

# Stock price booms from technology news in a heterogeneous agent model with portfolio choice

Maximilian Weiß

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# Stock price cycles

- ▶ Why are high stock prices followed by low returns on stocks? (“boom-bust cycle”)
- ▶ Why do stock prices often co-move with the business cycle (especially investment)?

I offer a new explanation that hinges on

- ▶ illiquid capital
- ▶ liquid stocks
- ▶ news about future productivity boost

Upshot:

- ▶ instead of time-varying *aggregate* risk, time-varying *idiosyncratic* risk of households moves the stock price
- ▶ This arises *endogenously* through portfolio choice and can be *tested in the data*

## News → portfolio choice → boom

- ▶ Two asset classes: liquid and illiquid ( $\sim$  “capital”)  
→ empirical categorization: Kaplan et al. (2014)
- ▶ In the model, only capital is productive, i.e. its accumulation directly increases output
- ▶ Both assets yield (gross) returns:  $R^L$  liquid,  $R^k$  capital return
- ▶ Households face idiosyncratic income risk → hold illiquid capital at a premium, i.e.  $R^k > R^L$  (*Liquidity premium*)

News:  $\mathbb{E}_t R_T^k \uparrow$ , consequence:

- ▶ wealthy households increase their consumption risk by holding more illiquid capital until  $T$  (in “anticipation phase”)
- ▶ higher investment increases output → higher income → business cycle boom
- ▶ growing income lowers stochastic discount factor → return on liquid assets rises → stock price boom

# Illiquid portfolios & falling incomes → low returns & bust

## Endogenous risk-increase

- ▶ Households with *high share of capital income* of total income respond most to the news, reducing liquid asset holdings
- ▶ Some become “wealthy hand-to-mouth” (Kaplan et al., 2014) in that process

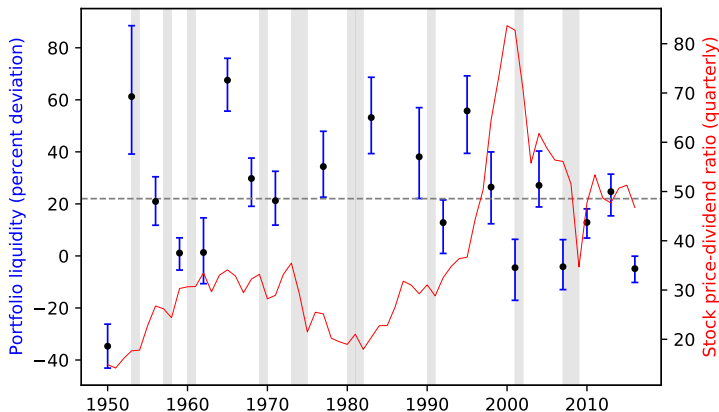
## Transitory productivity boost

- ▶ News is about transitory acceleration of productivity growth, or transitory capital share increase
- ▶ Causes high capital returns that fall back to steady state

## Marginal savers

- ▶ households with incomes dominated by capital income face steepest expected income decline
- ▶ for *self-insurance*, these households demand more liquid assets
- ▶ the return on liquid assets falls → stock prices fall

# Evidence from survey of consumer finances



*Portfolio liquidity:* ratio of portfolio liquidity of households with high capital income share ( $> 75\%$ ) by portfolio liquidity of top 10%. Data: SCF+ (Kuhn et al., 2020)  
*Stock market:* S&P 500 data by Robert Shiller. *Whiskers:* 68% CIs

Portfolio liquidity of marginal savers falls in booms, rises in busts

# Relations to literature

## ► Finance

Microfoundation for “discount rate risk”. Alternative to time-varying risk-aversion/habits (Campbell and Cochrane, 1999), long-run risk/uncertainty (Bansal and Yaron, 2004). Consistent with time-varying equity term structure (Gormsen, 2021)

## ► Heterogeneous agents

Time-varying idiosyncratic risk amplifies cycle, as in Ravn and Sterk (2017). “Capitalists” price liquid asset return, as in Bilbiie (2020). New: idios. risk varies endogenously through portfolio choice, capital income decisive

## ► News literature

News about temporary productivity boost can drive business cycle. Portfolio choice as indicator for news? Boom coincides with growing real interest rate, different from standard New Keynesian demand shock (Christiano et al., 2010)

Two-asset structure

# Liquid asset, modelling of stocks I

## Definition:

- ▶ stock is claim to dividend  $d(A)$ ,  $d'(A) > 0$ , where  $A$  is TFP
- ▶ time-constant supply of stocks, traded at price  $q^\Pi$
- ▶ liquid asset return (ex-post):  $R_t^L = \frac{q_t^\Pi + d_t}{q_{t-1}^\Pi}$

