

Optimism, Net Worth Trap, and Asset Returns

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- Budding literature on the interactions between financial frictions and investors' beliefs ([Krishnamurthy and Li, 2020](#); [Maxted, 2022](#); [Camous and Van der Ghote, 2023](#); [Khorrami and Mendo, 2023](#))
- Mostly the focus has been on [diagnostic expectations](#) or [incomplete information on tail risk](#) to explain pre-crisis frothy periods
- Empirical evidence from [Bordalo et al \(2023\)](#): “Overreaction of long term profit expectations emerges as a promising mechanism for reconciling Shiller’s excess volatility puzzle with the business cycle”

What do we do?

- Analyze the role of intermediary’s (or expert’s) **optimism** in the [long-term growth prospects](#) on (i) the amplification of boom-bust cycles; (ii) build-up to a financial crisis; (iii) creation of [net worth trap](#), i.e., perennial crisis
- Build a tractable heterogeneous agent model with financial frictions where optimists hold dogmatic beliefs over long-run output growth
- Tie the model predictions to the empirical predictions by building an optimism measure from the [Survey of Professional Forecasters \(SPF\)](#)
- Study the cross-sectional asset pricing implications of the optimism factor

The key model predictions are:

- 1 Optimism exacerbates risk amplification and financial instability (e.g., contrary to **Maxted, 2022**)
- 2 At the stochastic steady state: **frothy periods** due to higher perceived risk premium of optimists \rightarrow leverage \uparrow , true risk premium \downarrow
- 3 **During crisis**: higher aggregate volatility and risk premium levels compared to a benchmark rational expectations case
- 4 **Net worth trap**: optimists never recapitalize due to their expectation error \rightarrow perennial crisis
- 5 Explains the **excess conditional momentum** of stock returns during crises

Cross-sectional implications:

- 1 A model with optimism as factor improves the pricing power of asset returns in the cross section, beyond conventional factors in the intermediary asset pricing literature (e.g., [He, Kelly, and Manela, 2017](#))
- 2 Optimism factor is crucial in explaining [momentum](#) and [long-term reversal](#) anomaly portfolio excess returns

The Model

Single capital: owned by optimists and (rational) households

Optimists: produces $y_t^O = \gamma_t^O k_t^O$, $\forall t \in [0, \infty)$ where

$$\frac{dk_t^O}{k_t^O} = \left(\Lambda^O(\iota_t^O) - \delta^O \right) dt, \quad \forall t \in [0, \infty)$$

Investment ratio

Their investment = $\iota_t^O y_t^O$

with technological growth:

$$\frac{d\gamma_t^O}{\gamma_t^O} = \alpha dt + \sigma \underbrace{dZ_t}_{\text{Brownian motion}}, \quad \forall t \in [0, \infty)$$

True (expected) growth

Households: produces $y_t^H = \gamma_t^H k_t^H$, $\forall t \in [0, \infty)$ where

$$\frac{dk_t^H}{k_t^H} = \left(\Lambda^H(\iota_t^H) - \delta^H \right) dt, \quad \forall t \in [0, \infty)$$

Investment ratio

Their investment = $\iota_t^H y_t^H$

with the same technological growth:

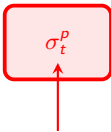
$$\frac{d\gamma_t^H}{\gamma_t^H} = \alpha dt + \sigma \underbrace{dZ_t}_{\text{Brownian motion}}, \quad \forall t \in [0, \infty)$$

True (expected) growth

→ **Level difference:** $\gamma_t^H = l \cdot \gamma_t^O$, $\Lambda^H(\cdot) = l \cdot \Lambda^O(\cdot)$, with $l \leq 1$

- Efficiency in both production and capital formation ↓

Capital price process: (endogenous) p_t follows

$$\frac{dp_t}{p_t} = \mu_t^p dt + \sigma_t^p dZ_t$$


Endogenous volatility

Capital return process:

- Optimists' total return on capital:

$$\begin{aligned} dr_t^{Ok} &= \underbrace{\frac{\gamma_t^O k_t^O - \iota_t^O \gamma_t^O k_t^O}{p_t k_t^O}}_{\text{Dividend yield}} dt + \underbrace{\left(\Lambda^O(\iota_t^O) - \delta^O + \mu_t^p \right) dt + \sigma_t^p dZ_t}_{\text{Capital gain}} \\ &= \underbrace{\frac{1 - \iota_t^O}{q_t}}_{\substack{\text{Price-earnings ratio} \\ \text{(optimists)}}} dt + \left(\Lambda^O(\iota_t^O) - \delta^O + \mu_t^p \right) dt + \sigma_t^p dZ_t \end{aligned}$$

