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

  $\Rightarrow$ "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": $\rho \sim \mathbf{N}(\rho_0, v_0)$, for $v_0 \geq 0$
    - ρ_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 ρ:
  (1) **Informed** money managers
    - superior information: **Observe** dividend drift ρ
    - 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 v_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 δ

Optimization problems

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

  (i) U-investors' problem:

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

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

  (i') Managers' problem:

  $$\max_{(\phi_t)_{t\in[0,T]}} E_0\left[\frac{(f_T W_T)^{1-\gamma}}{1-\gamma}\right]$$

  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:

$$dY_t = Y_t \left(r + \phi^Y(\mu_t - r)\right) dt + Y_t \phi^Y \sigma_t dB_t$$

- ϕ^Y: fixed portfolio weight in the stock
  - $\phi^Y = 0$: money market rate $\Rightarrow$ "absolute return strategy" (e.g. HFs)
  - $\phi^Y = 1$: stock market benchmark $\Rightarrow$ "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 $r_T \equiv \ln(W_T/W_0)/T$ 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
    - $\triangleright$ $\phi_t^U = 1$: market portfolio
  - Allows for analytic characterization of strategies and prices
- Stock price S potentially differs from **fundamental value** S^{CI}

$$OV_t \equiv \left(S_t / S_t^{CI}\right)^{1/(T-t)} - 1 = \exp\left\{\left((\tilde{\rho}_t - \rho) - \left(\gamma - \tfrac{1}{2}\right) v_t (T-t)\right)\right\} - 1$$

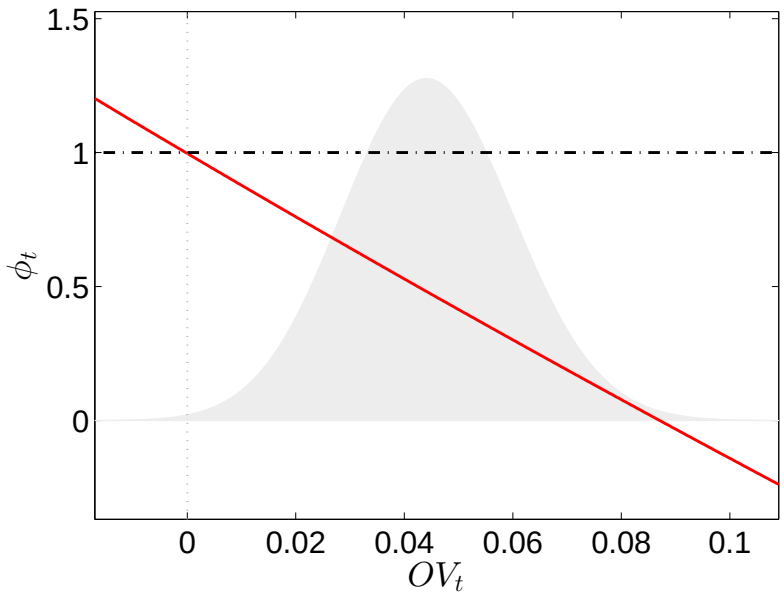
  - S^{CI}: Equilibrium stock prices under *full information* about ρ
  - As seen by informed traders (managers)
  - Over- and under-pricing likely depending on estimation error $\tilde{\rho}_t - \rho$

Standard Case: Trading Against Mispricing

Normal Investment Policy

- Informed Investor w/o Convex Incentives ("normal" policy ϕ_t^N)

$t = 3/4\,T$

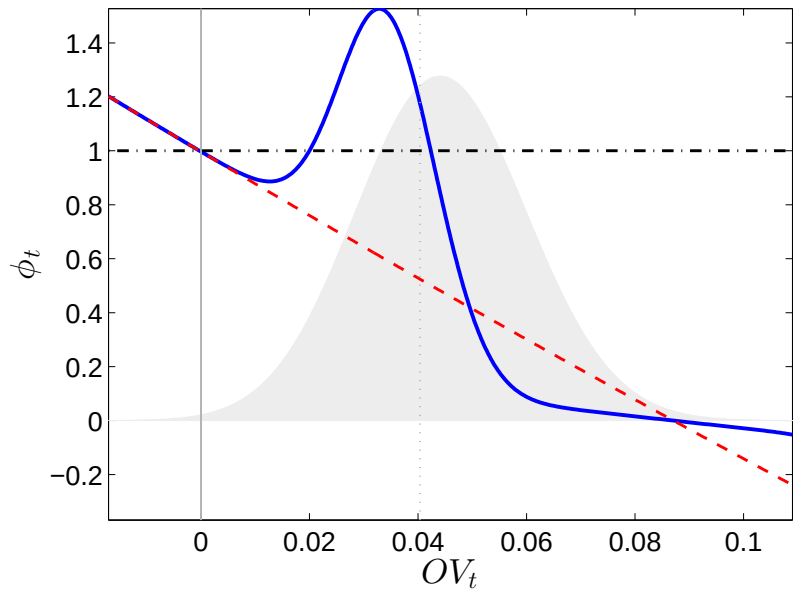


- Relative to the market portfolio, ϕ_t^N:
  - (i) under-weighs (over-weighs) overpriced (underpriced) assets
  - (ii) **increases bets against mispricing** as mispricing worsens
  - (iii) can result in **substantial short-selling** for largely overvalued securities
- Consistent with expected behavior 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 $sgn(\phi_t^N - \phi^Y)$
  - (3) An "indexing" (IDX) component: mimics the benchmark
- Weight in each component depends on OV_t through W_t/Y_t

