Asset Purchases in a Monetary Union with Default and Liquidity Risks

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Motivation

- Financial market fragmentation can impair the transmission of monetary policy [Schnabel (May 2023) and others].
- ECB has asset purchase programs to address market fragmentation driven by default and liquidity risks, i.e. OMT and TPI.
- How do default risks, when interacted with liquidity risks, impact the economy, and how useful are asset purchases to counter them?
  - We build a two-country monetary-union model with both risks.
  - Deterioration in macro fundamentals $\rightarrow$ default risks $\uparrow$ $\rightarrow$ liquidity risks $\uparrow$.

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  - We build a two-country monetary-union model with both risks.
  - Deterioration in macro fundamentals $\rightarrow$ default risks $\uparrow$ $\rightarrow$ liquidity risks $\uparrow$.
- Findings:
  - Both risks dampen economic conditions following an increase in government debt.
  - The magnifying effect from liquidity risks is far more consequential, making asset purchases markedly more effective in the presence of liquidity risks.

Two-Country Model

Model Overview

Home country:

- Government sets taxes and public expenditures and can issue bonds.
  - Default risks: follow an endogenous regime switching process [Bi and Traum (2012)].
- Financial intermediaries [Gertler and Karadi (2011)]:
  - Channel funds from households to Home government and firms.
  - Liquidity risks: tightness of incentive constraint can vary with default probability.

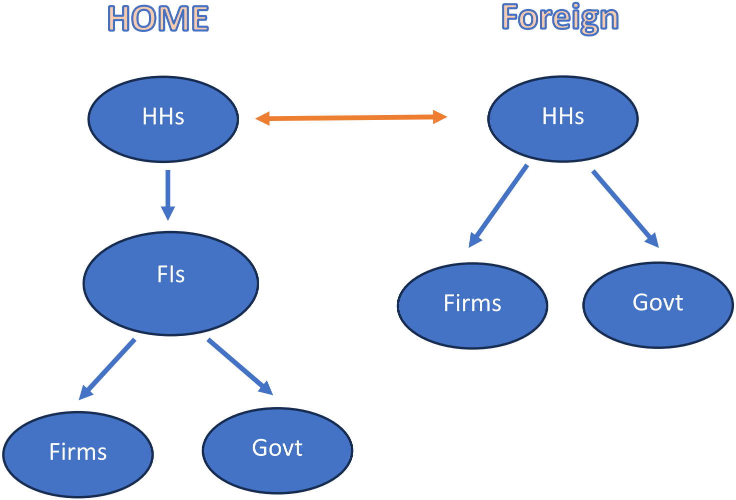
Foreign country:

- Abstract from segmented financial market (no financial intermediaries, no default/liquidity risk).

Union-wide monetary policy:

- Follow Taylor rule and can purchase government bonds.

Model Overview



Home Government

- Budget constraint:

$$\rho_{H,t} g + (1 - \Delta_t)(1 + \kappa^b Q_t^b) \frac{b_{t-1}}{\pi_t} = Q_t^b b_t + t_t + \tau^i p_t^w y_t + \tau^c c_t$$

- Lump-sum tax follows fiscal rule:

$$\frac{t_t - t}{t} = \phi_t \frac{Q_{t-1}^b b_{t-1} - Q^b b}{Q^b b}$$

- Government may default on bonds by taking a haircut δ_b:

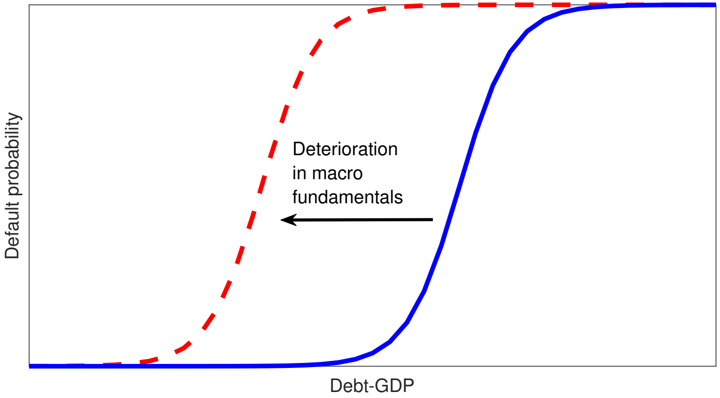
$$\Delta_t = \begin{cases} \delta_b, & \text{if default} \\ 0, & \text{otherwise} \end{cases}$$

  - Default probability follows a logistic function of debt-GDP ratio s_t and macroeconomic shocks o_t:

$$\Pr(def_t = 1 | o_{t-1}, s_{t-1}) = \frac{\exp(\eta^0 + \eta^1 o_{t-1} + \eta^2 s_{t-1})}{1 + \exp(\eta^0 + \eta^1 o_{t-1} + \eta^2 s_{t-1})}$$

Default Risks

- Default probability increases with debt-GDP ratio.
- Deterioration in macro fundamentals also shifts the distribution of fiscal limits.