- Households' total return on capital:

$$dr_t^{Hk} = \frac{\gamma_t^H k_t^H - \iota_t^H \gamma_t^H k_t^H}{p_t k_t^H} dt + \left(\Lambda^H(\iota_t^H) - \delta^H + \mu_t^p \right) dt + \sigma_t^p dZ_t$$

Optimists: dogmatically believe γ_t^O follows

$$\frac{d\gamma_t^O}{\gamma_t^O} = \boxed{\alpha^O} dt + \sigma \underbrace{dZ_t^O}_{\text{Optimists' Brownian Motion}}, \quad \forall t \in [0, \infty)$$

$\alpha^O > \alpha$

even if the **true process** is given as

$$\frac{d\gamma_t^O}{\gamma_t^O} = \alpha dt + \sigma \underbrace{dZ_t}_{\text{True Brownian Motion}}$$

with the following consistency (see e.g., **Yan (2008)**):

$$\underbrace{Z_t^O}_{\text{Optimists' BM}} = \underbrace{Z_t}_{\text{True BM}} - \frac{\alpha^O - \alpha}{\sigma} t$$

Note that: ▶ Capital return

- Optimists infer a true σ by calculating the process' quadratic variation

Financial market: capital and risk-free (zero net-supplied)

Optimists: consumption-portfolio problem (price-taker) ▶ Solution

$$\max_{c_t^O, x_t \geq 0, c_t^O \geq 0} \boxed{\mathbb{E}_0^O} \left[\int_0^\infty e^{-\rho t} \log(c_t^O) dt \right]$$

Believes dZ_t^O is
the true BM

subject to

$$dw_t^O = x_t w_t^O dr_t^{Ok} + (1 - x_t) r_t w_t^O dt - c_t^O dt, \text{ and } \underbrace{w_t^O \geq 0}_{\text{Solvency constraint}}$$

Rational households: solve the similar problem with $\boxed{\mathbb{E}_0} (\neq \mathbb{E}_0^O)$

Believes dZ_t is
the true BM

Total capital $K_t = k_t^O + k_t^H$ evolves with

$$\frac{dK_t}{dt} = \underbrace{\left(\Lambda^O \left(l_t^O \right) - \delta^O \right) k_t^O}_{\text{From optimists}} + \underbrace{\left(\Lambda^H \left(l_t^H \right) - \delta^H \right) k_t^H}_{\text{From households}}, \quad \forall t \in [0, \infty)$$

Debt: zero net-supplied

$$\underbrace{\left(w_t^O - p_t k_t^O \right)}_{\text{Optimists' lending}} + \underbrace{\left(w_t^H - p_t k_t^H \right)}_{\text{Households' lending}} = 0$$

Good market equilibrium:

$$\underbrace{\frac{x_t^O w_t^O}{p_t} \left(\gamma_t^O - l_t^O \gamma_t^O \right)}_{\text{Optimists' production net of investment}} + \underbrace{\frac{x_t^H w_t^H}{p_t} \left(\gamma_t^H - l_t^H \gamma_t^H \right)}_{\text{Households' production net of investment}} = c_t^O + c_t^H$$

Markov equilibrium: optimists' wealth share η_t as state variable

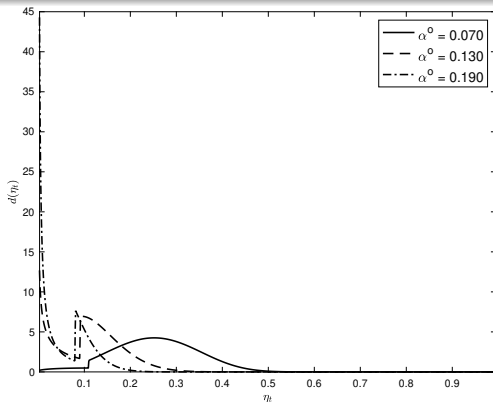
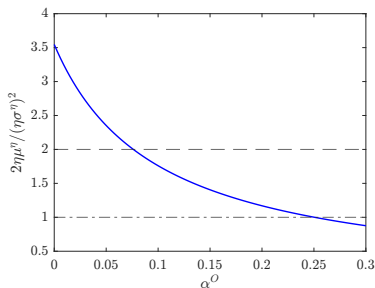


