

INTERNATIONAL EQUITY FLOWS: A QUANTITATIVE EQUILIBRIUM APPROACH

Rui Albuquerque

University of Rochester

Greg Bauer

Bank of Canada

Martin Schneider

New York University

STYLIZED FACTS

In developed country equity markets,...

■ Persistence (Flow Momentum) and Flow Reversal

... US investors change market share gradually

[on persistence: Bohn-Tesar 95, Froot-Donohue 02]

■ Return Chasing

... US investors increase market share after, during, and when expecting high return periods.

[Bohn-Tesar 95 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01].

■ Bursts of Gross Trading Activity

... US investors buy and sell simultaneously.

Wanted: model of trading dynamics !

DATA ON INTERNATIONAL EQUITY FLOWS

- Data: Aggregate gross purchases (GP) and gross sales (GS) of equity by investors with accounts in the US. Source: TIC database.
- Quarterly, 1977-2000.
- Normalized by end-of quarter market capitalization.
- Paper looks at G7 countries. Here: France only.

STYLIZED FACTS

In developed country equity markets,...

■ Persistence (Flow Momentum) and Flow Reversal

... US investors change market share gradually

[on persistence: Bohn-Tesar 95, Froot-Donohue 02]

■ Return Chasing

... US investors increase market share after, during, and when expecting high return periods.

[Bohn-Tesar 95 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01].

■ Bursts of Gross Trading Activity

... US investors buy and sell simultaneously.

Wanted: model of trading dynamics !

STYLIZED FACTS

In developed country equity markets,...

■ Persistence (Flow Momentum) and Flow Reversal

... US investors change market share gradually

[on persistence: Bohn-Tesar 95, Froot-Donohue 02]

■ Return Chasing

... US investors increase market share after, during, and when expecting high return periods.

[Bohn-Tesar 95 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01].

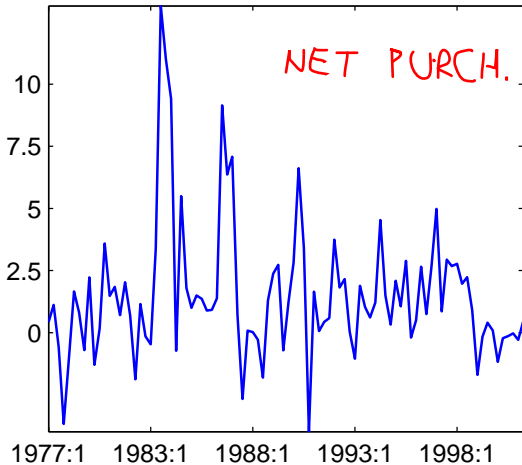
■ Bursts of Gross Trading Activity

... US investors buy and sell simultaneously.

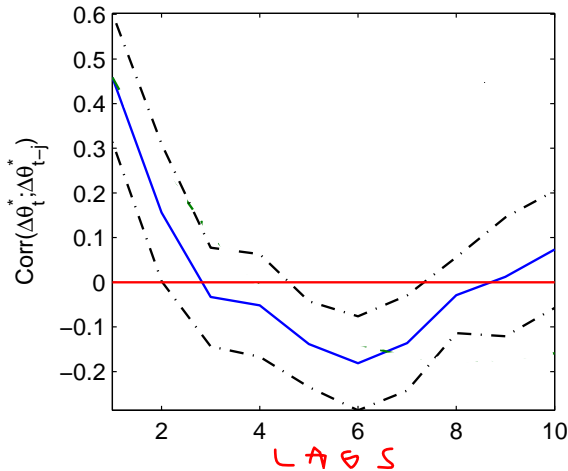
Wanted: model of trading dynamics !

$\times 10^{-3}$

France



France



STYLIZED FACTS

In developed country equity markets,...

■ Persistence (Flow Momentum) and Flow Reversal

... US investors change market share gradually

[on persistence: Bohn-Tesar 95, Froot-Donohue 02]

■ Return Chasing

... US investors increase market share after, during, and when expecting high return periods.

[Bohn-Tesar 95 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01].

■ Bursts of Gross Trading Activity

... US investors buy and sell simultaneously.

Wanted: model of trading dynamics !

