RESEARCH STATEMENT
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I am a theorist, working in the fields of behavioral finance and asset pricing. I am interested in models that feature less than fully rational decision-making on the part of some agents—for instance, decision-making based on incorrect beliefs or non-traditional preferences—and also in models that feature frictions of some kind, especially financial frictions. When building the models, I restrict myself to relatively small deviations from the traditional framework, deviations that are motivated by robust evidence from the laboratory or the field. I then derive the implications and predictions of these models. Also, I collaborate with empiricists to design and test model predictions.

In this statement, I briefly discuss the types of irrational beliefs, non-traditional preferences, and financial frictions that I have studied in my published and ongoing work. I then offer a few concluding remarks about my future research agenda.

MODELS WITH INCORRECT BELIEFS

Relevant papers:

(1) "X-CAPM: An Extrapolation-based Model of the Aggregate Stock Market," with Nicholas Barberis, Robin Greenwood, and Andrei Shleifer, *Journal of Financial Economics*, 2015.
(2) "Asset Pricing with Return Extrapolation," with Pengfei Sui, Working paper.
(3) "Extrapolation and Bubbles," with Nicholas Barberis, Robin Greenwood, and Andrei Shleifer, Accepted, *Journal of Financial Economics*.
(4) "Extrapolative Beliefs in the Cross-section: What Can We Learn from the Crowds?," with Zhi Da and Xing Huang, Working paper, 2017.
(5) "A Speculative Asset Pricing Model of Financial Instability," Working paper, 2015.
(6) "A Model of Credit Market Sentiment," with Robin Greenwood and Samuel Hanson, Working paper, 2016.
(7) "The Cushioning Benefits of Biased Beliefs," with Matthew Shum and Mali Zhang, Working paper, 2017.

In economics and finance, recent survey evidence on actual investor expectations has highlighted the role of incorrect beliefs. One important type of incorrect beliefs is *return extrapolation*, the notion that real-world investors tend to forecast that stock returns will be high after they have been high in the recent past, and low after they have been low recently. While beliefs of this kind are directly supported by both survey data and fund flow data, they are at odds with the predictions of leading asset pricing models, which typically imply that, after good past returns, investors expect *low* returns going forward. In [1], Barberis, Greenwood, Shleifer, and I show that, by introducing some investors who extrapolate past returns into an otherwise traditional consumption-based asset pricing model, we can make sense not only of many important facts about prices and

returns, but also, by construction, of the available evidence on the expectations of real-world investors.

One main issue with the model of [1] is that it does not generate well-defined distributions for the ratio-based quantities such as the price-dividend ratio that are at the heart of asset pricing. In [2], my co-author and I try to resolve this issue. We develop a Lucas-type general equilibrium model with return extrapolation featuring Epstein-Zin preferences. We compare the model predictions seriously with the data. And we find that the model matches important facts about aggregate asset prices, matches extrapolative expectations in surveys, and allows for a direct comparison with rational expectations models. The model also implies that the correlation between the price dividend ratio and subjective expectations about future dividend growth is much *higher* than the correlation between the price dividend ratio and subjective expectations about future returns. That is, a Campbell-Shiller decomposition using investor expectations suggests that stock market movements primarily come from changes in the subjective expectations about future dividend growth. This finding contradicts the traditional view that stock market movements come from discount rate variation, but is consistent with the recent empirical findings of De la O and Myers (2017).

In [3], my co-authors and I further make the case that a model of return extrapolation may also be very helpful for thinking about asset bubbles. In the model, many investors form their demand for a risky asset by weighing two signals—an average of the asset's past price changes and the asset's degree of overvaluation—and "waver" over time in the relative weight they put on them. The model predicts that good news about fundamentals can trigger large price bubbles, that bubbles will be accompanied by high trading volume, and that volume increases with past asset returns. We present empirical evidence that bears on some of the model's distinctive predictions.

So far, most of the survey evidence on return extrapolation pertains to the aggregate stock market (see the summary in Greenwood and Shleifer, 2014). There has not been much direct evidence of such extrapolation in the cross-section. In [4], my co-authors and I provide such evidence. Specifically, we use novel data from a crowdsourcing platform for ranking stocks to investigate how individuals form beliefs about future stock returns. In each contest on the platform, competitors are asked to rank ten stocks according to their expected performance (% gain) over the course of the contest (usually one week). These rankings allow us to investigate how investors form return expectations on individual stocks in the cross-section. We find that individuals extrapolate from past returns, with more weight on more recent returns, especially when recent returns are negative. Such an extrapolation bias is stronger among large stocks and users who are not financial professionals. The consensus rankings negatively predict future stock returns in the cross-section, consistent with the asset pricing implications of extrapolative beliefs. The return predictability associated with extrapolative beliefs is robust to controlling for past returns over multiple horizons; it extends to large stocks that are not covered on the platform; and it is unlikely to be driven by liquidity-shock-induced price reversals.