Figure: Stationary distribution of η_t and the net worth trap

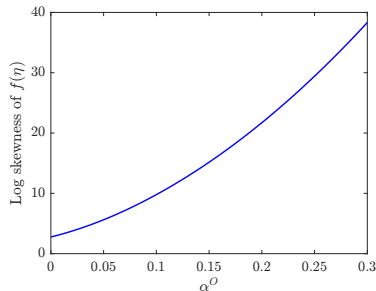
- In the stochastic steady state, higher optimism of experts \rightarrow more leverage: increasing the probability that a crisis occurs
- Once crisis hits, higher optimism of experts \rightarrow higher risk premium helping them to recapitalize faster
- Higher occupancy time in crisis on average

Around $\eta \sim 0$:

$$d(\eta) \sim \left(\frac{2\mu^\eta(0)}{(\sigma^\eta)^2(0)} - 1 \right) \eta^{\frac{2\mu^\eta(0)}{(\sigma^\eta)^2(0)} - 2} \quad (1)$$



(a) Tail analysis of stationary distribution



(b) Skewness of the distribution around $\eta \sim 0$

Proposition (Net Worth Trap)

$\exists \bar{\alpha}^O$ such that if $\alpha^O \geq \bar{\alpha}^O$, the economy is trapped at $\eta = 0$, and the probability of recapitalization for optimists goes to zero.

Does optimism hurt the household's welfare?

$$\text{Welfare Loss} = \mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log c_t^H dt \right] - \mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log c_t^{H, REE} dt \right] \quad (2)$$

- $c_t^{H, REE}$: household's consumption in the rational expectations benchmark

Decomposition:

$$\begin{aligned} \mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log c_t^H dt \right] &= \underbrace{\mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log(1 - \eta_t) dt \right]}_{\text{Wealth effect}_+} + \underbrace{\mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log(1 - \iota_t) dt \right]}_{\text{Investment effect}_+} \\ &\quad + \underbrace{\mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log K_t dt \right]}_{\text{Capital effect}_-} + \underbrace{\mathbb{E}_0 \left[\int_0^\infty e^{-\rho t} \log A(\psi) dt \right]}_{\text{Misallocation effect}_-} \\ &\quad + \underbrace{\quad}_{\text{t.i.e.}} \\ &\quad \text{Terms independent of equilibria} \end{aligned}$$

- $A(\psi) = \psi_t + l(1 - \psi_t)$: productivity-adjusted aggregate capital share

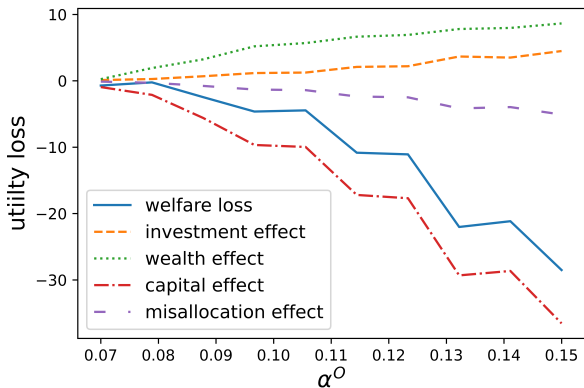


Figure: Decomposition of the rational household's welfare loss

- Overall, optimism $\alpha^O \uparrow \rightarrow$ welfare of households \downarrow (aggregate capital effects are the strongest)

Empirical Analysis

Empirical: run the following regression with monthly S&P500 excess return:

$$r_{t+h}^e = \alpha(h) + \beta_1(h) \times r_t^e + \underbrace{\beta_2(h)}_{\text{Excess conditional momentum}} \times r_t^e \times 1_{\text{Recession}} + \epsilon_{t+h}$$

Model-implied: simulate the model for 1,000 times for 5,000 years and run the following regression:

$$R_{t+h}^e = \alpha(h) + \beta_{1,\text{model}}(h) \times R_t^e + \underbrace{\beta_{2,\text{model}}(h)}_{\text{Excess conditional momentum}} \times R_t^e \times 1_{\text{Recession}} + \epsilon_{t+h}$$

with

$$R_t^e = \int_{t-\Delta}^t \left(\frac{d(q_u K_u) + (A(\psi_u) - \iota_u) K_u du}{q_u K_u} - r_{f,u} du \right) \quad (3)$$