STYLIZED FACTS

In developed country equity markets,...

■ Persistence (Flow Momentum) and Flow Reversal

... US investors change market share gradually

[on persistence: Bohn-Tesar 95, Froot-Donohue 02]

■ Return Chasing

... US investors increase market share after, during, and when expecting high return periods.

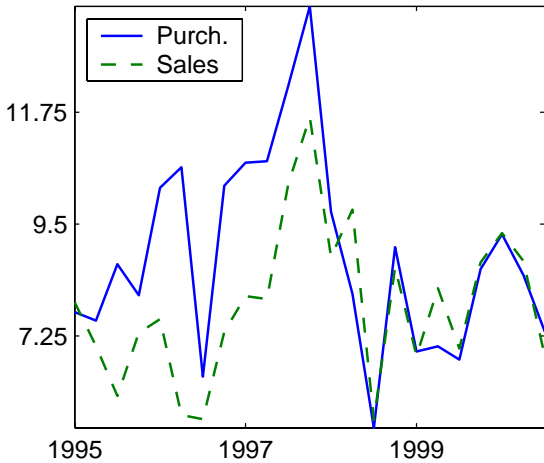
[Bohn-Tesar 95 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01].

■ Bursts of Gross Trading Activity

... US investors buy and sell simultaneously.

Wanted: model of trading dynamics !

$\times 10^{-3}$ France



IDEA (1)

- Domestic and Foreign Investors differ by sophistication:

| | Sophisticated (S) | Unsophisticated (U) |
|--------------|-----------------------------------|---------------------|
| Stock Market | private info (market research) | no private info |
| Other Assets | generate private opportunities | bonds only |

- Populations differ in composition: average American has less local knowledge!

- Direct evidence:

- ▲ Grinblatt-Keloharju (2000), Cho-Khoh-Stulz (2001).

- ▲ Heaton-Lucas (2004).

IDEA (2)

■ Business Cycle

1. drives dividends (momentum and reversal!)
2. more private opportunities in booms than recessions.

■ Two motives for trade

Risk Sharing }
Disagreement } change over cycle !

A TYPICAL BOOM

- Good news about the business cycle.

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers
- U investors

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers
- U investors
 - ▲ initially less optimistic
 - ▲ gradually learn state of cycle

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers
- U investors
 - ▲ initially less optimistic
 - ▲ gradually learn state of cycle
 - \implies risk sharing slowed by disagreement
 - \implies predictable inflow of American money follows

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers
- U investors
 - ▲ initially less optimistic
 - ▲ gradually learn state of cycle
 - \implies risk sharing slowed by disagreement
 - \implies predictable inflow of American money follows
- Business cycle momentum in short run

A TYPICAL BOOM

- Good news about the business cycle.
- On impact, all investors update: stock price \uparrow
- S investors:
 1. find more private opportunities.
 2. to limit exposure to bc risk, shed tradable part: sell stocks
 - \implies burst of gross trading activity
 - \implies American population (more U) net buyers
- U investors
 - ▲ initially less optimistic
 - ▲ gradually learn state of cycle
 - \implies risk sharing slowed by disagreement
 - \implies predictable inflow of American money follows
- Business cycle momentum in short run
- Eventually reversal & S investors return to market

RELATED LITERATURE

■ Evidence on Flows and Returns

Bohn-Tesar 96, 96, Brennan-Cao 97, Froot-O'Connell-Seasholes 01, Froot-Donohue 02, Froot-Ramadorai 02.

■ Evidence on Individual Positions

Frankel-Schmukler 96, Karolyi 99, Grinblatt-Keloharju 00, Seasholes 00, Choe-Kho-Stulz 01, Ahearne-Griever-Warnock 01, Dahlquist-Robertson 01, Hamao-Mei 01, Hau 01.

■ Models of Equity Flows and Returns

Brennan-Cao 97, Griffin-Nardari-Stulz 02, Hau-Rey 02

■ RE Models of Trading with Asymmetric Information

Wang 94, Coval 99.

