

Asset Purchases in a Monetary Union with Default and Liquidity Risks

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The views expressed in this paper are those of the authors and not of the Federal Reserve Bank of Kansas City or San Francisco, or the Federal Reserve System.

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.

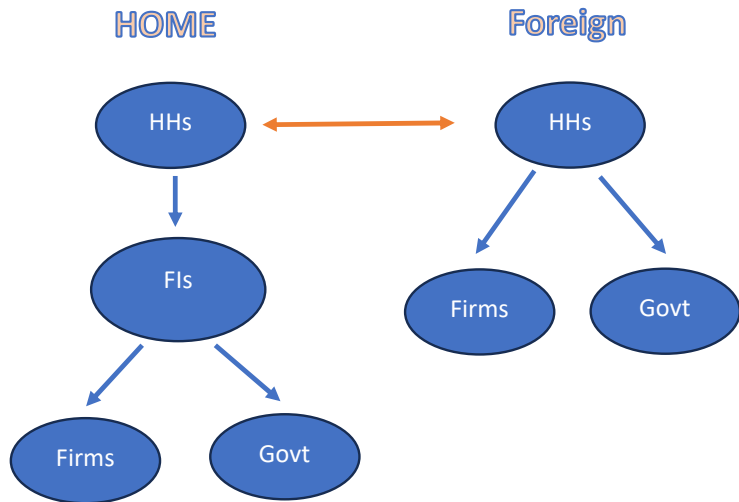
Foreign country:

- ▶ 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 :

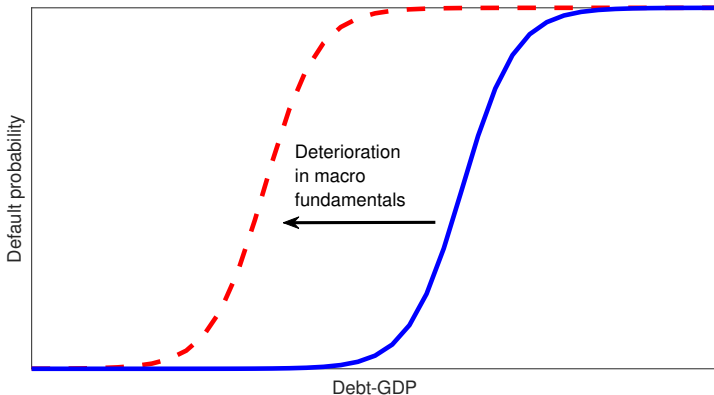
$$\Delta_t = \begin{cases} \delta_b, & \text{if default} \\ 0, & \text{otherwise} \end{cases}$$

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

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

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)].

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

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

- ▶ 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.

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, $def_t = 0$.

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

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

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

Results

Analysis

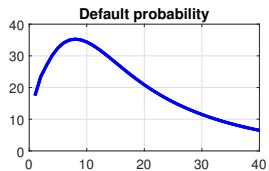
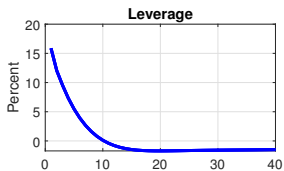
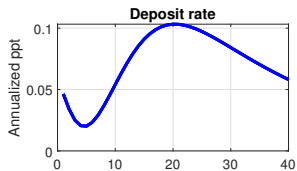
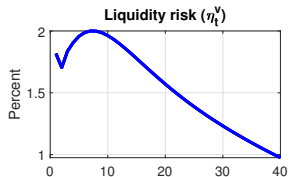
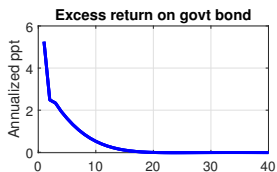
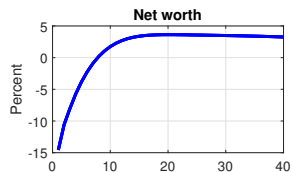
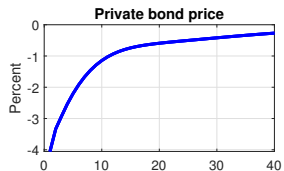
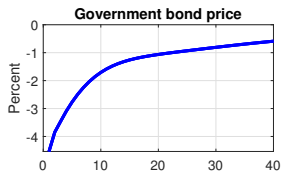
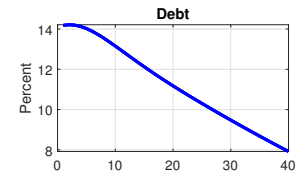
Questions:

- ▶ 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?

