);
  - collateral (leverage).

- Indeterminacy arises if the fraction of variable-rate loans in the economy \( \omega \) is higher than 0.5 (the same rule as in the simple analytical solution).

Bayesian Estimation Strategy

- Estimate the model in both the deterministic regime with \( \omega \leq 0.5 \) and the indeterminate regime with \( \omega > 0.5 \).

Estimation Results

- In the deterministic regime, data pushes towards the highest possible value for \( \omega \) (that is, 0.5);
- The indeterminate model dominates the deterministic model in terms of model fit;
- The indeterminate model with sunspot shocks on investment (“animal spirits”) fits the data best (the highest log marg. data density);
- Explains significant share of volatility for output, investment, labor hours, credit (variance decomposition).

What We Do

Show that a Kyriakos-Moore model accounts for (i) and (ii), with the key assumption: loan contract with variable interest rate, which is prevalent in practice (Vickery, 2008).