Tao Wang
347-260-3960
twang80@jhu.edu

To
Organizers of NBER Behavioral Macroeconomics Research Boot Camp

December 9, 2019

Hi!

This is Tao Wang, currently a 3rd year Ph.D. student in economics at Johns Hopkins University. I am applying to be considered as a participant of the NBER Behavioral Macroeconomics Research Boot Camp.

I am enclosing my CV and two-page research statement for your reference. Prof. Christopher Carroll (ccarroll@jhu.edu) will be my reference.

I look forward to hearing from you.

Thanks you.

Tao Wang

Tao Wang

Last update: December 8, 2019

CONTACT INFORMATION

Johns Hopkins University
Wyman Park Building, 5th Floor
3100 Wyman Park Dr
Baltimore, MD 21211

Homepage: http://taowangecon.github.io
GitHub: https://github.com/iworld1991
✉ E-mail: twang80@jhu.edu
Phone: (410) 516-7601

RESEARCH INTEREST

- **Behavioral macroeconomics**: expectation formation
- **Heterogeneous-agent macroeconomics:** household behaviors and macroeconomic dynamics

EDUCATION

Johns Hopkins University, Baltimore, MD — 2017– 2022 (expected)

- M.A. and Ph.D. candidate in Economics
- Advisor: Prof. Christopher Carroll
- Coursework: Time Series Econometrics, Asset Pricing, Decision Making under Uncertainty, Computational Macroeconomics, Information in Economics and Finance, International Finance, Advanced Macroeconomics I & II

Cornell University, Ithaca, NY — 2013–2015

- M.P.A. in Cornell Institute for Public Affairs
- Thesis: *Chinese Macroeconomic Policies, Restrictive Central Bank Independence, and Market Expectations*, advisor: Prof. Assaf Razin

Renmin University of China, Beijing, China — 2009–2013

- B.A. in Economics
- Thesis: *Economic Behaviors of Local Governments*

WORK IN PROGRESS

1. *"Rigidity of Expectations, Additional Evidence from Density Forecasts of the Inflation by Professionals and Households"*, working paper draft, 2019.

   Abstract: Density forecasts of macroeconomic variables provide one additional moment restriction, uncertainty, for testing and exploring the implications of theories about how people form expectations differently from full-information rationality benchmark. This paper first documents the persistent dispersion in inflation uncertainty of professionals and households, and how it conveys different information from the widely used proxies to uncertainty such as cross-sectional disagreement and forecast errors. Second, utilizing the panel data structure of both surveys, I provide additional reduced-form test results as well as structural estimates for each particular theory of "irrational expectation" by jointly accounting for its predictions for different moments. This is a natural extension of Coibion and Gorodnichenko (2012), which examines different moments separately. Also, motivated by the time-varying pattern of the uncertainty observed from surveys, I extend their work to allow for an alternative inflation process featuring stochastic volatility. These extensions allow me to match the joint dynamics of inflation and forecast moments in a better degree of fitness. It also illustrates how incorporating higher moments from survey data helps understand both the expectation formation mechanisms and inflation dynamics.

2. *"Perceived Income Risks"*, work in progress.

   Abstract: What econometricians have assumed to be the labor income risks facing agents based on estimates from cross-sectional inequality may not necessarily be consistent with what is truely perceived. This work in progress studies individual-specific perceived income risks utilizing a density survey of labor income. Empirically, I have found the earners who are female, from low-income households and low education has higher perceived risks. And both perceived variance and tail risk measure skewness are negatively correlated with stock market returns. The ongoing work includes characterizing how the subjective differences are both driven by the true income risk profile and perceptual heterogeneity from alternative mechanisms of expectation formation deviating from full-informational rationality. I will also incorporate empirical findings in an otherwise standard life-cycle model of consumption and portfolio choice to explore their implications on consumption insurance and asset pricing.

Research Assistant Experience

- **Heterogeneous-agent macroeconomic modeling** 2019
  Econ-ARK Project led by Prof. Christopher Carroll
  - Wrote Python code that evaluates, illustrates and visualizes the dimension-reduction by Bayer and Luetticke (2018).
  - Contributed to the Jupyter notebook replicating Krusell-Smith (1998) algorithm via HARK toolkit.
- **Tutorials on quantitative economic modeling** 2017
  QuantEcon, Prof. Thomas Sargent (New York University)
- **Capital account liberalization and exchange rate dynamics** 2015
  Prof. Eswar Prasad (Cornell University)

Employment Experiences

- **International Monetary Fund** 2016-2017
  Research Assistant in the Research Department
- **The Brookings Institution** 2015-2016
  Research Analyst in Global Economy and Development Program

Technical Skills

- *Programming Languages*: Python, Matlab, Stata

Policy Publication

1. **A Sy and T Wang** . *"De-risking, Renminbi Internationalization and Regional Integration: Evidence from Payment Flows of Sub-Saharan Africa"*. Brookings Working Paper, 2016.