Conditional predictability

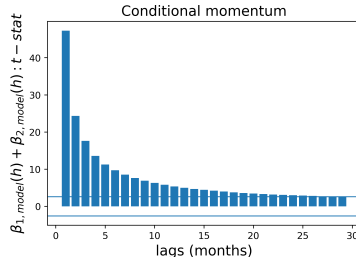
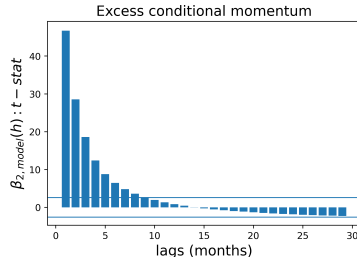
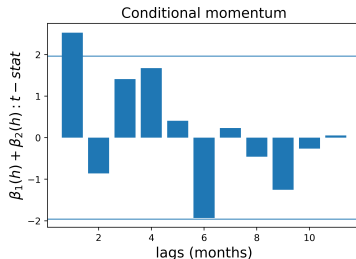
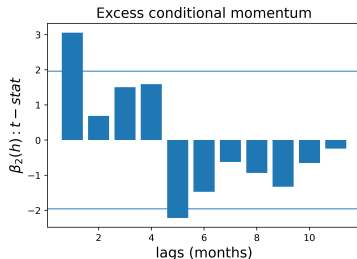


Figure: Time series return predictability. The data is at monthly frequency from 1945 till 2022.

- Empirical optimism is computed as

$$O_t = \frac{f_{75}}{|f_{50}|}$$

where f_k : $k\%$ percentile analyst forecast of quarter-on-quarter GDP growth rate for the $T+2^{\text{th}}$ quarter ahead at date T , from the [Survey of Professional Forecasters \(SPF\)](#)

- Model-implied optimism: the component of leverage attributable to optimism

$$x_t^{\text{net}} = x_t - x_t^{\text{REE}}$$

where x_t^{REE} : leverage under the rational expectations

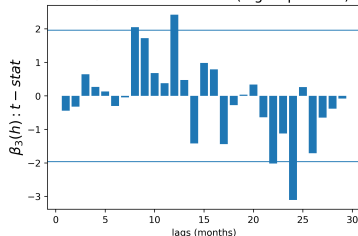
- Optimism dummy:**

$$1_o = 1 \text{ if } O_t \geq O_{\text{median}} \text{ (empirics) or } x_t^{\text{net}} \geq x_{\text{median}}^{\text{net}} \text{ (theory)}$$

Run the following predictability regression:

$$r_{t+h}^e = \alpha(h) + \beta_1(h)r_t^e + \beta_2(h) \times r_t^e \times 1_{\text{Recession}} + \underbrace{\beta_3(h)}_{\text{Due to optimism}} \times r_t^e \times 1_{\text{Recession}} \times 1_o + \epsilon_{t+h}$$

Excess conditional momentum (high Optimism): Data



Excess conditional momentum (high O): Model

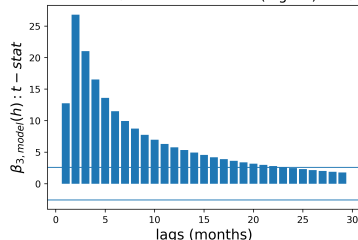


Figure: Time series return predictability. The left panel presents empirical autocorrelation coefficients from regressing the excess return on S&P500 on its lagged excess return. The data is at monthly frequency from 1945 till 2022. The macro-optimism factor is available at a quarterly frequency and hence interpolated to get monthly values. The left panel presents the conditional t-stats when the optimism is high ($\beta_3(h)$). The right panels presents the model-implied conditional t-stats when the optimism is high ($\beta_{3,model}(h)$).

- Define a factor $o_t = \Delta \log(1 + O_t)$

Run two-stage Fama-MacBeth with $f_t \equiv [\underbrace{M_t}_{\text{Market excess return}}, \underbrace{\eta_t}_{\text{HKM equity share}}, \underbrace{o_t}_{\text{Optimism}}]'$ with first

stage:

$$R_{i,t}^e = a_i + \beta_{i,t}' f_t + v_{i,t}$$

and the second stage

$$\mathbb{E}[R_{i,t}^e] = \alpha_i + \hat{\beta}_{i,f} \lambda_f + \epsilon_i$$

- Test assets (1970Q1 - 2022Q4): 25 size and book-to-market portfolios; 25 size and momentum sorted portfolios; 10 long-term reversal portfolios; 25 profitability and investment portfolios; 10 maturity sorted US treasury bond portfolios from CRSP Fama bond dataset with maturities in 6 month intervals up to 5 years
- Other asset classes (1970Q1 - 2012Q4): 18 option portfolios; 20 CDS portfolios; 12 FX portfolios used in He, Kelly, and Manela (2017)