## Household optimization:

- ▶ Euler equation for liquid asset:  $\mathbb{E}_{t-1} [SDF_{t,i} R_t^L] + \mu_{i,t}^L = 1$   
( $\mu_{i,t}^L > 0$  when household at borrowing constraint  $\underline{b}$ )
- ▶ define long-term return  $R_{t,T}^L := \frac{q_T^\Pi + d_T}{q_{t-1}^\Pi}$
- ▶ Intertemp. arbitrage:  $\mathbb{E}_{t-1} [\hat{R}_{t,T}^L] = -\mathbb{E}_{t-1} \left[ \sum_{k=t}^T \widehat{SDF}_{i,k} \right]$   
( $\hat{\cdot}$  denotes deviation from steady state)



## Liquid asset, modelling of stocks II

News  $\mathbb{E}_t[A_T] \uparrow$  increases expected long-term return  $R_{t,T}^L$

The increase is divided into two effects:

- ▶ lowers expected future SDFs of marginal savers
- ▶ increases ex-post return  $R_t^L$

Less effect on SDFs  $\rightarrow$  higher  $R_t^L$ , i.e. more *frontloading* of future dividend increase

Stock price boom is indicative of effect on future SDFs, namely, falling SDFs of *all* households (since  $\max_i\{SDF_i\}$  prices the asset)  
 $\Rightarrow$  rising incomes, i.e. a business cycle boom, generates the stock price boom

# Illiquid asset: capital I

## Definition:

- ▶ capital is claim to capital rent  $r(A)$ ,  $r'(A) > 0$
- ▶ can be produced subject to adjustment costs, trades at price  $q$
- ▶ households can adjust capital holdings each period with probability  $\lambda$

## Household optimization:

- ▶ Euler equation for capital:  
$$\mathbb{E}_{t-1} \left[ SDF_{i,t} \left( \frac{r_t}{q_{t-1}} + \lambda g_{i,t} \left( \frac{q_t}{q_{t-1}} \right) \right) \right] + \frac{\mu_{i,t}^k}{q_{t-1}} = 1$$
  
( $\mu_{i,t}^k > 0$  when household at borrowing constraint 0)
- ▶ Policy function  $g_{i,t}(\cdot)$  states to which degree household *realizes* capital returns
- ▶  $\lambda \cdot g'_{i,t} \ll 1$  inhibit intertemporal arbitrage

## Illiquid asset: capital II

News  $\mathbb{E}_t[A_T] \uparrow$  increases expected long-term return  $\frac{q_T + r_T}{q_{t-1}}$

It will not be frontloaded:

- ▶  $g'_{i,t}$  falls for  $t$  close to  $T$ , as households want to hold capital when rent  $r_T$  increases
- ▶ hence, intertemporal arbitrage even more inhibited

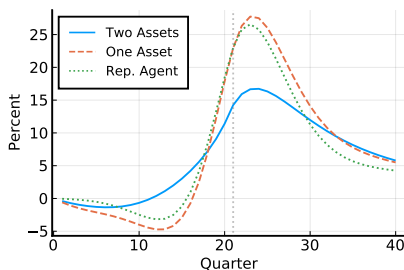
Instead, news is channeled into  $\mathbb{E}_t[R_T^k] \uparrow$ , where  $R_T^k = \frac{q_T + r_T}{q_{T-1}}$   
gross capital return

Taken together, good news about future productivity lowers the *liquidity premium*,  $R_t^k - R_t^L$ , in the anticipation phase,  $t < T$ .

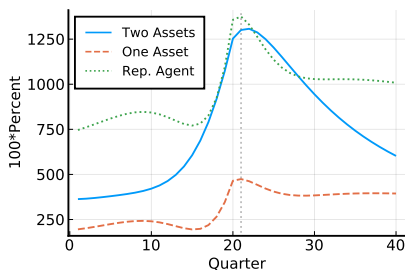
Responses in HANK model

# Stock price cycle from technology news

- ▶ Take estimated HANK-model from literature (Bayer et al., 2020)
- ▶ Shock: news about future higher capital share in production (alternatively: TFP), 5-year horizon
- ▶ Compare across model varieties: with liquid capital (*One Asset*), complete markets (*Rep. Agent*)