OUTLINE

1. Model

2. Properties

- ▲ Optimal Portfolio Choice
- ▲ Disagreement
- ▲ Equilibrium Trades
- ▲ Cross-Border Trades

3. Calibration

4. Results

- ▲ Stylized Facts
- ▲ Structural Analysis

MODEL

- Infinite horizon; many long lived investors; CARA utility.
- Two investors types (S, U).
- Two nationalities (American, French).
- Populations

| | | FRA | USA |
|-----|-------------|-------------|--|
| | | $1 - \nu^*$ | ν^* |
| U | ν_U | ... | $\nu^* \nu_U + \delta \nu_U (1 - \nu_U)$ |
| S | $1 - \nu_U$ | ... | ... |

where δ is "regression coefficient" (nationality on type)

MODEL

- Infinite horizon; many long lived investors; CARA utility.
- Two investors types (S, U).
- Two nationalities (American, French).
- Populations

| | FRA | USA |
|-----|-----------------|--|
| | $1 - \nu^*$ | ν^* |
| U | ν_U ... | $\nu^* \nu_U + \delta \nu_U (1 - \nu_U)$ |
| S | $1 - \nu_U$... | ... |

where δ is "regression coefficient" (nationality on type)

ASSETS AND INFORMATION

■ Riskless bond, ‘world’ stock index.

■ ‘Local’ stock index with return R_t^D ; trades at price P_t , pays dividends

$$D_t = \bar{D} + F_t^D + \varepsilon_t^D,$$

F_t^D = “business cycle factor”.

■ Private opportunities with return

$$R_{t+1}^B = \bar{R}^B + \eta_D F_t^D + \eta_B F_t^B + \varepsilon_t^B,$$

F_t^B = “off-market factor.”

■ $\text{Cov}(\varepsilon_t^D, \varepsilon_t^B) = 0$.

■ Information about local economy:

▲ U investors observe $\{P_t, D_t\}$,

▲ S investors observe $\{P_t, D_t, F_t^B, R_t^B\}$, perhaps $y_t^S = F_t^D + \varepsilon_t^S$.

EQUILIBRIUM

■ Rational Expectations Equilibrium

- ▲ investors choose portfolios optimally, given info sets.
- ▲ stock market clears.

■ Solution

- ▲ Nontrivial informational role of prices.
- ▲ Infinite regress does not occur: hierarchical information
- ▲ CARA-normal setup \Rightarrow updating by Kalman filter.

OPTIMAL PORTFOLIO CHOICE

■ Stockholdings (up to constants)

| | Myopic Demand | | Intertemporal Hedging |
|-------------|--|---|----------------------------------|
| $U \propto$ | $E_t^U [R_{t+1}^D]$ | + | $\underbrace{H_t^U}_{\approx 0}$ |
| $S \propto$ | $E_t^S [R_{t+1}^D] - \rho_s \frac{\sigma_s}{\sigma_b} E_t^S R_{t+1}^b$ | + | H_t^S |

■ U demand driven by expected stock returns.

■ S demand depends on

▲ expectations about stock returns

▲ current private opportunities

▲ future private opportunities (hedging demand large!)

RISK SHARING AND DISAGREEMENT

Key assumptions

- ▲ imperfect information about business cycle (also for S!)
- ▲ expected private returns depend on business cycle

■ Private returns informative about cycle

⇒ $\rho_s = \text{corr}(\text{stock returns}, \text{private returns}) > 0$

⇒ S investors view assets as substitutes.

■ S investors shift risk in booms

(myopic demand for stocks lo when private opp. good!)

■ Stock prices depends on off-market news F_t^B .

U investors can't distinguish business cycle, off-market news.

EQUILIBRIUM TRADES

- U investors net purchases

$$NP_t^U \propto \underbrace{\Delta E_t^U [R_{t+1}^D] - \Delta E_t^S [R_{t+1}^D]}_{\text{DISAGREEMENT}} + \underbrace{\rho_s \frac{\sigma_s}{\sigma_b} \Delta E_t^S [R_{t+1}^b] + \Delta (H_t^U - H_t^S)}_{\text{RISK SHARING}}.$$

Dynamics come from:

- Factors moving risk sharing motives.
- Imperfect & asymmetric information:
 - ▲ Over- and Underreaction to Shocks
 - ▲ Disagreement

CROSS-BORDER TRADES

- Americans' net purchases:

$$NP_t^* = \delta NP_t^U,$$

- move with U net purchases iff $\delta > 0$.
(more U in American population)