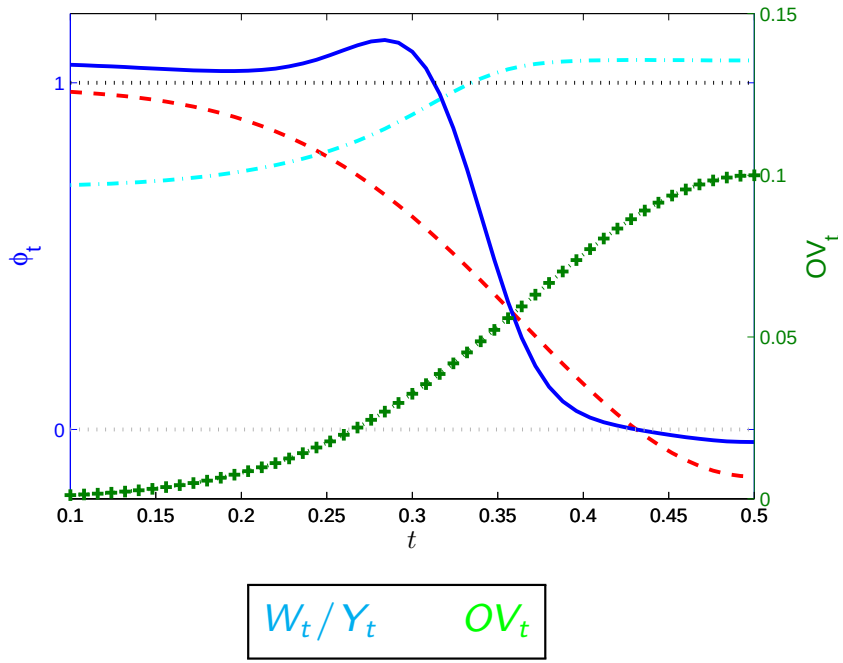


Interim Portfolio Weight in a Mispriced Stock ($t = 3/4T$)

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

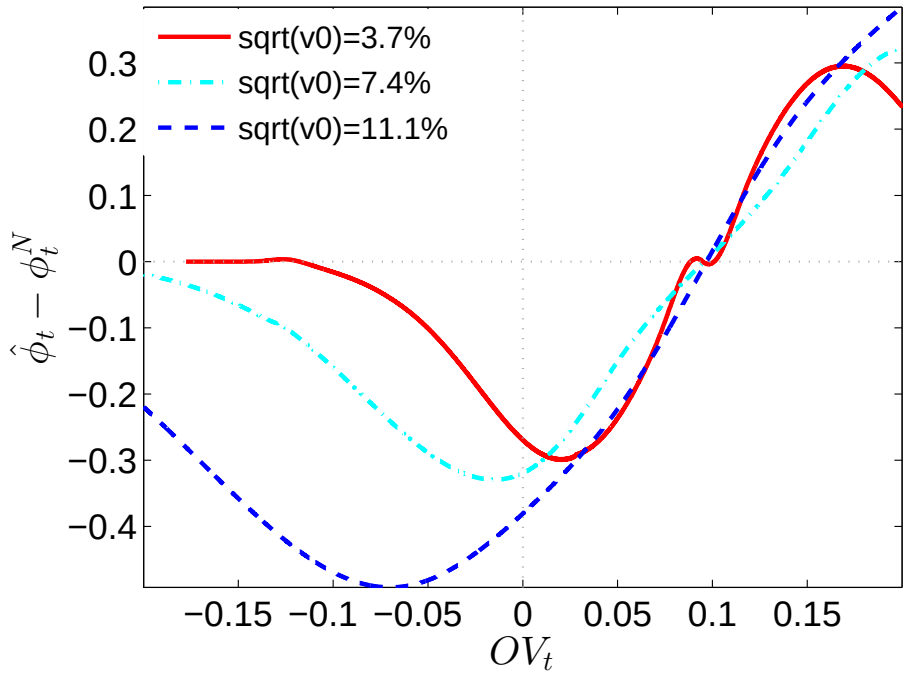
Informed Hedge Fund Manager

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 ($\nearrow$ 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) $\rho_0 - \rho \sim \mathbf{N}(0, v_0)$