Home Firms and Households

- Wholesale firms:
  - Issue long-term private bonds to finance private investment with a loan-in-advance constraint [Sims and Wu (2021)].

$$\eta^I p_t^k I_t^w \leq Q_t^f \left(f_t - \kappa^f \frac{f_{t-1}}{\pi_t} \right)$$

$$K_t = I_t^w + (1-\delta) K_{t-1}$$

  - Produce output using labor and private capital.
- Home investment producers:
  - Assemble investment with adjustment costs.
- Households:
  - Hold deposits at financial intermediary as well as hold one-period cross-region bond.

Details

Financial Intermediary

- Balance sheet [Gertler and Karadi (2011)]:
  - Collect deposits and purchase government & private bonds.

$$Q_t^b b_t^j + Q_t^f f_t^j = d_t^j + n_t^j$$

  - Net worth depends on realized returns on holding bonds, $R_t^b = (1 - \Delta_t) \frac{1+\kappa^b Q_t^b}{Q_{t-1}^b}$, $R_t^f = \frac{1+\kappa^f Q_t^f}{Q_{t-1}^f}$.

- Maximize expected net worth with a survival rate of σ:

$$\begin{aligned} \max \quad & V_t^j = E_t \Lambda_{t,t+1} \left((1-\sigma) n_{t+1}^j + \sigma V_{t+1}^j \right) \\ s.t. \quad & V_t^j \geq \eta_t^v (Q_t^f f_t^j + Q_t^b b_t^j) \end{aligned}$$

  - Liquidity channel: η_t^v can vary with default risks [Bocola (2016)].

$$\eta_t^v = \bar{\eta}^v \left[1 + \phi_\eta \Pr\left(def_t = 1 | o_{t-1}, s_{t-1} \right) \right]$$

- The first-order conditions for bonds:

$$E_t \underbrace{\Lambda_{t,t+1} \Omega_t}_{\text{lev. adj. discount}} \frac{R_{t+1}^i - R_t^d}{\pi_{t+1}} = \frac{\lambda_t^v}{1+\lambda_t^v} \eta_t^v \qquad (i = f, b)$$

Details

The Rest of the Model

- Foreign economy:
  - Abstract from segmented financial market: no financial intermediaries, no default/liquidity risks.
  - Households hold government bonds and invest in private firms directly.
- Monetary policy:
  - Union-wide Taylor rule.
  - Unconventional policy of asset purchases:

$$T_t^{cb} = R_t^b Q_{t-1}^b \frac{b_{t-1}^{b,cb}}{\pi_t} - Q_t^b b_t^{b,cb}$$

When utilized, asset purchased determined by the rule:

$$b_t^{cb} = b^{cb} + \phi_{cb} \left(\ln \underbrace{R_t^{spread}}_{E_t R_{t+1}^b - R_t^d} - \ln R^{spread} \right)$$

Solution Method

- Use perturbation approach for solving endogenous regime-switching models [Benigno, Foerster, Otrok & Rebucci (2020)].
- Default regimes:
  - If default, $def_t = 1$; otherwise, $def_t = 0$.

$$\Pr\left(def_t = 1 | o_{t-1}, s_{t-1}\right) = \frac{\exp(\eta^0 + \eta^1 o_{t-1} + \eta^2 s_{t-1})}{1 + \exp(\eta^0 + \eta^1 o_{t-1} + \eta^2 s_{t-1})}$$

- Liquidity channel:
  - The time-varying liquidity constraint depends on default probability:

$$\eta_t^v = \bar{\eta^v}\left[1 + \phi_\eta \Pr\left(def_t = 1 | o_{t-1}, s_{t-1}\right)\right]$$