- more volatile flows if more heterogenous populations:

$$\sigma(NP_t^*) = \delta \sqrt{\frac{\pi}{2}} E[\text{Volume}]$$

- Polar examples

| | Homogenous ($\delta = 1$) | | Scaled ($\delta = 0$) | |
|-----|-----------------------------|---------|---------------------------|---------------------|
| | FRA | USA | FRA | USA |
| U | 0 | ν^* | $(1 - \nu^*) \nu_U$ | $\nu^* \nu_U$ |
| S | $1 - \nu^*$ | 0 | $(1 - \nu^*) (1 - \nu_U)$ | $\nu^* (1 - \nu_U)$ |
| | all trades international | | no international | |

CALIBRATION

- Estimate process for detrended dividends

$$D_t = F_t^D + .02\varepsilon_t^D,$$
$$\Delta F_t^D = \underset{\text{(Momentum)}}{.42\Delta F_{t-1}^D} - \underset{\text{(Reversal)}}{.06F_{t-1}} + .11\varepsilon_t^{F^D}.$$

- Parsimonious class of processes for private returns
(Premium, Sharpe ratio same as US stock market)
- Choose private return and population parameters to match

| | |
|-----------------------------|------|
| E [US holdings] | 12.7 |
| σ (NP_t^*) | 0.28 |
| $corr$ (NP_t, NP_{t-1}) | 0.46 |
| E [Volume] | 16.9 |
| E [GP] | 0.9 |

\implies 60% S types, but only 57% S in American population ($\delta = .015$).

CALIBRATION

- Estimate process for detrended dividends

$$D_t = F_t^D + .02\varepsilon_t^D,$$
$$\Delta F_t^D = \underset{\text{(Momentum)}}{.42\Delta F_{t-1}^D} \overset{\text{(Reversal)}}{- .06F_{t-1}^D} + .11\varepsilon_t^{F^D}.$$

- Parsimonious class of processes for private returns
(Premium, Sharpe ratio same as US stock market)
- Choose private return and population parameters to match

| | |
|------------------------------------|------|
| E [US holdings] | 12.7 |
| σ (NP_t^*) | 0.28 |
| corr (NP_t, NP_{t-1}) | 0.46 |
| E [Volume] | 16.9 |
| E [GP] | 0.9 |

\implies 60% S types, but only 57% S in American population ($\delta = .015$).

CALIBRATION

- Estimate process for detrended dividends

$$D_t = F_t^D + .02\varepsilon_t^D,$$
$$\Delta F_t^D = \underbrace{.42\Delta F_{t-1}^D}_{\text{(Momentum)}} - .06F_{t-1} + .11\varepsilon_t^{F^D}.$$

(Reversal)

- Parsimonious class of processes for private returns
(Premium, Sharpe ratio same as US stock market)
- Choose private return and population parameters to match

| | |
|-----------------------------|------|
| E [US holdings] | 12.7 |
| σ (NP_t^*) | 0.28 |
| $corr$ (NP_t, NP_{t-1}) | 0.46 |
| E [Volume] | 16.9 |
| E [GP] | 0.9 |

\implies 60% S types, but only 57% S in American population ($\delta = .015$).

CALIBRATION

- Estimate process for detrended dividends

$$D_t = F_t^D + .02\varepsilon_t^D,$$
$$\Delta F_t^D = \underset{\text{(Momentum)}}{.42\Delta F_{t-1}^D} - \underset{\text{(Reversal)}}{.06F_{t-1}} + .11\varepsilon_t^{F^D}.$$

- Parsimonious class of processes for private returns
(Premium, Sharpe ratio same as US stock market)
- Choose private return and population parameters to match

| | |
|-----------------------------|------|
| E [US holdings] | 12.7 |
| σ (NP_t^*) | 0.28 |
| $corr$ (NP_t, NP_{t-1}) | 0.46 |
| E [Volume] | 16.9 |
| E [GP] | 0.9 |

\implies 60% S types, but only 57% S in American population ($\delta = .015$).