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

- Inefficient investment worsens as *expected* mispricing heightens

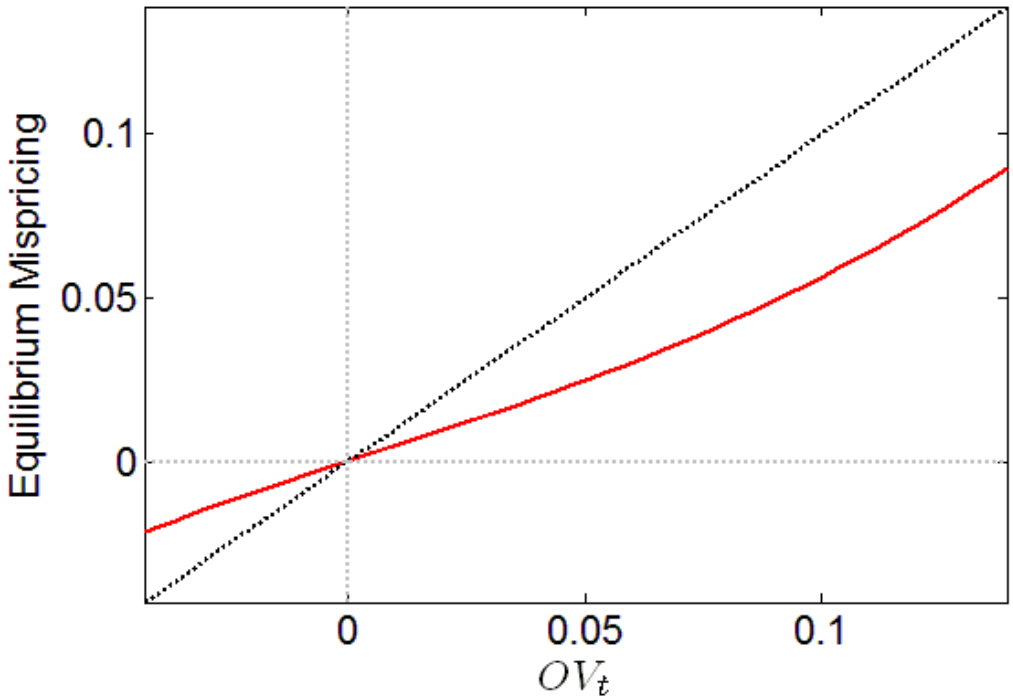
Price Impact

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 π_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 ($t = 3/4T$)

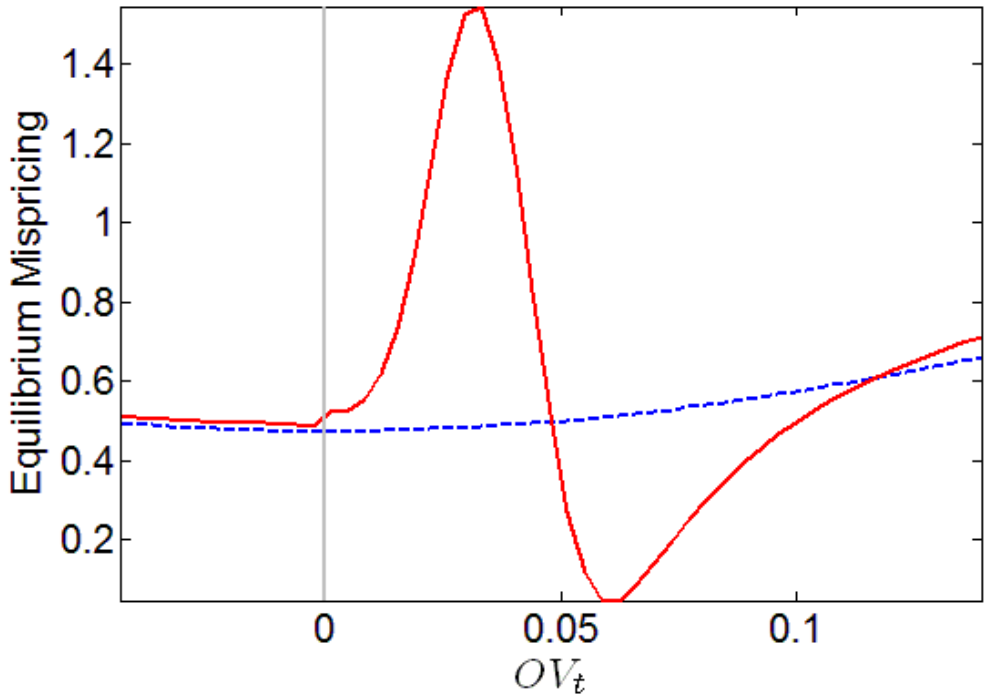


"Normal" economy All-uninformed economy

- 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 ($t = 3/4T$) - 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