	Equities and Bonds		HKM + Momentum	
	Two-factor	Three-factor	Two-factor	Three-factor
Mean excess return	1.88	1.88	1.18	1.18
Std. excess return	0.84	0.84	1.32	1.32
Mean β_M	0.9	0.9	0.55	0.55
Std β_M	0.37	0.37	0.46	0.46
Mean β_η	0.08	0.08	0.07	0.0
Std β_η	0.11	0.11	0.13	0.13
Mean β_O	-	0.004	-	-0.04
Std β_O	-	0.04	-	0.08
Assets	95	95	95	129
Quarters	211	211	211	171
Controls	Yes	Yes	Yes	Yes

Table 2: Expected returns and risk exposures. Equity assets include 25 size and book-to-market portfolios, 25 size and momentum portfolios, 10 long-term reversal portfolios, and 25 profitability and investment portfolios. Bond portfolios include 10 maturity sorted portfolios from CRSP Fama bond portfolio dataset. HKM assets include 25 size and book-to-market portfolios, 10 U.S. Govt. bond portfolios, 10 U.S. corporate bond portfolios, 18 option portfolios, 20 CDS portfolios, and 12 foreign exchange portfolios taken from [He et al. \(2017\)](#). HKM+Momentum includes 25 size and momentum portfolios and 10 long-term reversal portfolios in addition to the HKM assets. Mean and standard deviation of the excess return is the difference in mean return and risk free rate of the corresponding test assets. The frequency is quarterly and time period is from 1970Q1 till 2022Q4. The mean and std. of betas ($\beta_M, \beta_\eta, \beta_O$) measure the average and standard deviation of the exposure of excess return to the market factor, the intermediary capital ratio, and the macro-optimism factor respectively.

	Equities and Bonds		HKM+Momentum	
	Two-factor	Three-factor	Two-factor	Three-factor
Market	0.01	0.01	0.02	0.02
t-stat Shanken	(1.17)	(1.20)	(1.53)	(1.42)
Intermediary	0.02	0.02	0.03	0.04
t-stat Shanken	(1.08)	(1.04)	(1.91)	(1.96)
Macro-optimism	-	0.07	-	0.04
t-stat Shanken	-	(2.93)	-	(2.84)
MAPE %	2.22	1.98	2.83	2.79
Adj. R2	0.22	0.40	0.45	0.52
Assets	95	95	129	129
Quarters	211	211	171	171

Table 3: Risk price estimates for equities and US government bond portfolios. Equity and bond test assets include 25 size and book-to-market portfolios, 25 size and momentum portfolios, 10 long-term reversal portfolios, and 25 profitability and investment sorted portfolios, 10 maturity sorted US government bond portfolios taken from the CRSP Fama bond portfolio dataset. HKM assets include 25 size and book-to-market portfolios, 10 U.S. Govt. bond portfolios, 10 U.S. corporate bond portfolios, 18 option portfolios, 20 CDS portfolios, and 12 foreign exchange portfolios taken from HKM2017. In addition, it also includes 25 size and momentum portfolios and 10 long-term reversal portfolios. The data is at quarterly frequency from 1970Q1 till 2022Q4. The factors are market, intermediary capital ratio, and macro-optimism. The macro-optimism factor o_t is computed as growth rate in O_t , the 75th percentile of GDP forecast scaled by median forecast by analysts. The forecast data is taken from The Survey of Professional Forecasters. The standard errors of risk price estimates are adjusted for generated regressor problem using Shanken correction. MAPE denotes the mean absolute pricing error in annualized terms.

		Macro-optimism			
		(1)	(2)	(3)	(3)-(1)
Intermediary	(1)	3.25	3.61	6.12	2.86
	(2)	7.50	5.03	7.76	0.26
	(3)	8.77	9.65	9.37	0.59
	(3)-(1)	5.52	6.04	3.25	-

Table: Average excess returns. The table reports the annualized mean excess return on equity and bond portfolios double-sorted on their exposures to the intermediary factor and the macro-optimism factor using the three-factor model. The data is at quarterly frequency from 1970Q1 till 2022Q4. The intermediary factor is from HKM2017, and the macro-optimism factor is computed from the growth rate of 75th percentile GDP projection, scaled by the median projection.