CALIBRATION

- Estimate process for detrended dividends

$$D_t = F_t^D + .02\varepsilon_t^D,$$
$$\Delta F_t^D = \underset{\text{(Momentum)}}{.42\Delta F_{t-1}^D} - \underset{\text{(Reversal)}}{.06F_{t-1}} + .11\varepsilon_t^{F^D}.$$

- Parsimonious class of processes for private returns
(Premium, Sharpe ratio same as US stock market)

- Choose private return and population parameters to match

| | |
|-----------------------------|------|
| E [US holdings] | 12.7 |
| σ (NP_t^*) | 0.28 |
| $corr$ (NP_t, NP_{t-1}) | 0.46 |
| E [Volume] | 16.9 |
| E [GP] | 0.9 |

\implies 60% S types, but only 57% S in American population ($\delta = .015$).

STYLIZED FACTS

Moments not used in calibration:

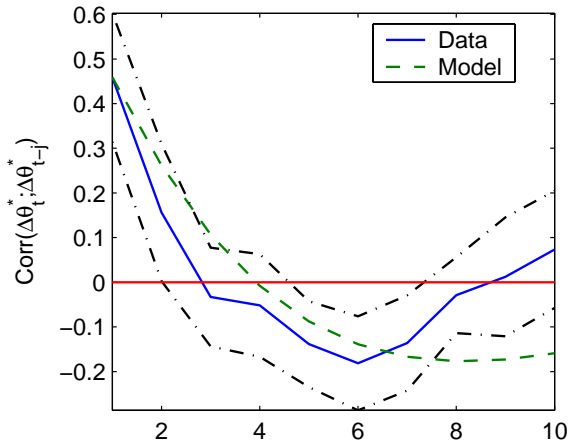
- Autocorrelation function of net purchases (beyond first lag)
- Gross trading activity: $\text{corr}(GP_t, GS_t) = .98$ (model) v. $.63$ (data).
- Return chasing:
 1. Cross-Correlogram of Local Returns & Net Purchases.

| | Data | Model |
|------------------------------|------|-------|
| $\text{corr}(R_t, NP_t)$ | .17 | .37 |
| $\text{corr}(R_{t-1}, NP_t)$ | .13 | .12 |

2. Bohn and Tesar (1996) exercise

$$\text{cov}\left(NP_t, E_t\left[R_{t+j} \mid \text{U investor information}\right]\right) = .15$$

France



STYLIZED FACTS

Moments not used in calibration:

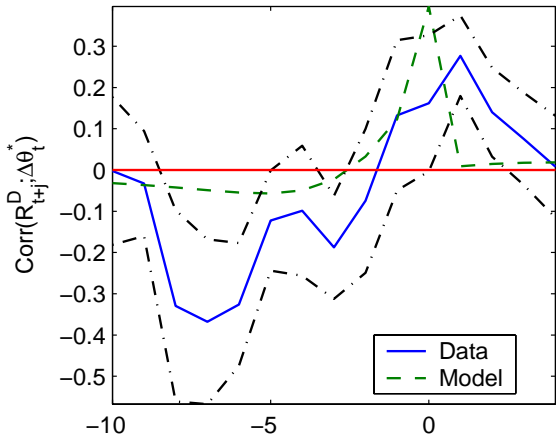
- Autocorrelation function of net purchases (beyond first lag)
- Gross trading activity: $\text{corr}(GP_t, GS_t) = .98$ (model) v. $.63$ (data).
- Return chasing:
 1. Cross-Correlogram of Local Returns & Net Purchases.

| | Data | Model |
|------------------------------|------|-------|
| $\text{corr}(R_t, NP_t)$ | .17 | .37 |
| $\text{corr}(R_{t-1}, NP_t)$ | .13 | .12 |

2. Bohn and Tesar (1996) exercise

$$\text{cov}\left(NP_t, E_t\left[R_{t+j} \mid \text{U investor information}\right]\right) = .15$$

France



STRUCTURAL ANALYSIS

Exercises

- Structural Impulse Responses
- Variance Decompositions

Results

- Return chasing as a business cycle phenomenon.
- No transitory components in flows (noise trades etc.)
- Small role for overreaction to public shocks: works against persistence.