References

- Prof. **Christopher Carroll** (JHU), ccarroll@jhu.edu
- Prof. **Jonathan Wright** (JHU), wrightj@jhu.edu

Research Statement

Tao Wang

December 8, 2019

Almost every real-world economic decision is based on expectations. As a Ph.D. macroeconomist in training at Johns Hopkins University, I have long seen it as a field of great importance and intellectual appeal to understand how economic agents form expectations, perceive their environments and make individual decisions that aggregate up to important macro patterns. Therefore, I have devoted my dissertation to studying mechanisms, drivers, measures, and macroeconomic implications of economic expectations of both micro and macro variables.

One of my working papers (see link here) employes density forecasts of the inflation by professionals and households to study the implications of information rigidity for higher moments of forecasts, i.e. uncertainty. In a similar spirit of Coibion and Gorodnichenko (2015), I first derive testable predictions by sticky expectations, noisy information and so forth on the dynamics of not only forecast errors and disagreement but also subjective uncertainties. The observed pattern of time-varying forecast uncertainty also motivates me to explore the alternative assumptions of the inflation process featuring stochastic volatility. I show in the paper that incorporating higher moments in the estimation of each theory of expectation formation, and joint estimation with the process of inflation help results in better fitness of the theory and the empirically observed forecasting moments. It also reveals the fruitfulness of jointly studying realized and expected macro series and how it avoids making stringent assumptions of either full-rationality of agents or the perfect correctness of model specifications by econometricians.

In my second ongoing project entitled *Perceived Income Risks* (preliminary draft here), I shift the gear to studying expectations of individual variables, the labor income, with a particular focus on higher moments. The central question of the paper is how much of the perceived income risks reflect their true income risks and how much of it comes from certainty perceptual mechanisms deviating from rational expectations and imperfect information. In order to achieve this goal, I first carry on density estimations for the surveyed forecasts of labor income. This directly provides household-specific subjective income distributions. The higher moments such as variance and skewness can be used to characterize the perceived risk profile of individuals. Next, perceived income risks can be decomposed into components of different degrees of persistence, and I can examine if an individual's perception of income process is systematically

different from what has been estimated by economists using realized income data. Besides, I can characterize how perceived income risks, skewness and so forth correlate with the risky asset returns. The paper also incorporates these findings into otherwise standard life-cycle models, and I expect it to shed some light on the consumption insurances and the participation puzzle. I also see this paper as an effort to marrying the literature on expectation formation and heterogeneous-agent macro, in which the individual uninsured income risk and heterogeneity matter in macro patterns.

As one side product of the abovementioned effort, and motivated by my zealous interest in open-sourced computation in economic modeling, I have been developing a Python-based toolkit modeling different mechanisms of expectation formation. My vision is that the toolkit will be written in a transparent and generalized way across different theories of expectation formation so that other researchers can incorporate it into their structural models of a specific purpose. I also devote my effort to the measurement of market expectations using non-conventional methodologies such as textual analysis. In the ongoing collaboration with Professor Chris Carroll and other coauthors, we are working on extracting information from social media and Google trends that can be used to predict high-frequency consumer sentiment at the regional level. This, combined with transaction-level retail data obtained from a payment service company, has the promise to quantify the impacts of market sentiment on macroeconomic activities.

As revealed above, my research efforts share a unified theme on understanding how subjective expectations of agents deviate from traditional assumptions and how these behavioral regularities lead to interesting patterns in aggregate macro models. I also aim at exploring the implications of existing theories on expectation formation for higher moments of the variables. This proves to be particularly relevant in environments which the risks are uninsured and heterogeneity in higher moments lies in the center of the economic decisions.