Results

Analysis

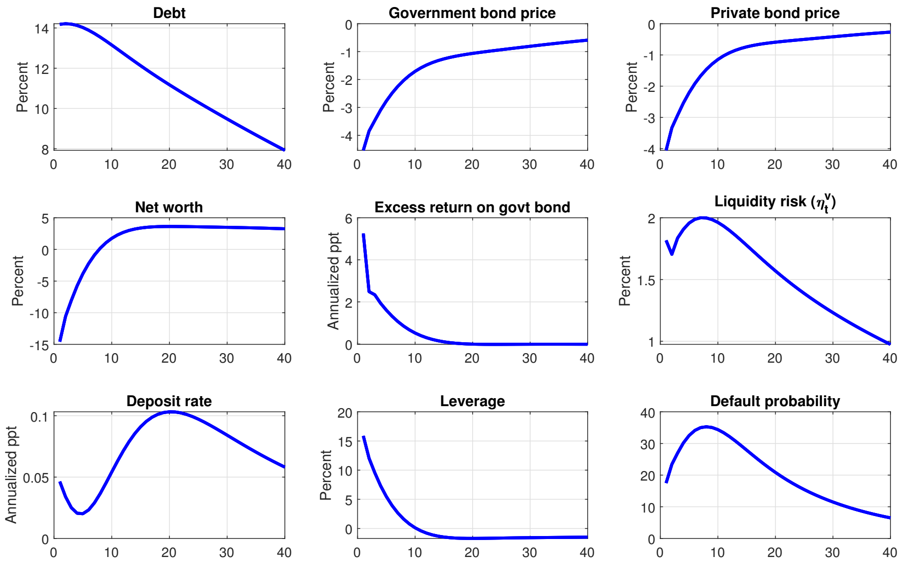
Questions:

- How do default risks, when interacted with liquidity risks, impact the economy?
- How does each channel (default vs. liquidity) contribute?
- How effective are asset purchases?

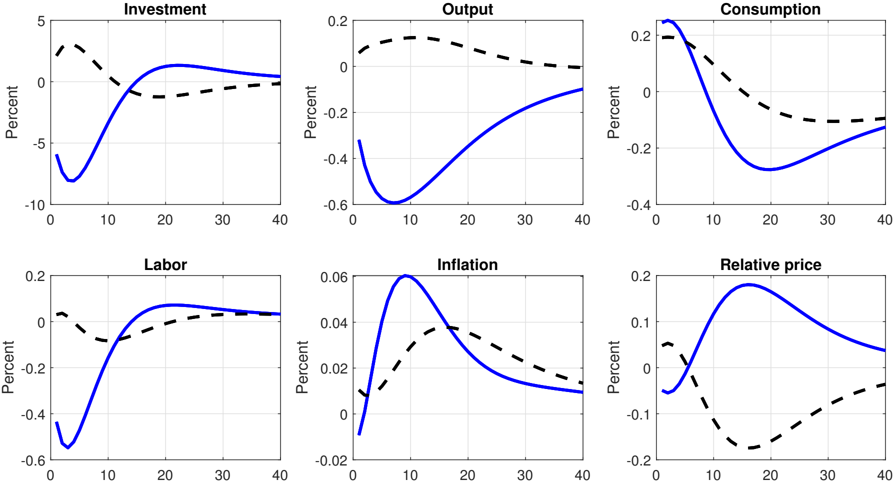
Scenarios:

1. Consider a simpler case with an increase in home government debt.
2. Consider a negative demand shock to home economy.