OVER- AND UNDERREACTION TO SHOCKS

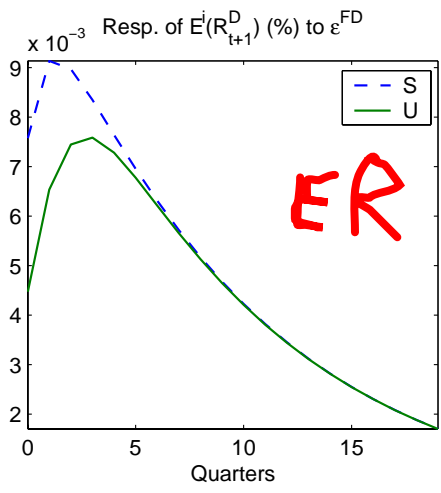
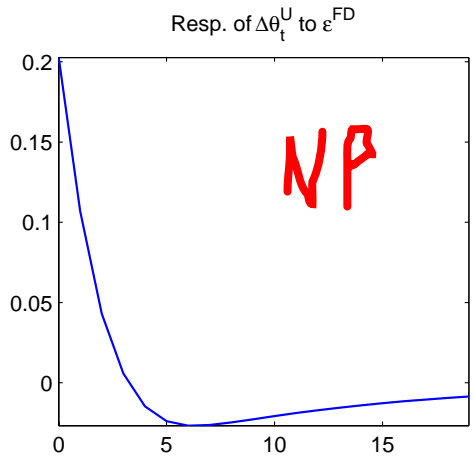
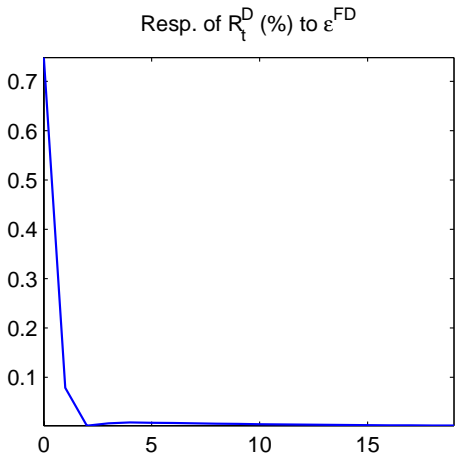
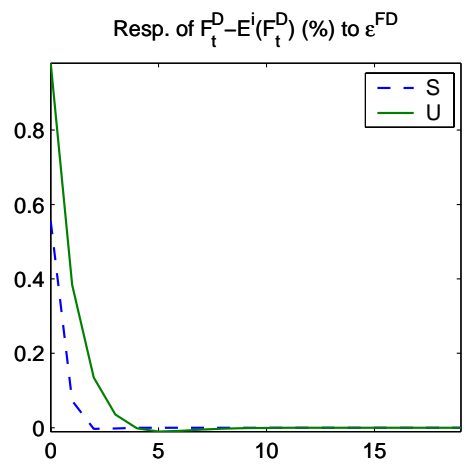
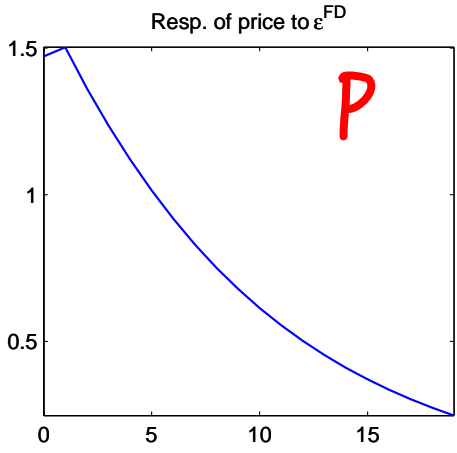
- Imperfect information: both investors try to infer state of cycle.