Besides return extrapolation, investors also exhibit another type of mistaken beliefs: incorrect beliefs about *crash risk*. Building on survey evidence in Goetzmann, Kim, and Shiller (2016), in [5] I use a model of incorrect beliefs about crash risk to think about a broad set of phenomena—about debt-driven booms and busts, crashes in financial markets, and bank failures and losses. Specifically, my model is a continuous-time general equilibrium model featuring investors who have incorrect beliefs about *crash likelihood*. While the true likelihood of a crash is constant over time, investors think that the likelihood is time-varying. In particular, if a long period of time goes by without a crash, some investors' perceived crash risk falls below the true crash risk, inducing them to take on excessive leverage. Following a drop in fundamentals, these investors de-lever substantially, both because of their high pre-crash leverage and because their beliefs about future crash risk deteriorate. Together, these two channels generate a crash in the risky asset price that is much larger than the drop in fundamentals. The lower perceived crash risk after years with no crashes also means that the average excess return on the risky asset is low at precisely the moment when any crash that occurs would be especially large in size; moreover, it means that, in the event of a crash, some investors may default and banks may sustain large unexpected losses. Finally, the model shows how pre-crash warning signs can generate financial fragility. By reducing investors' optimism, warning signs also increase investors' uncertainty about their beliefs and thereby make them more likely to overreact to future bad news.

In the context of the corporate bond market, my co-authors and I present in [6] a model of credit market sentiment in which investors form beliefs about future creditworthiness by extrapolating past *defaults*. Our key contribution is to model the endogenous two-way feedback between credit market sentiment and credit market outcomes. This feedback arises because investors' beliefs depend on past defaults, but beliefs also drive future defaults through investors' willingness to refinance debt at low interest rates. Our model is able to capture many documented features of credit booms and busts, including the link between credit growth and future returns, and the "calm before the storm" periods in which fundamentals have deteriorated but the credit market has not yet turned.

Most studies of incorrect beliefs focus on the negative impact of such beliefs. For instance, in [2] my co-authors and I show that extrapolating past returns leads to bubbles and crashes that have negative consequences for the economy. However, incorrect beliefs can also have *positive* impact. In [7], my co-authors and I present a model of dynamic investment and production when producers may have biased beliefs in which they over-extrapolate recent demand conditions into the future. This bias leads producers' beliefs to exhibit *insufficient mean reversion*, as these producers underestimate the degree of mean reversion in the demand process. We point out that in a volatile industry, while biased beliefs lead firms to make sub-optimal investment decisions in the short-run, they can be beneficial in the long-run by counteracting the general trend in the industry, "cushioning" the industry against prolonged downturns and aiding faster recovery. As an empirical case study, we consider oil exploration in Alaska. We present evidence that firms in this industry were subject to extrapolation bias, leading to drilling of lower-revenue wells after recent price increases. Calibration of our model to Alaska oil exploration shows that the cushioning effect can be large: in a typical episode of oil price decline arising from a

sequence of adverse demand shocks, the cushioning effect reduces the decline of the oil price by 8.2% and accelerates the price recovery by 27%. This showcases the potential positive implications that biased beliefs can have on industry dynamics.

MODELS WITH NON-TRADITIONAL PREFERENCES

Relevant paper:

(8) "Realization Utility with Reference-Dependent Preferences," with Jonathan Ingersoll, *Review of Financial Studies*, 2013.

Realization utility is the idea that, rather than deriving utility only from consumption or wealth, investors also derive utility directly from the act of realizing a gain or loss on an asset they hold. Earlier models of realization utility, such as the model of Barberis and Xiong (2012), have shown that this idea can shed light on a number of financial phenomena; however, they have also struggled to match some aspects of the data—most strikingly, they have a hard time explaining why investors would ever voluntarily sell an asset at a loss. In [8], Ingersoll and I analyze a model that combines realization utility with diminishing sensitivity, the notion that the pleasure or pain brought to investors by an extra dollar of gain or loss is decreasing in the overall level of gains or losses. We find that this simple and apparently minor extension of prior models of realization utility significantly improves our ability to match empirical facts about trading behavior and asset prices. For example, in our model, investors do sometimes voluntarily sell at a loss: they take the loss, painful though it is, so as to transfer the proceeds to a new asset where they have a chance to make future gains.

MODELS WITH FINANCIAL FRICTIONS

Relevant paper:

(9) "A Two-Tree Intermediary Asset Pricing Model," Work in progress, 2015.

A growing body of theoretical work highlights the importance of intermediary capital in driving asset prices and investment and consumption decisions. In [9], I develop a dynamic general equilibrium model that studies how the presence of intermediaries can generate contagion between two asset markets—say between the aggregate stock market and the mortgage-backed security (MBS) market. In my model, households can directly access the aggregate stock market but can only access the MBS market through intermediaries; moreover, as in He and Krishnamurthy (2013), the intermediaries face an equity constraint due to financial frictions. I show that, under these assumptions, the contagion takes a particular form: a price drop in the MBS market can have a significant impact on the aggregate stock market, but only when the amount of intermediary capital is low.

I conclude with some final thoughts about this research agenda. First, for research about incorrect beliefs, it is important to understand the connection between different types of incorrect beliefs. One possibility is to design experiments to better understand the microfoundations of belief formation. Second, the interaction between incorrect beliefs and non-traditional preferences remains largely understudied. For instance, realization utility preferences modelled in [8] may interact with return extrapolation studied in [1] and [2] to explain patterns about asset prices and trading behavior. Lastly, both behavioral biases and financial intermediaries may play an important role in segmented markets; certainly, this is suggested by the recent financial crisis. In [5], I attempt to study them both, but there is clearly much more work of this type to be done.

REFERENCES

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