Given my research passion, it will be a big loss of mine if I bypass the NBER behavioral boot camp to be held under this interesting theme. The three-day camp will be an invaluable opportunity to learn about the cutting-edge work on economic expectations and get feedback from many of the top scholars in the field. Because of my ongoing work, I have had an in-depth understanding of modeling details of some well-known theories developed by the researchers in the organizing committee, such as extrapolative expectations by Professor Andrei Shleifer, experience-based-learning by Professor Ulrike Malmendier and other behavioral-biased expectation formation by Professor Michael Woodford. This will undoubtedly facilitate more efficient exchanges between me and other participants during the camp. I appreciate the organizing committee's consideration of me as a participant in the great event.

JOHNS HOPKINS
UNIVERSITY
ECONOMICS

Christopher D. Carroll
Professor of Economics
econ.jhu.edu/people/ccarroll
E-mail: ccarroll@jhu.edu

21218

3400 N. Charles St.
Wyman Hall 590
Baltimore, MD

Tel: (410) 516-7601
Fax: (410) 516-7600

Ms Pepe,

Tao Wang is a 3rd year JHU Ph.D. student under my supervision. Tao has known since he arrived at JHU exactly what he wants to focus on: Expectations formation. This interest has developed into a research agenda that falls squarely in the field of behavioral macroeconomics.

While many papers have proposed structural models, for asset pricing as well as conventional macroeconomic variables like inflation expectations, it has proven difficult to whittle the candidates down to a small set of canonical models because the available aggregate data do not robustly and reliably support any of the available candidates. (Or, rather, many candidates are roughly equally well supported).

Tao's core approach will be to use individual-level (microeconomic) data on expectations to discipline the construction of structural models. As with other "microfoundations" approaches, the availability of many orders-of-magnitude more data should help us settle on a small number of models that have reasonably robust performance in explaining microeconomic data. The aggregate implications of those surviving models can then help discriminate further among them.

He has begun this program with an ongoing dissertation project that studies individual perceptions of income risks, using density forecasts of earnings available in the New York Fed's the Survey of Consumer Expectations. His first question is the extent to which people's perceptions reflect the true underlying risk profiles facing them. His early results are promising, in that respondents' answers to the survey seem both to be *ex ante* reasonable and to have considerable accuracy in predicting mean outcomes. He is now working to understand the information content in higher moments of expected income change, which is feasible because the survey actually asks households questions about their beliefs about the *distribution* of future changes. Given the recent work suggesting that uncertainty is an important driver of business cycle dynamics, understanding the evolution of people's views about the degree of uncertainty they face is a potentially first-order priority for macroeconomics, both of consumption and financial/portfolio choice.

He is also working on some ideas at a higher level of aggregation, but below the macroeconomic level. The macroeconomic time-series evidence on the role of consumer sentiment in explaining

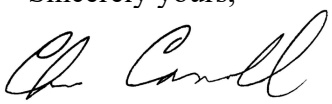
consumption dynamics has been hampered (as usual) by the fact that aggregate history is a single sample without very many data points (and by the usual endogeneity problems). Together with other collaborators, Tao and I have been working to quantify geographically-specific sentiment and uncertainty from social media and Google search records using mature tools from the field of natural language processing. We hope to construct proxies for local or state-level sentiment by reverse engineering the natural language correlates of national measures of sentiment, as from Michigan household survey. Separately, we are working to construct corresponding local or state-level consumption series based on transaction-level data from payment service providers and local retail stores.

Tao has also completed a working paper draft that compares the inflation expectations of professionals and households. The paper extends Coibion and Gorodnichenko (2012) by examining implications for uncertainty from a variety of theories featuring expectation rigidity, such as sticky expectations and noisy information. He also uses these additional moment restriction to provide test results of the full-information rationality benchmark and model-specific parameter estimates. His results confirm information rigidity in inflation expectationsTao Wang is a 3rd year JHU Ph.D.\ student under my supervision. Tao has known practically since he arrived at JHU exactly what he wants to focus on: Expectations formation. This interest has developed into a research agenda that falls squarely in the field of behavioral macroeconomics.

Tao has also developed a deep understanding of quantitative modeling and strong programming and computational skills that are necessary for him to pursue this kind of work, in part through contributions to the open-source "HARK" toolkit that I have been developing for computational economics modeling. Last summer, he also participated in the creation of code to implement a state-of-the-art set of tools for solving HANK models (specifically, he helped replicate the Bayer-Luetticke 2018 *Econometrica* paper).

In sum, I highly recommend him.

Sincerely yours,



Christopher D. Carroll