» Cross-sectional fit: additional assets

» Robustness

Thank you very much!
(Appendix)

Basic framework based on Brunnermeier and Sannikov (2014)

- Macro-finance with financial frictions: He and Krishnamurthy (2013), Gertler et al. (2020)
- Heterogeneous beliefs, and deviations from the rational expectations: Harrison and Kreps (1978), Detemple and Murthy (1997), Basak and Croitoru (2000), Basak (2000), Gallmeyer and Hollifield (2008), Simsek (2013), Caballero and Simsek (2020), Krishnamurthy and Li (2020), Maxted (2023),¹ Camous and Van der Ghote (2023)
- Heterogeneous beliefs about risk-premium, financial markets, and the macroeconomy (e.g., inflation): Welch (2000), Coibion et al. (2020), Candia et al. (2021), Weber et al. (2022), Beutel and Weber (2022)²
- Long-run optimism and boom-bust cycles: Bordalo et al. (2023)
- Intermediary and capital-share based empirical asset pricing: He, Kelly, and Manela (2017), Lettau, Ludvigson, and Ma (2019)
- Momentum during crises: Cujean and Hesler (2017)

¹Maxted (2023) incorporates diagnostic expectations into a model with intermediaries based on He and Krishnamurthy (2013)

²Beutel and Weber (2022) find that individuals are heterogeneous both at the information acquisition and processing stages, forming their own beliefs and choosing portfolios based on them

Perceived capital return process

- **Optimists'** total return on capital:

$$\begin{aligned}
 dr_t^{Ok} &= \underbrace{\frac{\cancel{\gamma_t^O} - \cancel{\iota_t^O} \cancel{\gamma_t^O}}{\cancel{p_t}}}_{\text{Dividend yield}} dt + \underbrace{\left(\Lambda^O(\iota_t^O) - \delta^O + \mu_t^p \right)}_{\text{Capital gain}} dt + \sigma_t^p dZ_t \\
 &= \frac{\gamma_t^O - \iota_t^O \gamma_t^O}{p_t} dt + \left(\Lambda^O(\iota_t^O) - \delta^O + \mu_t^p + \underbrace{\frac{\alpha^O - \alpha}{\sigma} \sigma_t^p}_{\text{Optimism premium}} \right) dt + \sigma_t^p dZ_t
 \end{aligned}$$

Observation (Belief heterogeneity in asset returns)

(Endogenous) volatility $\sigma_t^p \uparrow \rightarrow$ the optimism premium in asset return \uparrow

Optimists' optimal portfolio decision (e.g., **Merton (1971)**)

$$x_t = \frac{\left(\frac{\gamma_t^O - \iota_t^O \gamma_t^O}{p_t} + \Lambda^O(\iota_t^O) - \delta^O + \mu_t^p + \frac{\alpha^0 - \alpha}{\sigma} \sigma_t^p \right) - r_t^*}{(\sigma_t^p)^2}$$

New term:
from optimism

For $\alpha^O > \alpha$ (experts = optimists)

- Given the risk-free r_t^* and the endogenous volatility σ_t^p , optimism (i.e., $\alpha^O \uparrow$ from α) raises the optimists' **leverage** \uparrow and **capital demand** \uparrow , i.e., booms
- Optimists bear 'too much' risk on their balance sheets \rightarrow crisis when dZ_t is negative enough (entering crisis **more frequently**, i.e., frothy periods)

$\sigma_t^p \uparrow \rightarrow$ has two effects on leverage x_t :

- $\sigma_t^p \uparrow$ lowers x_t as the required risk-premium level \uparrow
- $\sigma_t^p \uparrow$ raises x_t as it raises the degree of optimism on asset returns

Proportion of optimists' wealth as state variable, similarly to Brunnermeier and Sannikov (2014):

$$\eta_t \equiv \frac{W_t^O}{W_t^O + W_t^H} \underbrace{=}_{\text{Debt market equilibrium}} \frac{W_t^O}{p_t K_t}$$

which leads to:

$$x_t^O \leq \frac{1}{\eta_t}$$

- When it binds - 'normal' (all capital is owned by experts)
- When it does not bind - 'crisis' (less productive households must hold capital)

Under Markov equilibrium: normalized variables depend only on η_t

$$\longrightarrow q_t = q(\eta_t), x_t = x(\eta_t), \underbrace{\psi_t}_{\text{Capital share (optimists)}} = \psi(\eta_t)$$

Investment function

$$\Lambda^O(\iota_t^O) = \frac{1}{k} \left(\sqrt{1 + 2k\iota_t^O} - 1 \right), \quad \forall t \in [0, \infty)$$

with

$$\Lambda^P(\iota_t) = l \cdot \Lambda^O(\iota_t), \quad \forall \iota_t \quad (4)$$

