

# Rational Inattention and Price Underreaction

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# Outline

1. High-Level Overview
2. This Paper's Results

# Background

## Well-known back and forth in the literature:

1. Excess volatility is pervasive, especially at very high & very low frequencies [Shiller (1981); LeRoy & Porter (1981); De Bondt & Thaler (1985); Lehmann (1990); lots of stuff over intervening 20 years. . .; Augenblick & Lazarus (2018); Giglio & Kelly (2018)]
  - ▶ Campbell (2017): Equity volatility is one of three “fundamental challenges for consumption-based asset pricing models”
2. At the same time, momentum is pervasive as well!
  - ▶ Especially in the medium term and in response to firm-specific announcements

## How/why??

- ▶ Point 1 interpreted as indicative of widespread overreaction
- ▶ Point 2: widespread underreaction
- ▶ Can these be reconciled?

# Reconciling Over- and Underreaction

**Some (excellent) work has been done writing down models to reconcile the two sets of results:**

- ▶ Overreaction coupled with some form of (mental or physical) adjustment friction generates both predictions [e.g., Barberis, Greenwood, Shleifer, Jin (2018)]
- ▶ Will talk about other possibilities in a bit

**For this paper, though, I want to focus on a higher-level question:**

**Over- or underreaction *relative to what benchmark?***

- ▶ That is, what does it mean to over- vs. underreact?
- ▶ And when can we call such behavior “rational”?

**This paper will have a good answer to the second question, but want to push as well on the first.**

# What is Over- vs. Underreaction?

- ▶ Imagine a “biased Bayesian” updating beliefs about the likelihood of some underlying state  $\theta$  given signals  $s^t \equiv (s_0, s_1, \dots, s_t)$  [Augenblick & Rabin (2018)]:

$$\pi(\theta|s^t) = \frac{\mathbb{P}(s_t|\theta, s^{t-1})^\alpha \pi(\theta|s^{t-1})^\beta}{\sum_{\theta' \in \Theta} \mathbb{P}(s_t|\theta', s^{t-1})^\alpha \pi(\theta'|s^{t-1})^\beta}$$

- ▶  $\alpha > 1$ : *Overreaction* to new signal relative to “correct” weight of  $\alpha = 1$
- ▶  $0 \leq \beta < 1$ : *Underattentiveness* (underreaction?) to prior (“base-rate neglect”)
- ▶ Note that *both* produce excess volatility of beliefs; both feature overreaction to new information *relative to prior information*
- ▶ But are they the same phenomenon? **No**:
  - ▶  $\alpha > 1$ : on avg., agent has beliefs that are *too certain* (too close to 0 or 1)
  - ▶  $\beta < 1$ : agent’s not certain enough [Benjamin, Bodoh-Creed, Rabin (2017)]
- ▶ What about  $\alpha < 1$  and  $\beta \ll 1$ ?
  - ▶ Underreaction to new signals, but excess belief volatility
- ▶ Starts to seem tough to disentangle over- vs. underreaction just from prices...
  - ▶ ...but risk-neutral beliefs are useful

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# This Paper's Framework

## Clever set of tests:

- ▶ Two-way sort of corporate bonds by “payoff relevance” of (i) interest-rate risk, (ii) credit risk
  - ▶ **Payoff relevance of risk  $j$ :** Variance of fundamental-value shocks attributable to risk  $j$
  - ▶ Concretely: Value =  $\sum_j f_j$ , with  $\{f_j\}$  uncorrelated mean-zero factors  $\implies$  Payoff relevance of factor  $f_j$  is  $\sigma_j$
- ▶ See how long it takes each set of bonds to incorporate all new info from interest-rate shocks and credit-risk shocks
  - ▶ In particular, what fraction of 8-week bond returns are realized within 1 week in response to change in interest rates vs. change in credit risk?
- ▶ Findings:
  - (a) Higher payoff relevance for a given risk  $\implies$  quicker price reaction to that risk
  - (b) Higher payoff relevance for a given risk  $\implies$  slower price reaction to other risk (though evidence is mixed on this one)

# Interpretation: Over- vs. Underreaction

$$\text{BondRet}_{i,t} = \alpha_i + \underbrace{\sum_{l=0}^7 \beta_l^{\text{stock}} \text{StockRet}_{i,t-l}}_{(1)} + \underbrace{\sum_{l=0}^7 \beta_l^{\text{Tsy}} \text{TsyRet}_{i,t-l}}_{(2)} + \varepsilon_{i,t}$$