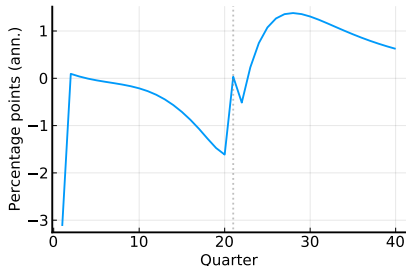


(a) Investment

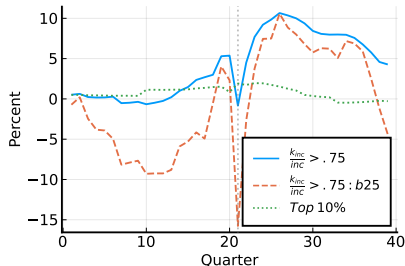


(b) Stock price

# Liquidity premium and marginal saver



(a) Liquidity premium  $R^K - R^L$



(b) Portfolio liquidity of top 10%  
(b25: lowest quartile of portf.-liqu. distr.)

*Portfolio liquidity*: share of liquid wealth over total wealth

- ▶ Heterogeneity allows identification of marginal saver: households with dominant capital income
- ▶ Empirical validation: significant indicator for boom-bust cycles in the data Regression

# General equilibrium effects I

## Elasticity of liquid asset supply

- ▶ lower demand for liquid assets in the anticipation phase puts pressure on government to reduce government bond supply
- ▶ if the government does *not* do so, this is *inflationary*, which inhibits the investment boom: rich households with high marginal propensities to invest lose  
→ the government can *harness* the positive news to have more productive (i.e. illiquid) portfolios, by reducing its supply of liquid assets

## General equilibrium effects II

### Extensive margin of capital holding

- ▶ the investment-boom is driven by *intensive* margin of wealthy households
- ▶ in bottom 50%, instead, more households abstain from holding capital in anticipation phase, when liquidity premium low (can profit from stock price boom)
- ▶ they buy capital *after* the boom, when liquidity premium high



# Conclusion and Outlook

- ▶ A heterogeneous agent-model with portfolio choice can account for stock price boom-bust cycles
- ▶ Time-varying liquidity premium as alternative to (or microfoundation of) time-varying aggregate risk premium
- ▶ Model-implied prediction about heterogeneous portfolio choice consistent with data

What would happen with aggregate risk in the model?

- ▶ Increasing stock-wealth increases risk of households' portfolios → puts downward pressure on stock price → liquidity premium becomes *more* important to explain stock price boom
- ▶ Allows for heterogeneous stock shares → with rich households having more stocks, the effect of news shocks on investment should be *higher*, as income gains from stocks would go to high MPI-households (*indirect* productivity of stocks)

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## Appendix

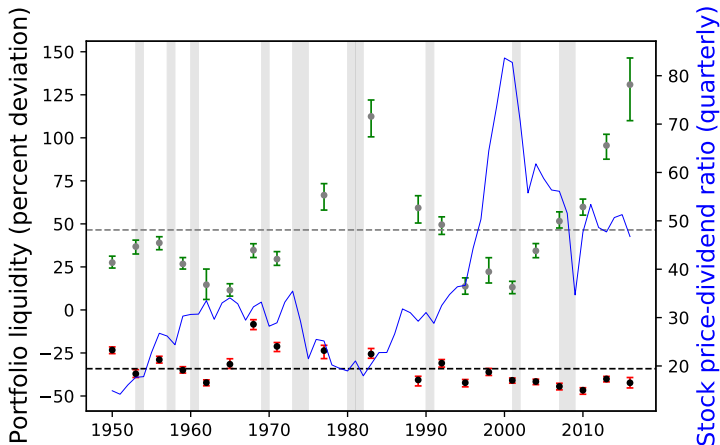
# Portfolio liquidity and the stock market

## Regression of price-dividend growth on relative portfolio liquidities

Specs	high cap. inc.	middle 40%	bottom 50%	rel. stock share
baseline	-0.290 (0.213)	0.113 (0.117)	-0.442** (0.118)	-
w/o b50%	-0.361 (0.235)	-0.089 (0.109)	-	-
bin. regr.	-0.477* (0.228)	0.824* (0.409)	-0.27 (0.266)	-
stock share	-0.381** (0.168)	0.086 (0.116)	-0.481** (0.133)	0.420* (0.228)
st.sh. & bin.	-0.876* (0.483)	0.482 (0.310)	-0.237 (0.242)	0.679 (0.520)

*Notes:* The baseline regression equation is  $\Delta_i \frac{q}{d} = \sum_g \beta_g \Delta_i \text{pflq}^g + \epsilon_i$ ,  $i = 1, \dots, 19$ . All variables are standardized. In *binary* specifications, all regressors are instead indicator variables  $\mathbb{I}_{\{\Delta_i \text{pflq}^g > 0\}}$  (not standardized). Specifications with the *relative stock share* include the growth of the ratio of the stock share of high capital-households by the stock share of households in the top 10% as a regressor. Newey-West (one lag) standard errors in parentheses. Asterisks indicate that the t-statistic of the coefficient is above the 5% (\*\*) or 10% (\*) level.

