Riding the Bubble with Convex Incentives

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Motivation

**Question**: How should institutional investors trade in mispriced assets?

**Common view**: money managers as example of “sophisticated” investors

- Better information / higher investment ability
- Should help correct mispricing and improve market efficiency
- Especially believed for Hedge Funds (HFs)

**Fact**: during tech bubble of late ’90s

- Institutional investors invested heavily in tech stocks
  - e.g., Brunnermeier & Nagel ’04
- HFs had the largest exposure
  - e.g., Griffin, Harris, Shu & Topaloglu ’11
- Didn’t short sell “overpriced” stocks despite little or no restrictions
  - e.g., Lamont & Stein ’04
This paper

- Incentive-based rationale for managers’ “bubble-riding”
  - Accounting for *convexities* in short-term compensation
  - Based on risk aversion & conditional risk-taking behavior
    - e.g., Basak, Pavlova & Shapiro ’07
  - Characterization of conditioning states in terms of asset *overvaluation*

- Money managers’ trading under, and effect on, asset *mispricing*
  - Mispricing arising from uncertainty about mean productivity
    - We consider both overpricing and underpricing
    - “Bubble-riding” as *overinvestment* in an *overpriced* security
  - “Bubbles” as an example of large overpricing episode
Preview of Results

- Short-term convex incentives can limit trading against mispricing
  - Informed investors over-weight overpriced securities
  - At a minimum, w.r.t. the case of no convex incentives
  - In many circumstances, even w.r.t. traders unaware of overpricing
    ⇒ “Bubble-riding” behavior

- Similar results for the case of underpriced securities

- These positions have an effect on equilibrium prices
  - Delay convergence of prices to fundamental values
  - Can exacerbate mispricing
Setup
Financial Markets

- Fixed investment horizon $T$
- 1 risk-free asset in zero net supply paying $r$ per unit time
- 1 risky asset (stock) in unit supply, with price $S$:
  - Claim to a cumulative dividend (Lucas’ tree):
    \[ dD_t = D_t(\rho dt + \delta dB_t) \]
  - “Fundamentals”: $\rho \sim \mathcal{N}(\rho_0, v_0)$, for $v_0 \geq 0$
    - $\rho_0$: prior for dividend growth rate
    - $\rho_0 > \rho$: growth rate over-estimation
Agents and Information Structure

- 2 types of traders, according to their information about $\rho$:

  1. **Informed** money managers
     - superior information: Observe dividend drift $\rho$
     - Short-term convex incentives
     - Fraction $\theta \in [0, 1]$ of the economy’s endowment

  2. **Uninformed** retail investors ($U$-investors)
     - Incomplete info: learn fundamentals over time: $\tilde{\rho}_t$, s.t. uncertainty $\nu_t$
     - Direct traders
     - Remaining $1 - \theta$ of the economy’s endowment

- $U$-investors learn from realized dividends
  - Enough to introduce mispricing dynamics with convergence to fundamentals
  - Both observe risk-free rate $r$, realized dividends $D_t$ and dividend vol $\delta$
Optimization problems

- CRRA preferences ($\gamma > 1$), consumption over final wealth only:

  (i) $U$-investors’ problem:

  $$\max_{(\phi_t^U)_{t \in [0, T]}} \mathbb{E}_0 \left[ \frac{(W_T^U)^{1-\gamma}}{1-\gamma} \right]$$

  $\mathbb{E}_0$: expectation under the filtered probability measure

  (i’) Managers’ problem:

  $$\max_{(\phi_t)_{t \in [0, T]}} \mathbb{E}_0 \left[ \frac{(f_T W_T)^{1-\gamma}}{1-\gamma} \right]$$

  for the fee rate function $f_T$ that characterizes managers’ incentives

- Risk aversion is essential to the argument

  - Under logarithmic utility, effects of incentives disappear
Money Managers’ Incentives

- $f_T$ convex function of managers’ short-term performance w.r.t. benchmark $Y$:
  
  $$dY_t = Y_t \left(r + \phi^Y (\mu_t - r)\right) dt + Y_t \phi^Y \sigma_t dB_t$$

- $\phi^Y$: fixed portfolio weight in the stock
  
  - $\phi^Y = 0$: money market rate ⟹ “absolute return strategy” (e.g. HFs)
  - $\phi^Y = 1$: stock market benchmark ⟹ “relative return strategy” (e.g., MFs)

- Focus on the case of HFs: 2% + 20% scheme
  
  $$f_T \approx k + k\alpha (r_T - (r + h))^+$$

  - Flat fee $k > 0$
  - Plus performance bonus $k\alpha (r_T - (r + h))$, $\alpha >> 1$
  - On profits $r_T \equiv \ln \left(W_T / W_0 \right) / T$ above a hurdle rate (or HWM) $r + h$
Partial Equilibrium
Exogenous Mispricing and “Efficient” Investment