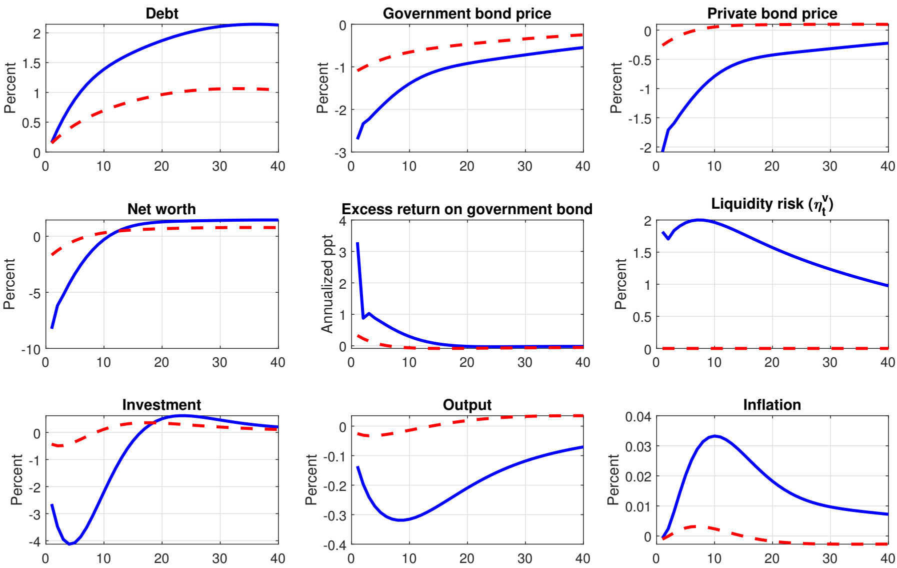
Simpler Case: Home Country



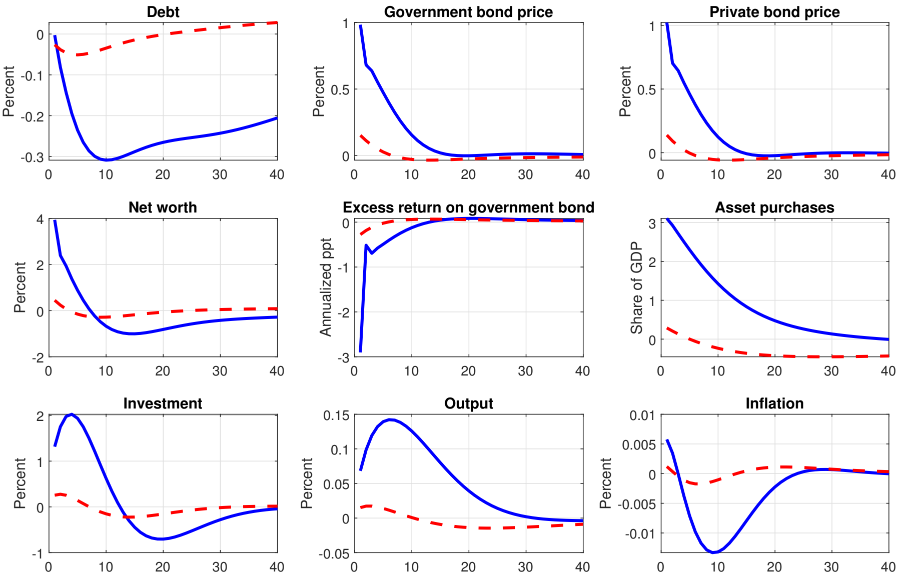
Simpler Case: Home vs. Foreign



Impact from Default vs. Both Channels



Asset Purchases with Default vs. Both Channels



Analysis

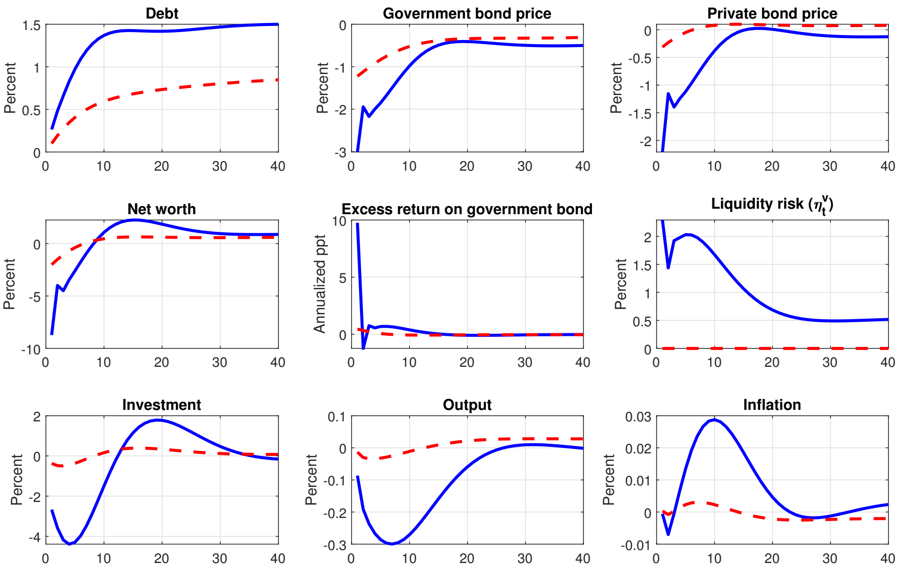
The simpler case with an increase in home government debt:

- Both default and liquidity risks dampen economic conditions.
- The impact from liquidity risks is far more consequential, thus asset purchases are more effective in this case.