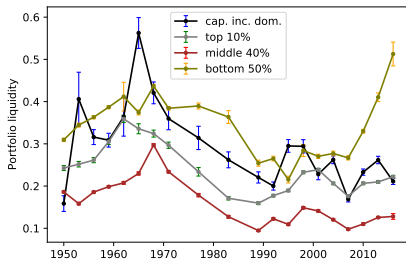
## Relative portfolio liquidity of bottom 90%



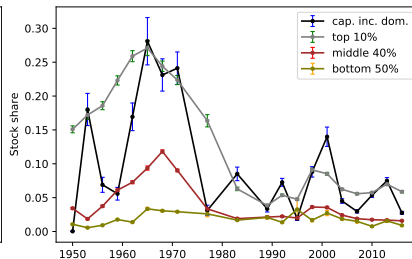
*Portfolio liquidity:* relative deviation of portfolio liquidity of households in the bottom 50% (grey dots, green CIs) / middle 40% (black dots, red CIs) from portfolio liquidity of the top 10% of wealth distribution. Data: SCF+ (Kuhn et al., 2020)  
*Stock market:* S&P 500 data by Robert Shiller. *Whiskers:* 68% CIs

# Survey of Consumer Finances: Heterogeneous Portfolios I

(a) Portfolio liquidity



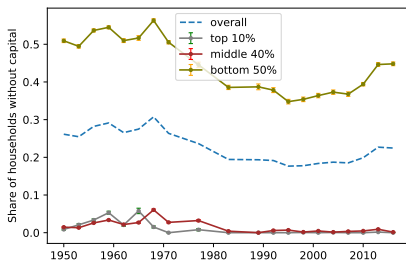
(b) Stock shares



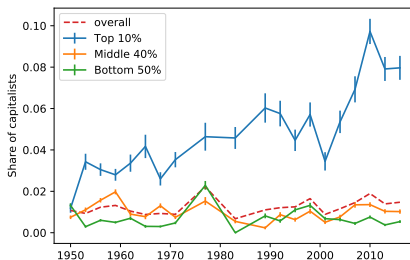
Source: SCF+ (Kuhn et al., 2020)

# Survey of Consumer Finances: Heterogeneous Portfolios II

(a) Households without capital



(b) Households with high capital income

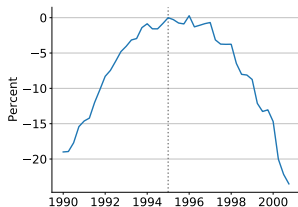


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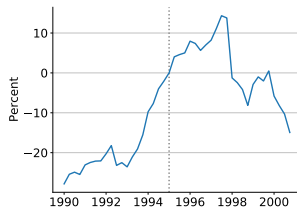


# Empirical data series

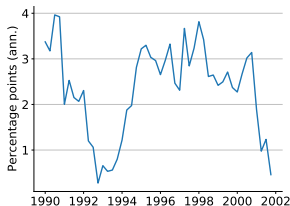
(a) Federal debt (real, growth-adj.)



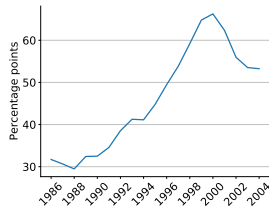
(b) Corporate profits (real, growth-adj.)



(c) 3-M T-Bill (real)

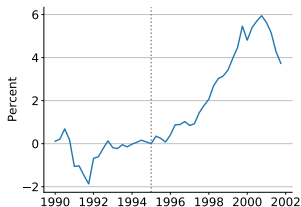


(d) Share of Stocks in liquid assets

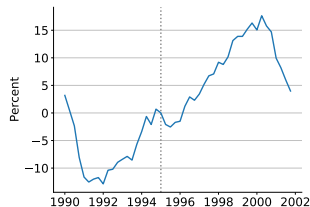


# Empirical data series (business cycle)

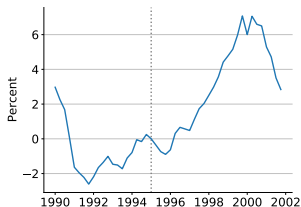
(a) Consumption (real, growth-adj.)



(b) Investment (real, growth-adj.)



(c) Output (real, growth-adj.)



(d) Governm. expend. (real, growth-adj.)