- Typical outcome under (steady state) Kalman filter:
 - ▲ underreaction to persistent shock
 - ▲ overreaction to temporary shock

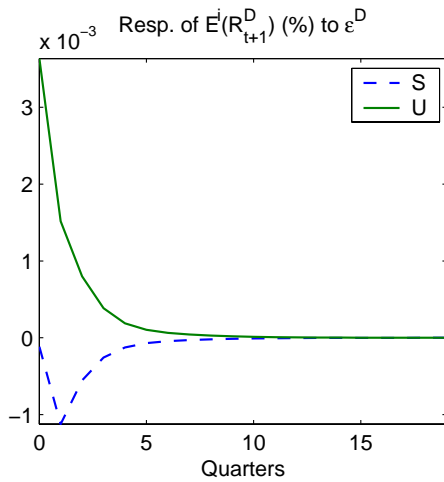
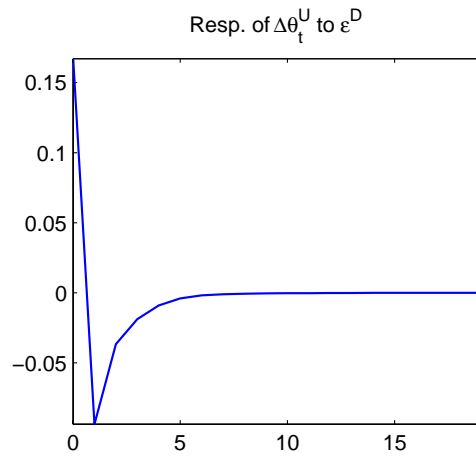
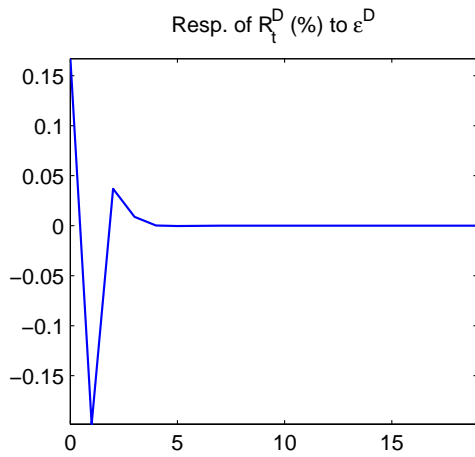
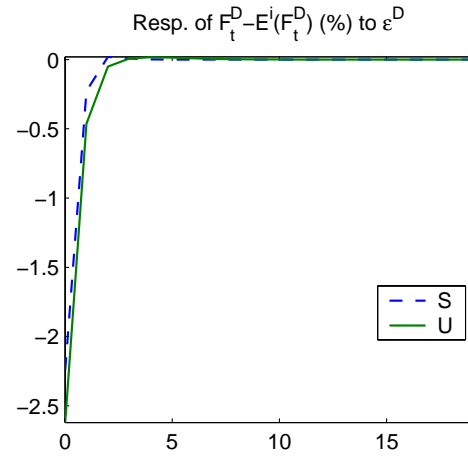
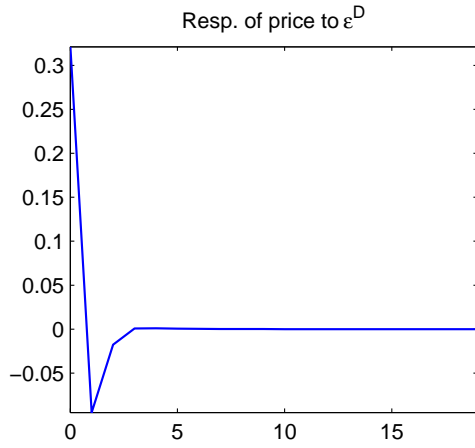
- Asymmetric information: hierarchical information sets.

- Unsophisticated investors
 - ▲ underreact more to persistent shock
 - ▲ overreact more to temporary shock to dividends (public signal)