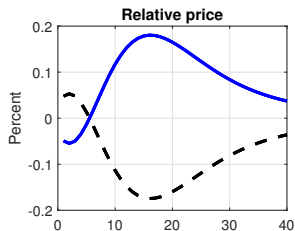
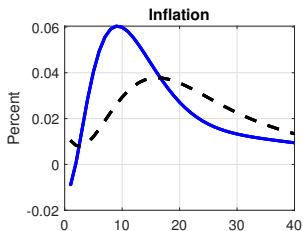
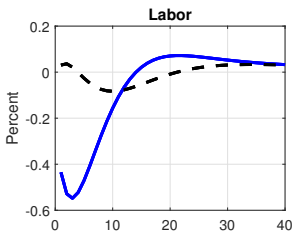
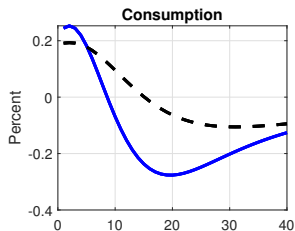
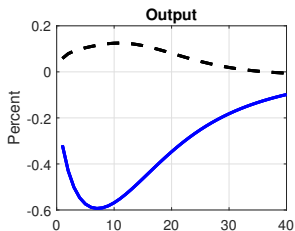
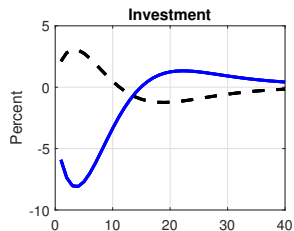
Scenarios:

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

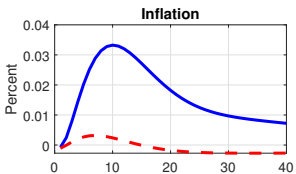
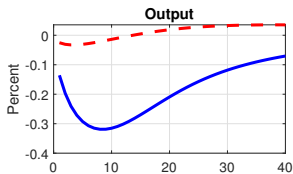
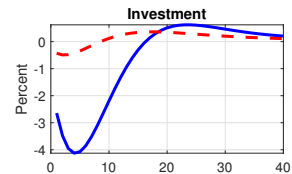
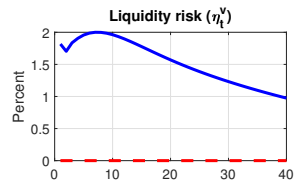
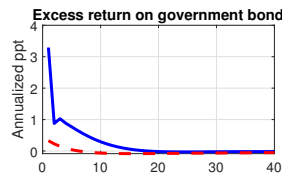
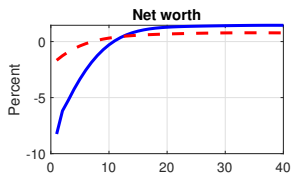
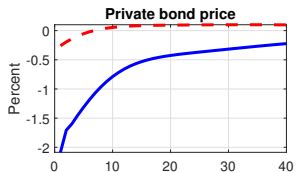
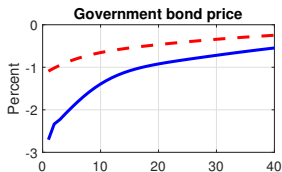
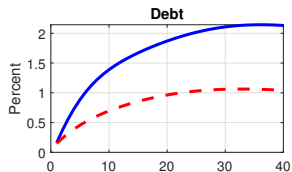
Simpler Case: Home Country



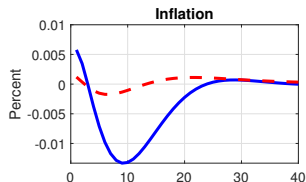
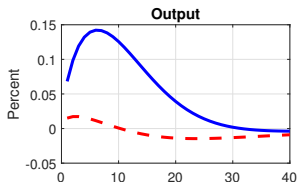
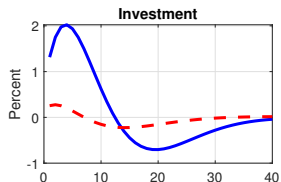
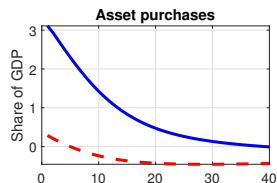
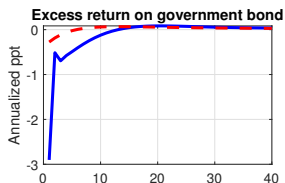
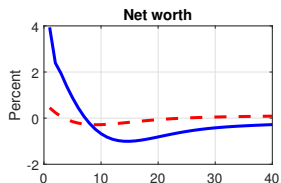
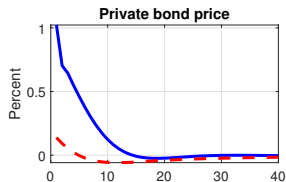
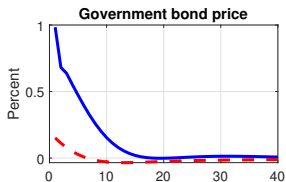
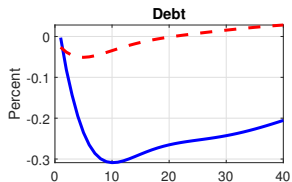
Simpler Case: Home vs. Foreign