Parametrization: target 5% chance of crisis

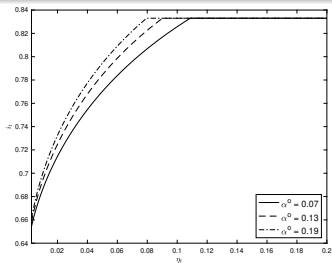
	l	δ^O	δ^H	ρ	χ	σ	k	α	α^O set
Values	0.4	0	0	0.03	1	0.08	18	0.07	[0.07, 0.13, 0.19]

Table: Parameterization for $\alpha^O \geq \alpha$

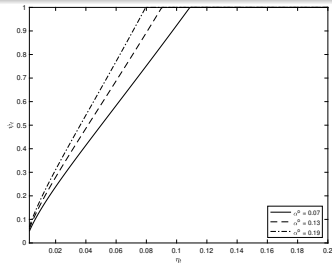
Capital price volatility σ_t^p is given by

$$\sigma_t^p \left(1 - (x_t - 1) \frac{\frac{dq(\eta_t)}{q(\eta_t)}}{\frac{d\eta_t}{\eta_t}} \right) \equiv \sigma_t^p (1 - (x_t - 1) \varepsilon_{q,\eta}) = \underbrace{\sigma}_{\text{Exogenous volatility}}$$

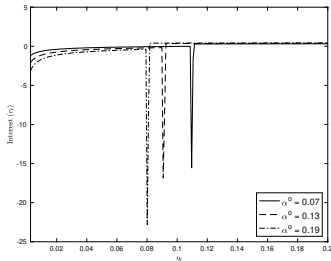
- $\varepsilon_{q,\eta}$ is the elasticity of the price-earnings ratio (i.e., normalized capital price) with respect to the experts' wealth share η_t
- 'Market illiquidity' effect: $\alpha^O \uparrow \longrightarrow \varepsilon_{q,\eta} \uparrow \longrightarrow \sigma_t^p \uparrow$
- 'Leverage' effect: $\alpha^O \uparrow \longrightarrow x_t \uparrow \longrightarrow \sigma_t^p \uparrow$



(a) Investment rate ι_t



(b) Capital share ψ_t



(c) Equilibrium interest rate r_t^*

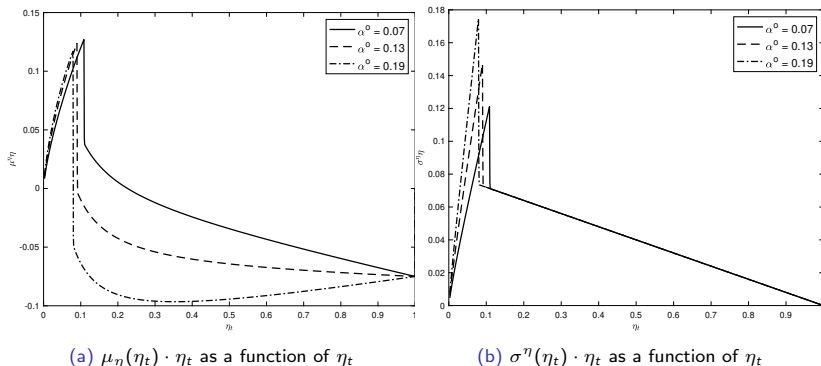


Figure: Wealth share dynamics: drift and volatility

- $\alpha^0 \uparrow \longrightarrow$ Wealth share drift $\mu_{\eta}(\eta_t) \cdot \eta_t \uparrow$ in a crisis: recapitalized faster
- $\alpha^0 \uparrow \longrightarrow$ Wealth share drift $\mu_{\eta}(\eta_t) \cdot \eta_t \downarrow$ in normal: more likely to enter crises

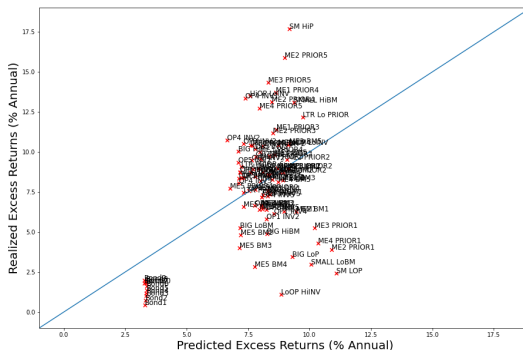


Figure: Pricing errors on equity and bond portfolios with two factors: Realized excess returns versus predicted excess returns using the two-factor model with market and intermediary factors. The data is at quarterly frequency and from 1970Q1 till 2022Q4.