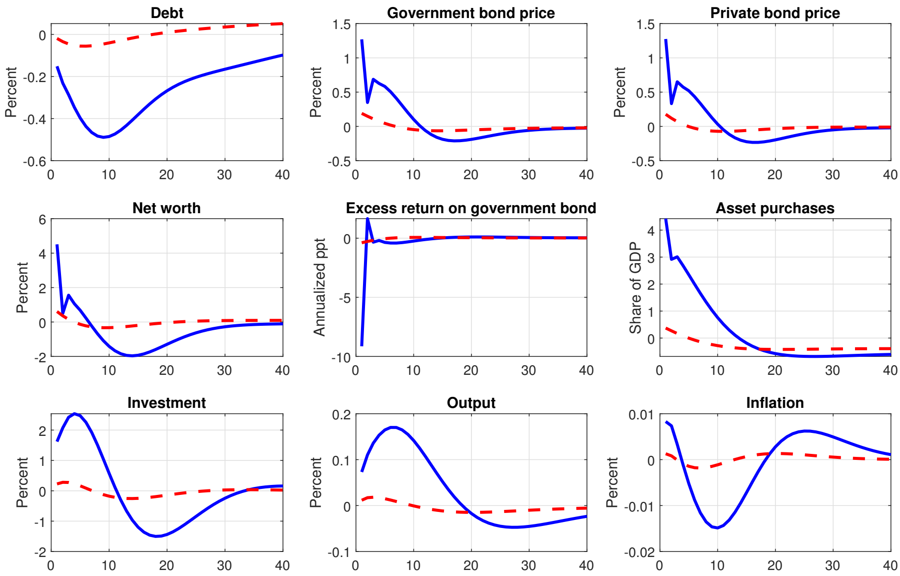
Now consider a negative demand shock to home country:

- A negative investment efficiency shock
  $\rightarrow$ deterioration in economic conditions
  $\rightarrow$ increase government debt & shift the distribution of fiscal limits lower.

Negative Demand Case: Default vs. Both Channels



Asset Purchases with Default vs. Both Channels

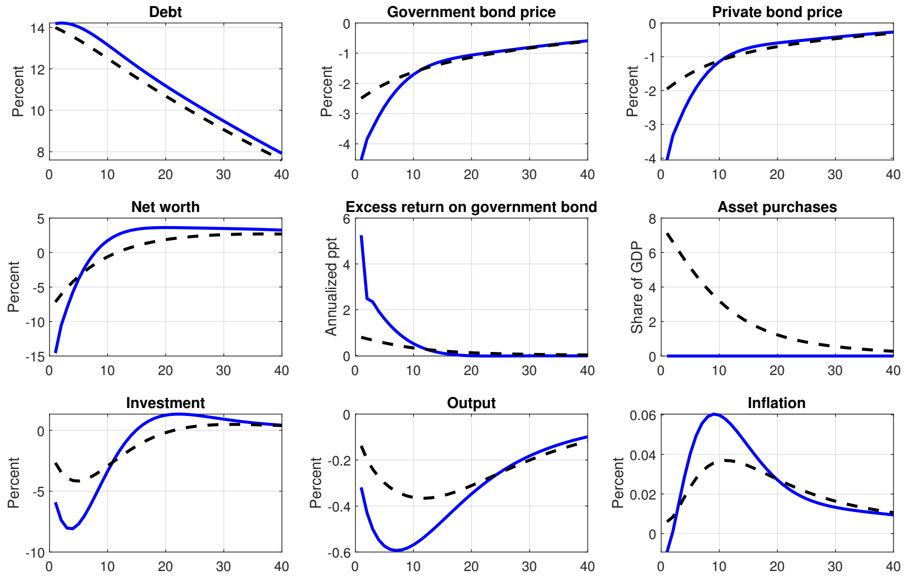


Conclusion

- While both risks dampen economic conditions, the magnifying effect from liquidity risks appears far more consequential.
- Asset purchases are more effective in the presence of liquidity risks.
- Next step:
  - Introduce financial intermediary to the foreign country block, and explore the cross-country spillover through the financial channel.
  - Question: How would a union-wide liquidity shock affect countries with weak macro fundamentals?