Impact from **Default** vs. **Both** Channels



Asset Purchases with **Default** vs. **Both** Channels



Analysis

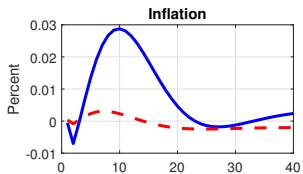
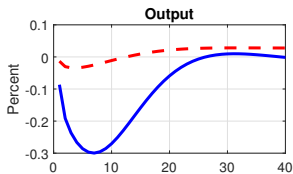
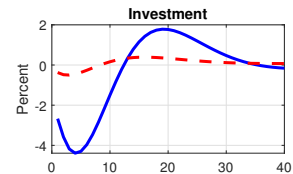
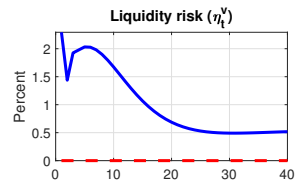
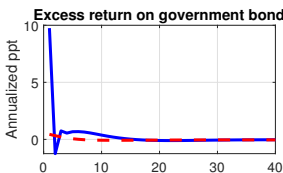
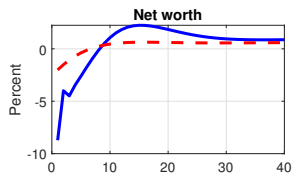
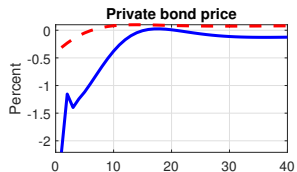
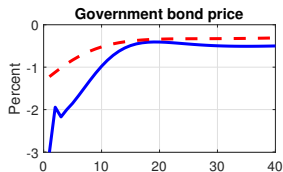
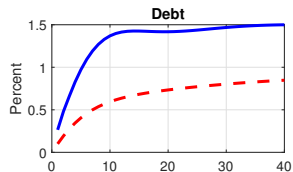
The simpler case with an increase in home government debt:

- ▶ 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.

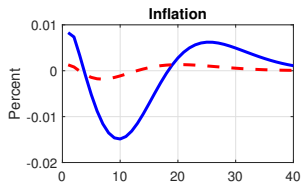
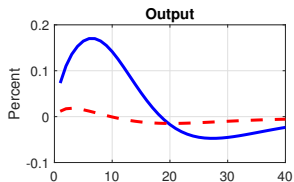
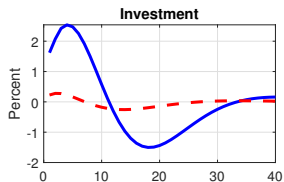
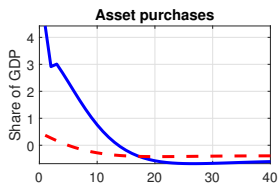
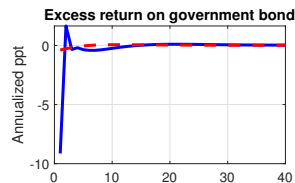
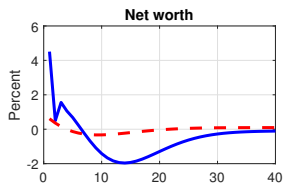
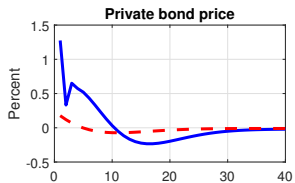
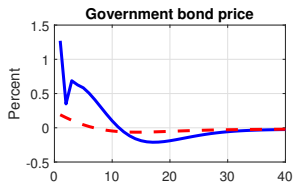
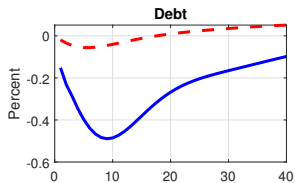
Now consider a negative demand shock to home country:

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

Negative Demand Case: **Default** vs. **Both Channels**



Asset Purchases with **Default** vs. **Both** Channels

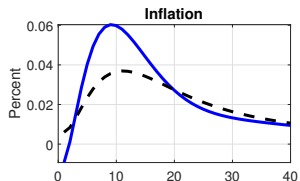
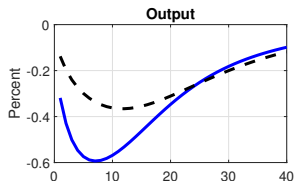
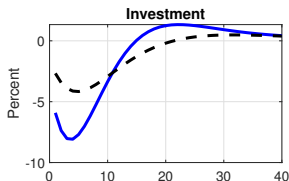
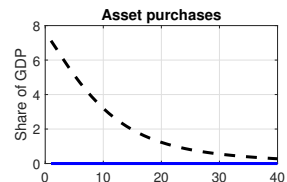
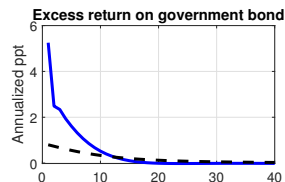
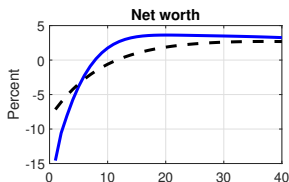
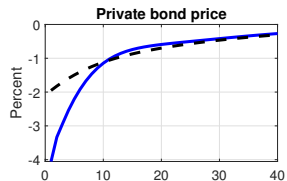
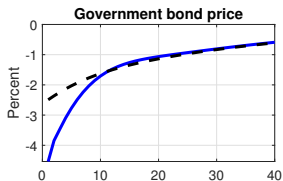
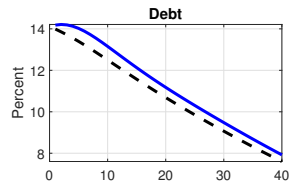


Conclusion

- ▶ 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:

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

- ▶ Budget constraint:

$$d_t + z_t + c_t (1 + \tau^c) = \frac{R_{t-1}^d d_{t-1}}{\pi_t} + \frac{R_{t-1}^z z_{t-1}}{\pi_t} + w_t l_t + \Pi_t^f + div_t - x - t_t + T_t^{cb}$$

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

Wholesale Firms

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

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

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

- ▶ Produce output using labor and private capital

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

- ▶ Optimal conditions:

$$\zeta_t^1 = p_t^k (1 + \eta^l \zeta_t^2)$$

$$Q_t^f (1 + \zeta_t^2) = \beta E_t \Lambda_{t+1} \frac{1}{\pi_{t+1}} \left(1 + \kappa^f Q_{t+1}^f (1 + \zeta_{t+1}^2) \right)$$

$$\zeta_t^1 = \beta E_t \Lambda_{t+1} \left(\frac{p_{t+1}^w \alpha y_{t+1}}{K_t} (1 - \tau_{t+1}^i) + (1 - \delta) \zeta_{t+1}^1 \right)$$

Financial Intermediary

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

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

- ▶ 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,

$$E_t \beta(c_t) \Lambda_{t,t+1} \Omega_{t+1} \frac{R_{t+1}^f - R_t^d}{\pi_{t+1}} = \frac{\lambda_t^v}{1 + \lambda_t^v} \eta^v$$

$$E_t \beta(c_t) \Lambda_{t,t+1} \Omega_{t+1} \frac{R_{t+1}^b - R_t^d}{\pi_{t+1}} = \frac{\lambda_t^v}{1 + \lambda_t^v} \eta^v$$

$$E_t \beta(c_t) \Lambda_{t,t+1} \frac{\Omega_{t+1}}{\pi_{t+1}} R_t^d = \frac{\phi_t}{1 + \lambda_t^v} \eta^v$$

- ▶ λ_t^v measures the tightness of the costly enforcement constraint.
- ▶ $E_t R_{t+1}^b - R_t^d$: excess returns
- ▶ $\phi_t = \frac{Q_t^f f_t + Q_t^b b_t^j}{n_t}$: leverage ratio
- ▶ $\Omega_t = 1 - \sigma + \sigma \eta_t^v \phi_t$