

Macro assets

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Proxy for real value of generic assets

Real value of generic assets fwy_t

$$fwy_t = fwy_t^{\text{fund}} \cdot fwy_t^{\text{bubble}}$$

where

- fwy_t^{fund} is the fundamental value (based on the "correct" present value of future cash flows)
- fwy_t^{bubble} is a "bubble", i.e. a persistent deviation of the observed (market) value from its fundamental value

Fundamental macro-based real value of assets

The value of existing assets is proportional to the (hypothetical) present value of claims on future real economic activity (i.e. a discounted sum of future GDP).

The discount factor depends on the hypothetical (unobservable) level of lending rates that would cover all lending costs and (expected) risks

$$fwy_t = (1 - \delta_{ss}) \mathbb{E}_t \left[y_t + \delta_{t,t+1} \cdot \frac{y_{t+1}}{y_{ss}^{roc}} + \delta_{t,t+1} \cdot \delta_{t+1,t+2} \cdot \frac{y_{t+2}}{y_{ss}^{roc\ 2}} + \dots \right]$$

with the discount factor between t and $t + 1$ defined as

$$\delta_{t,t+1} \equiv \frac{1}{1 + c_0 + c_1 \cdot r_t^{cond}}$$

where

- $\delta_{ss} \equiv \frac{1}{1+c_0}$ is the steady-state discount factor
- y_{ss}^{roc} is the steady-state (gross) rate of growth in real output

Technical corrections for steady state

For analytical and calibration convenience, we want

$$fwy_{ss} = y_{ss}$$

To achieve this, we make two types of technical corrections

$$fwy_t = \boxed{(1 - \delta_{ss})} E_t \left[y_t + \delta_{t,t+1} \cdot \frac{y_{t+1}}{\boxed{y_{ss}^{roc}}} + \delta_{t,t+1} \cdot \delta_{t+1,t+2} \cdot \frac{y_{t+2}}{\boxed{y_{ss}^{roc \ 2}}} + \dots \right]$$

Recursive representation of the present value

The model specification cannot handle infinite forward sums. The fundamental value of assets needs to be rewritten into forward recursive form

$$fwy_t = (1 - \delta_{ss}) E_t \left[y_t + \delta_{t,t+1} \cdot \frac{fwy_{t+1}}{y_{ss}^{roc}} \right]$$

Asset price bubble

A bubble is a persistent (autocorrelated) deviation of the observed (market) value of assets from the fundamental value

$$\log fwy_t^{\text{bubble}} = c_0 \log fwy_{t-1}^{\text{bubble}} + \varepsilon_t$$

In the long run, we assume that the value of assets is consistent with their fundamental value, and bubble does not exist

$$fwy_{ss} = fwy_{ss}^{\text{fund}}$$

$$fwy_{ss}^{\text{bubble}} = 1$$