Appendix

Simpler Case: Baseline vs. Asset Purchases



Households

- Consumption c_t aggregates Home and Foreign consumption sub-baskets, $c_{H,t}$ and $c_{F,t}$, in Armington form:

$$c_t = \left[\alpha_H^{\frac{1}{\phi}} \left(c_{H,t} \right)^{\frac{\phi-1}{\phi}} + \left(1 - \alpha_H \right)^{\frac{1}{\phi}} \left(c_{F,t} \right)^{\frac{\phi-1}{\phi}} \right]^{\frac{\phi}{\phi-1}}$$

- Budget constraint:

$$d_t + z_t + c_t \left(1 + \tau^c \right) = \frac{R^d_{t-1} d_{t-1}}{\pi_t} + \frac{R^d_{t-1} z_{t-1}}{\pi_t} + w_t l_t + \Pi^f_t + div_t - x - t_t + T^{cb}_t$$

- Endogenous discount factor ensures stationarity [Uzawa (1968); Schmitt-Grohe and Uribe (2003)]

Back

Wholesale Firms

- Issue long-term private bonds to finance private investment with loan-in-advance constraint [Sims and Wu (2021)]

$$(\zeta_t^1) \qquad K_t = I_t^w + (1-\delta)K_{t-1}$$

$$(\zeta_t^2) \qquad Q_t^f\left(f_t - \kappa^f \frac{f_{t-1}}{\pi_t}\right) \geq \eta^I p_t^k I_t^w$$

- Produce output using labor and private capital

$$y_t^w = A_t l_t^{1-\alpha} K_{t-1}^{\alpha}$$

- Optimal conditions:

$$\begin{aligned}
\zeta_t^1 &= p_t^k(1+\eta^I\zeta_t^2) \\
Q_t^f(1+\zeta_t^2) &= \beta E_t \Lambda_{t+1} \frac{1}{\pi_{t+1}}\left(1+\kappa^f Q_{t+1}^f(1+\zeta_{t+1}^2)\right) \\
\zeta_t^1 &= \beta E_t \Lambda_{t+1}\left(\frac{p_{t+1}^w \alpha y_{t+1}}{K_t}(1-\tau_{t+1}^i) + (1-\delta)\zeta_{t+1}^1\right)
\end{aligned}$$

Financial Intermediary

- Balance sheet [Gertler and Karadi (2011)]:
  - Collect deposits from households and accumulate net worth.
  - Purchase government bonds as well as corporate bonds.

$$Q_t^b b_t^j + Q_t^f f_t^j = d_t^j + n_t^j$$

$$n_t^j = \frac{R_{t-1}^d n_{t-1}}{\pi_t} + \left(R_t^b - R_{t-1}^d\right) \frac{Q_{t-1}^b b_{t-1}^j}{\pi_t} + \left(R_t^f - R_{t-1}^d\right) \frac{Q_{t-1}^f f_{t-1}^j}{\pi_t}.$$

  - Realized returns on holding bonds:

$$R_t^b = (1 - \Delta_t) \frac{1 + \kappa^b Q_t^b}{Q_{t-1}^b}, \quad R_t^f = \frac{1 + \kappa^f Q_t^f}{Q_{t-1}^f}.$$

Financial Intermediary

The first-order conditions are,

$$E_t\beta(c_t)\Lambda_{t,t+1}\Omega_{t+1}\frac{R^f_{t+1}-R^d_t}{\pi_{t+1}} = \frac{\lambda^v_t}{1+\lambda^v_t}\eta^v$$

$$E_t\beta(c_t)\Lambda_{t,t+1}\Omega_{t+1}\frac{R^b_{t+1}-R^d_t}{\pi_{t+1}} = \frac{\lambda^v_t}{1+\lambda^v_t}\eta^v$$

$$E_t\beta(c_t)\Lambda_{t,t+1}\frac{\Omega_{t+1}}{\pi_{t+1}}R^d_t = \frac{\phi_t}{1+\lambda^v_t}\eta^v$$

- λ^v_t measures the tightness of the costly enforcement constraint.
- $E_t R^b_{t+1} - R^d_t$: excess returns
- $\phi_t = \frac{Q^f_t f_t + Q^b_t b^i_t}{n_t}$: leverage ratio
- $\Omega_t = 1-\sigma+\sigma\eta^v_t\phi_t$

Back