

# Research Statement

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I am a macroeconomist with the interests in the role of learning and expectation in asset pricing. This research statement is organized as follows. The first section discusses my current work. In the second section I describe my future research plan.

## 1. Current Work

In the field of asset pricing, there exists many interesting asset market facts in addition to the well-known equity premium and asset prices volatility. My research has grounded on reconciling empirical facts in asset market and consumption-based asset pricing models, especially the models with the agents who don't have rational expectations.

In my job market paper, *Stock Price, Risk-free Rate and Learning* I study the co-movement between stock price and risk-free rate. The widespread viewpoint or the classical Gordon model with risk-neutral agents predicts that stock price-dividend ratio should negatively correlated with risk-free rate and risk-free rate could be an important factor in driving stock price volatility. In the consumption-based asset pricing models with rational expectation, risk-free rate is determined by stochastic discount factor (SDF) and the stock price is the discounted sum of future dividend by SDF. When two assets are priced by the same SDF, the model-implied co-movement between stock price and risk-free rate should be strong.

This paper raises the question "Is the co-movement strong in the data?". This question is often ignored in the literature even though lots of works contribute to explain equity premium and volatility. This question, however, in the first is important for the asset markets participants since both stock and risk-free bond are two typical assets in their portfolios. Understanding the co-movement helps them efficiently invest their wealth. Second, policy makers also concerns about this question. Since the financial crisis, should and how central bank designs monetary policy to stabilize stock market fluctuation has been the subject of a heated debate. The co-movement should be well studied considering the risk-free rate is the channel for conducting monetary policy.

I use US S&P 500 index data for stock price and 3-month T-Bill data for risk-free rate. The paper first documents empirical evidences regarding the co-movement between stock price and risk-free rate. It finds a weak correlation between stock price-dividend ratio and risk-free rate. Also using Campbell and Ammer variance decomposition approach the variance of the news about future risk-free rate only contributes a little to the variance of unexpected stock excess return. These empirical facts are robust to different sample periods including 1927 to 2007, 1952 to 2007 and 1970 to 2007. I then investigate if two rational expectation (RE) asset pricing models—Campbell and Cocharane’s Habit model and Bansal, Kiku and Yaron’s Long-run Risk model—can imply the weak co-movement. The reason for choosing these two models is that both them are successful in generating important stock market facts including equity premium, volatility and the mean-reversion. The paper finds that the model-implied correlations between price-dividend ratio and risk-free rate are much stronger than observed empirically primarily because prices of both assets (stock and bond) are influenced by the same set of fundamental variables. Furthermore, both models’ variance decomposition results cannot match the data.

Considering the difficulties of RE models in matching data, I propose a simple model by relaxing the RE assumption and allow the existence of "Internally Rational" agents. I extend Adam, Marcet and Nicolini (2016) to introduce an exogenous time-varying risk-free

rate. When each agent doesn't know other agents' preferences and information, they don't know the mapping from fundamentals to stock price and stock can no longer be priced as the discounted sum of future dividends. "Internally Rational" agents still optimize their behaviors based on their subjective beliefs about all variables that are beyond their control. Given the subjective beliefs I specify, agents optimally update their expectations about stock price behavior using Kalman filter. Agents' subjective expectations in turn influence equilibrium stock price, and the realized stock price feeds back into agents' beliefs. This self-referential aspect of the model implies that even though risk-free rate is still in the SDF, stock price is dominatedly determined by agents' expectations instead of SDF.

Quantitative evaluation of all models utilized in this paper relies on the method of simulated moments (MSM) to test them. The simulation results confirm that my "Internal Rational" model outperforms the above-mentioned RE models in simultaneously matching basic stock market moments and the moments measuring the weak co-movement between stock and short-term bond markets. To explore model's dynamics, I estimate the impulse response of stock price to risk-free rate shock using vector-autoregression analysis. The large confidence band of data impulse response covering from positive to negative territories implies the weak co-movement between stock and short-term bond markets. And our learning model's impulse response is quite close to the data one.

The paper contributes to the literature by formally studying the co-movement between stock price and risk-free rate. First, it documents that two RE asset pricing models are not consistent with empirical facts regarding the co-movement. Second, it provides a simple theory to account for the weak co-movement.

My second paper jointly with Renbin Zhang, *Understanding AH Premium in China Stock Markets* studies AH premium in China stock markets. There are 88 companies (AH share) dual-listed in China mainland stock markets (A share) and Hong Kong market (H share). The market value of AH share accounts for 20% of total A share. The stocks of AH share pay the same dividends to investors holding A share or H share. The price differences of

AH share between mainland and Hong Kong market is called AH premium. Since November 2014, the starting of Shanghai-Hong Kong Stock Connect program makes two previously segmented markets—Shanghai and Hong Kong—connected. According to standard theory, AH premium should be expected to converge. Contrast to theory's prediction, AH premium measured by Hang Seng AH Premium Index continually increases and reaches at 150 as the peak, which means price of AH share in Shanghai market is 50% higher than it in Hong Kong.

There exists a lot of works on the price differences of the same stock in different segmented markets (Fernald and Rogers, 2002). But the AH premium problem is an interesting anomaly because two markets now are connected. We then investigate if heterogenous agents asset pricing model can generate AH premium. Agents could have different risk-aversions, different dividend taxes, transaction costs and diverse beliefs about the fundamentals. We arrive at the conclusion that in the complete market or incomplete market risk-aversions and diverse beliefs cannot generate any AH premium, transaction cost can be ignored, and dividend taxes can generate 5%-6% almost constant AH premium.

Given the failure of these asset pricing models, we propose an "Internal Rationality" learning model, in which agents don't know the pricing functions from fundamentals to stock prices and have different subjective beliefs about tomorrow's capital gains between Shanghai and Hong Kong markets. We show that these different beliefs can come from different initial beliefs or different learning speeds, both of them can be supported by the data. This model is able to successfully generate data-like weekly AH premium due to the more optimistic belief in Shanghai market than it in Hong Kong. We also investigate whether the convergence trader can make money with the strategy short-selling in Shanghai and long-buying in Hong Kong. By Monte-Carlo simulation we find that convergence trader will be asked for liquidation with probability from 40% to 90% if not adding security deposit. Even without forced liquidation convergence trader has about 35% probability to lose money in 3, 6, 9 and 12 months.

This paper first contributes to the literature by studying price differences of the same stock in two connected markets. Second, technically it contributes by numerically studying how agents with diverse beliefs have the same SDF through trading contingent bonds in the complete market.

## 2. Research Plan

My plans for further research encompass two aspects. First, in an on-going project jointly with Jian Wang and Jianfeng Yu we are trying to explain uncovered interest parity puzzle and volatility puzzle in the exchange rate market using "Internally Rational" agent approach. We are also exploring the sources empirically leading to the exchange rate level puzzle introduced in Engel (2016). Second, I plan to work with Albert Marcet on how to correct small sample bias in estimating mean-reversion property of stock price (Stambaugh (1999), Ferson, Sarkissan and Simin (2003), and Campbell and Yogo (2006)).

To summarize, in these pieces of research I combine the interests in asset pricing in different asset markets at the theoretical as well as at the empirical level. I hope to continue working on these topics in the near future.

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