ϵ^{FD}



ϵ^D



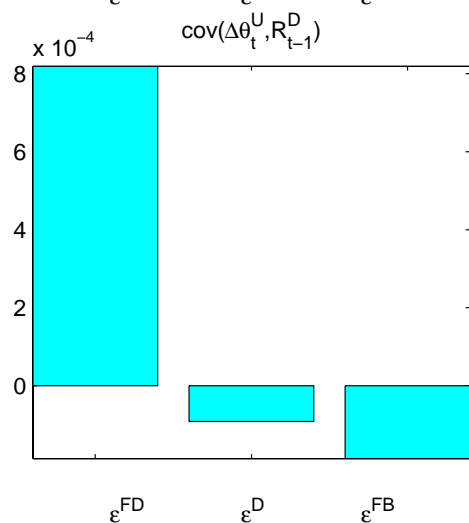
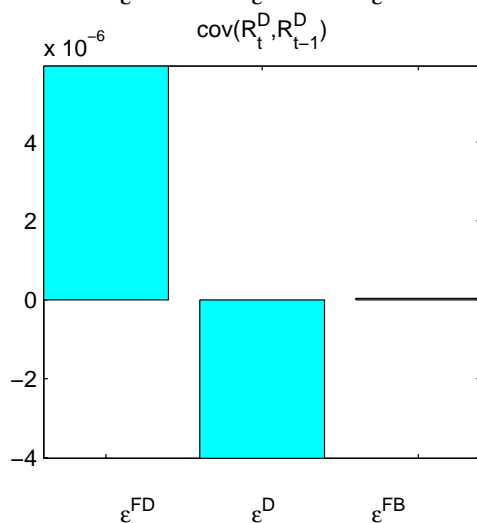
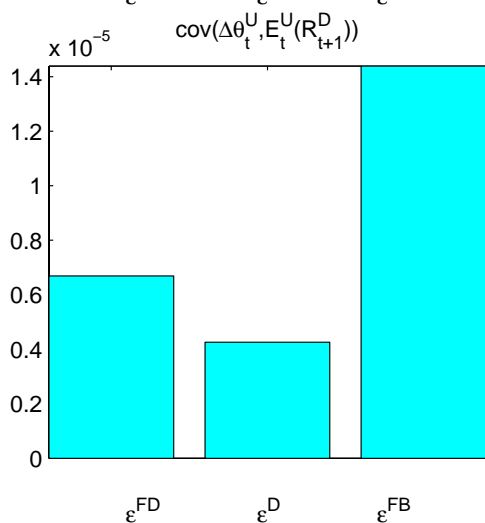
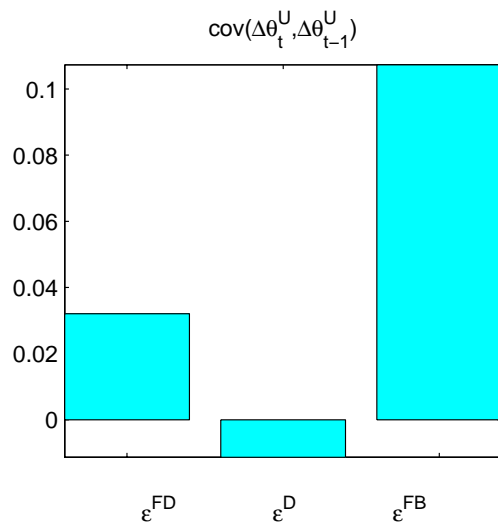
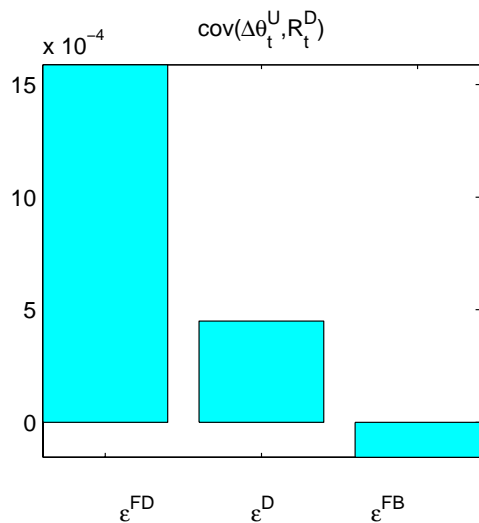
STRUCTURAL ANALYSIS

Exercises

- Structural Impulse Responses
- Variance Decompositions

Results

- Return chasing as a business cycle phenomenon.
- No transitory components in flows (noise trades etc.)
- Small role for overreaction to public shocks: works against persistence.



CONCLUSION

- 4 facts: Gross activity, flow momentum & reversal, return chasing.
 - Structural model of dynamic trading; quantitatively matches facts.
 - Key assumptions
 1. Within-country heterogeneity.
 2. On- and off-market opportunities; asymmetric information.
 3. Business cycle.
- ⇒ Risk sharing and disagreement systematically change over cycle.
- ⇒ Rational return chasing by less informed Americans.