PayoffRelevance<sub>i</sub><sup>stock</sup> = explained sum of squares from (1)

$$\text{Underreaction}^{\text{stock}} = 1 - \frac{\hat{\beta}_0^{\text{stock}}}{\sum_{l=0}^7 \hat{\beta}_l^{\text{stock}}}$$

- ▶ Stock underreaction is lower for bond portfolios with greater payoff relevance from stocks (proxy for higher credit risk); corollary holds for interest-rate risk
- ▶ Let's return to the overview: What are we ruling in vs. out?
  - ▶ Finding: Bond prices react too little *relative to predicted eventual reaction in response to stock-return innovations*
  - ▶ But what if stock returns are also positively autocorrelated at this horizon?



# Interpretation: Over- vs. Underreaction

- ▶ Finding: Bond prices react too little *relative to predicted eventual reaction in response to stock-return innovations*
- ▶ But what if stock returns are also positively autocorrelated at this horizon?
  - ▶ P. 10: *“In using these returns as shock proxies, I am relying on Treasuries and stock returns being faster to reflect interest-rate and firm-level fundamental movements. . . investors in [the] stock market should pay much more attention to firm-specific fundamental information because, being lower in the capital structure, stocks are more sensitive to firm fundamentals than corporate bonds.”*
  - ▶ Not sure this always follows. Consider Merton model: risky debt is risk-free bond minus put on firms' assets with strike equal to face value of debt; stock is call on assets with same strike
  - ▶ Put-call parity tells us that put and call with same strike have exact same price response to change in asset vol.  $\implies$  stocks and debt have exact same sensitivity to this change in default risk
  - ▶ Also know from lots of other literature [Hou & Moskowitz (2005); Asness, Moskowitz, Pedersen (2013); Bittlingmayer & Moser (2014)] that stocks exhibit momentum at medium horizon

# Interpretation: Over- vs. Underreaction

- ▶ Finding: Bond prices react too little *relative to predicted eventual reaction in response to stock-return innovations*
- ▶ But what if stock returns are also positively autocorrelated at this horizon?
  - ▶ Takeaway: Bond market may be reacting “correctly” *relative to contemporaneous stock-market reaction* if stocks also take time to fully incorporate info
  - ▶ Do results survive controlling for lagged bond-market returns?
  - ▶ Either way, still finding momentum; issue is just how to interpret it
- ▶ More on over- vs. underreaction: What if investors are underreacting to market-wide info, but *overreacting* to private info (relative to Bayesians)?  
[Daniel, Hirshleifer, Subrahmanyam (1998); Gennaioli, Ma, Shleifer (2018)]
  - ▶ Seems consistent with longer-term excess volatility, which Giglio & Kelly (2018) find direct evidence for in corporate CDS markets
  - ▶ And the fact that there are such high Sharpe ratios for momentum strategy, *but* that transactions costs are large enough to render these small from a trading perspective, would seem to indicate this is a market where private info is important

# Interpretation: Rational Inattention

- ▶ While I'm a bit skeptical of “underreaction” framing, the rational inattention framing seems interesting and robust
- ▶ My quibbles over the past few slides are about how to interpret momentum, but *not* how to interpret relatively less momentum in response to more-relevant shocks
- ▶ Seems to me to be a nice, fairly clean test of the fact that attention allocation makes sense directionally within this market (which is dominated by institutional investors)
  - ▶ But one note: inattention that's rational doesn't preclude overattention that's irrational
  - ▶ ...especially since (I think) evidence is at least consistent with overattentiveness to private info, as on last slide

# Final Notes

- ▶ What we learn from this exercise:
  1. Underreaction in bonds *relative to predicted eventual reaction* in response to stock-return (and interest-rate) innovations
  2. This response “makes sense,” in that investors do underreact less when innovations are more payoff-relevant
- ▶ Jury still out on overreaction vs. underreaction more generally, and lots of conceptual issues to sort through
  - ▶ To disentangle a bit better between different explanations, would love to know about behavior of risk-neutral beliefs (e.g., from options on corporate CDS)
- ▶ Neat paper overall