- Investment policies in partial equilibrium
  - \( \theta = 0 \): prices determined by uniformed traders only
    - \( \phi^U_t = 1 \): market portfolio
  - Allows for analytic characterization of strategies and prices

- Stock price \( S \) potentially differs from fundamental value \( S^{CI} \)
  \[
  OV_t \equiv \left( \frac{S_t}{S^{CI}_t} \right)^{1/(T-t)} - 1 = \exp \left\{ \left( (\tilde{\rho}_t - \rho) - \left( \gamma - \frac{1}{2} \right) \nu_t(T-t) \right) \right\} - 1
  \]
  - \( S^{CI} \): Equilibrium stock prices under full information about \( \rho \)
  - As seen by informed traders (managers)
  - Over- and under-pricing likely depending on estimation error \( \tilde{\rho}_t - \rho \)
Standard Case: Trading Against Mispricing
Normal Investment Policy

- Informed Investor w/o Convex Incentives ("normal" policy $\phi^N_t$)

$$t = \frac{3}{4} T$$

- Relative to the market portfolio, $\phi^N_t$:
  
  (i) under-weighs (over-weighs) overpriced (underpriced) assets

  (ii) increases bets against mispricing as mispricing worsens

  (iii) can result in substantial short-selling for largely overvalued securities

- Consistent with expected behavior of an informed trader under efficient markets
Informed Money Manager
Optimal Portfolio

- The optimal portfolio $\hat{\phi}_t$ includes:
  1. A “normal” component: trades against mispricing
  2. A “risk-shifting” (RS) component: trades in the direction of $\text{sgn}(\phi^N_t - \phi^Y_t)$
  3. An “indexing” (IDX) component: mimics the benchmark

- Weight in each component depends on $OV_t$ through $W_t/Y_t$

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Interim Portfolio Weight in a Mispriced Stock $(t = 3/4T)$

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Informed Hedge Fund Manager
Trading Against Overpricing

- RS component can overweight an OV stock more than U-investors
  1. Dominant while underperforming
     - Still consistent with worsening of mispricing
  2. Magnified by size of performance fees in HF industry
  3. Long the OV stock due to “absolute” performance condition
     - The opposite holds for stock market benchmarks

- IDX component over-invests in stock with negative RP
  - Dominant while outperforming

HF Investment in the Stock during OV Path

\[ W_t/Y_t \quad OV_t \]
HF managers’ over-investment in overpriced stocks:

- Can be larger than the market portfolio’s (underperf.)
- Implies less short-selling than optimal for high $OV_t$ (outperf.)
  - “Self-imposed” short-selling restriction (no constraint in our model)
  - Behavior worsens with performance fee (↗ in effective RRA)
    - Contrasts with view of HFs as ’absolute return’ strategies
  - Limited stabilizing role of informed investors in overvalued markets
Expected Interim Trading

- Averaging over initial estimation errors (overvaluation) \( \rho_0 - \rho \sim N(0, \sigma_0) \)

![](image)

Average Interim Overinvestment in an Overpriced Stock \((t = 1/2T)\)

- Inefficient investment worsens as expected mispricing heightens
Price Impact
Price Impact of Informed Trading in GE

- We set $\theta = 0.5$
  - Prices determined by trading of both informed and uniformed traders
  - Results hold for any $\theta \in (0, 1)$
- We solve for the equilibrium SPD $\pi_T$ in closed form
  - Similar approach to Cuoco & Kaniel ’11
  - Equilibrium prices $S_t$ ($t \in [0, T]$) easily computed
    - Direct integration against normal density
- Comparison of equilibrium prices relative to:
  - No-convex-incentive case
  - All-uninformed case
No Convex Incentives
Price impact of the normal policy \((t = 3/4 T)\)

- Prices corrected towards fundamental value (Efficient Market Hypothesis)
- Holds for situations of both OV and UV
- Initial OV shrunk by 53.4%
Convex Incentives
Price impact of HFs’ policy \((t = 3/4 T)\) - Fraction of mispricing under all-uninformed economy

- Stock OV can be 55% higher than in all-uninformed economy
- For severe stock OV, only 84% of the “efficient” price correction is attained
- Only 28.2% our of 53.4% of initial stock OV is corrected
Conclusions

- Informed investors’ trading under mispricing can go against EMH
  - Present under the type of incentives proposed to alleviate herding
  - Seems to compound reputation-induced disincentives
  - Optimal contract?

- Problem worsens with extent of information advantage

- Sophisticated investors with convex incentives can magnify mispricing
  - At the very least, they delay convergence of prices to fundamentals
  - Bubble-riding behavior can exacerbate the bubble