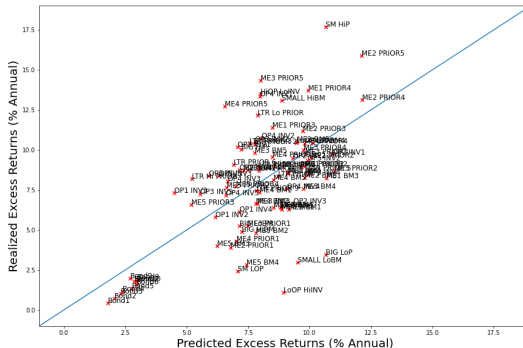
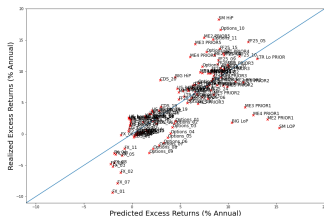


Figure: Pricing errors on equity and bond portfolios with three factors: Realized excess returns versus predicted excess returns using the three-factor model with market, intermediary, and macro-optimism factors. The data is at quarterly frequency and from 1970Q1 till 2022Q4.



(a) Pricing error in two-factor model.



(b) Pricing error in three-factor model.

Figure: Pricing errors on HKM+Momentum portfolios. Realized excess returns versus predicted excess returns using the two-factor model with the market and the intermediary factor in panel (a), and the three-factor model with the market, intermediary, and macro-optimism factors in panel (b). The data is quarterly and from 1970Q1 till 2012Q4.

	HKM		HKM+Momentum	
	Two-factor	Three-factor	Two-factor	Three-factor
Mean excess return	0.85	0.85	1.2	1.2
Std excess return	1.31	1.31	1.32	1.32
Mean β_M	0.46	0.46	0.62	0.62
Std β_M	0.46	0.46	0.48	0.48
Mean β_η	0.03	0.03	0.04	0.04
Std β_η	0.09	0.09	0.1	0.09
Mean β_O	-	-0.02	-	-0.03
Std β_O	-	0.04	-	0.06
Assets	94	94	129	129
Quarters	195	195	195	195
Controls	Yes	Yes	Yes	Yes

Table A1: Expected returns and risk exposures- Robustness check. HKM assets include 25 size and book-to-market portfolios, 10 U.S. Govt. bond portfolios, 10 U.S. corporate bond portfolios, 18 option portfolios, 20 CDS portfolios, and 12 foreign exchange portfolios taken from [He et al. \(2017\)](#). HKM+Momentum includes 25 size and momentum portfolios and 10 long-term reversal portfolios in addition to the HKM assets. Mean and std. of excess return is the difference in mean return and risk free rate of the corresponding test assets. The frequency is quarterly and time period is from 1970Q1 till 2012Q4. The mean and std. of betas ($\beta_W, \beta_\eta, \beta_O$) measure the average and standard deviation of exposure of the excess return to market factor, intermediary capital ratio, and macro-optimism measure respectively. Controls include price-dividend ratio, cyclically adjusted earnings ratio (CAPE), cay, and capital share risk.

	HKM		HKM+Momentum	
	Two-factor	Three-factor	Two-factor	Three-factor
Market	0.02 (1.6)	0.01 (1.32)	0.02 (1.83)	0.02 (1.36)
Intermediary	0.09 (4.48)	0.10 (3.64)	0.05 (3.01)	0.07 (2.47)
Macro-optimism	- -	0.06 (1.68)	- -	0.09 (2.89)
MAPE %	1.7	1.49	2.36	1.95
Adj. R2	0.82	0.86	0.60	0.74
Assets	94	94	129	129
Quarters	195	195	195	195

Table A2: Risk price estimates for HKM and HKM+Momentum portfolios- Robustness check. HKM assets include 25 size and book-to-market portfolios, 10 U.S. Govt. bond portfolios, 10 U.S. corporate bond portfolios, 18 option portfolios, 20 CDS portfolios, and 12 foreign exchange portfolios taken from [He et al. \(2017\)](#). HKM+Momentum includes 25 size and momentum portfolios and 10 long-term reversal portfolios in addition to the HKM assets. The data is at quarterly frequency from 1970Q1 till 2012Q4. The factors are market, intermediary capital ratio, and macro-optimism. The macro-optimism factor is computed as growth rate in the inter-quartile dispersion of GDP forecast scaled by median forecast by analysts. The forecast data is taken from The Survey of Professional Forecasters. The standard errors of risk price estimates are adjusted for generated regressor problem using Shanken correction. MAPE denotes the mean absolute pricing error in annualized terms.