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## UNIVERSITY OF PENNSYLVANIA

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**Education:**

Ph.D., Economics, University of Pennsylvania, 2016 – 2021
(Fields: Networks, Macro, Finance, and Machine Learning)
Thesis Title: "Networks in Macroeconomics, Finance, and Machine Learning"
Master, Statistics, Department of Statistics, Wharton, Expected in 2021
(Machine Learning)
M.A in Economics, CCER, Peking University, 2016
B.S in Materials Physics, University of Science and Technology, Beijing, 2009

THESIS COMMITTEE AND REFERENCES:

Professor Frank Schorfheide
Department of Economics, University
Of Pennsylvania, Philadelphia, PA
215-898-8486
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Professor Rakesh Vohra (Primary advisor)
University Professor, Department of
Economics and Electrical and Systems
Engineer, University of Pennsylvania
215-898-6777, rvohra@sas.upenn.edu

Professor Linda Zhao (Co-advisor)
Department of Statistics, Wharton,
University of Pennsylvania, Philadelphia, PA,
215-898-8228, lzhao@wharton.upenn.edu

**Research Fields:**

Primary Fields: Macroeconomics
Secondary Fields: Networks, Machine Learning, Asset Pricing, and Corporate Finance.

**Relevant Position:**

Jun2018- Sep2018 IMF (International Monetary Fund), Machine Learning, Behavior Bias and Credit Market Crashes (IMF Summer Funding Internship Program for Ph.D.)
Jan2014 - Jun2014 R.A. Counsellor Office of the State Council, Central Government, China.

**Conference and Seminar Talk (* talk by coauthor):**

JSM(Aug2021,American Statistical Association), AFA(Jan2021), NBER Chinese Economy Meeting(Dec2020)*, NSF 6th Annual Conference for Network-Economics(x4,UChicago,Booth), FMA(Nov2020,NYC), MFA(x2, Mar2020), AEA(Jan 2020,Sandiego), Summer Meeting of Econometric Society(NA, July2019), IMF(Apr2019)*, Jane Street Symposium (Jan2019), Asian Meeting of Econometric Society(Jun2019, Xiamen), Bank of Finland (Jul 2019)*, Penn-Wharton-GSM(June2019), Penn Econ(Macro Lunch, 2019), Penn Econ(Micro Theory Lunch,2019), Penn Econ(Micro Empirical Lunch,2019), PKU(June 2018), Penn Econ (Econometric Lunch, April 2018), IMF(April 2018)*, Wharton(Oct 2017, MBA Talk), AEA Conference San Francisco(Jan

2016)*, Alibaba(2016), NBER-CCER Conference(June 2015)*, Stockholm-China Meeting(Sep 2014).

**Teaching Experience:**

Spring 2017 Economics 102, Professor Rakesh Vohra
Fall 2017 Economics 201, Professor Jose-Victor Rios-Rull
Spring 2021 Modern Data Mining, Professor Linda Zhao

**Honors and Awards Related to Math:**

Finalist of best paper in investment (Financial Management Association, 2020), Finalist of best Ph.D. paper (MFA,2020), Wharton Mack Institute for Innovation Fellowship (2020, Networks, Machine Learning, and Asset Pricing), UPENN SAS DEAN Travel Grant (x3)
Meritorious Winner (First Prize), Mathematical Contest Modeling United States (2008), First Prize, Chinese National College Mathematical Competition of Modelling (2007), First prize, the 17th and 18th College Mathematical Olympic of China (highest competition at that time).

**Programming and Skills:**

Python (High Proficiency), R (Proficiency), Stata (High Proficiency), and SQL.

**Research Statement:**

My research spans several fields: Macroeconomics, Finance, Machine Learning, Micro Theory, and the Chinese Economy. However, it shares a common theme - the use of big data (firm-level) to emphasize the role of networks in investor behavior, business cycles, asset pricing, and systemic risk. Under this common theme, my work can be divided into three groups: *Innovation Networks, Machine Learning, and Equity-holding Networks.*

**Papers under Review:**

1. **The Network Effects of Agency Conflicts** (with Rakesh Vohra (Penn Econ and ESE) and Yiqing Xing (JHU), Under Review) (NSF 6th Annual Conference in Network Economics (U Chicago Booth))
2. **Tiered Intermediation in Business Groups and Targeted SME Support** (with Yu Shi (IMF) and Robert M Townsend (MIT), Under Review) (Finalist of best Ph.D. paper (MFA, 2020), AEA 2020, IMF 2020, NSF 6th Annual Conference in Network Economics(UChicago,Booth,2020), Asian Econometric Meeting 2019, North American Econometric Meeting 2019, Penn, Wharton, IMF, PKU, CUFE, VOX China)

**Papers on Innovation Networks:**

3. **Networks and Business Cycles.**
(Job Market Paper, with Yucheng Yang, Princeton Applied Math) (Talk: UPenn, Princeton)
The speed at which the US economy has recovered from different recessions ranges from months to years. In this paper, we argue that the underlying network of knowledge flow on technology and its interactions with production networks and cross-sectional shocks explains the large variations in the speed of recovery across recessions in US.
We show that these interactions allow us to decompose the effects of shocks, even idiosyncratic shocks, on future growth into components with various levels of persistence and loadings. The persistence can be fully captured by the eigenvalue distribution of the matrix representation for the innovation network, while the loadings can be fully captured by two sufficient statistics - the correlation between the centrality in innovation networks and shocks, and the correlation between centralities in innovation and production networks.
The slow recovery occurs when the loading on the persistent component increases sharply. We further document a set of new stylized facts in the U.S. and show the importance of our channel in explaining the slow recovery. Finally, we explore the explanations of our theory on puzzles in financial markets - time-varying equity-premium and risk-free rate puzzles.
4. **Innovation Networks, Linking Complexity, and Cross Predictability**
(Finalist of best paper in investment in FMA (Financial Management Association))

This paper provides evidence that network complexity limits investors' ability to process non-local information, through the lens of return cross predictability. Using firm-to-firm citation networks, we find that the non-local indirectly-linked firms can well predict the return of the focal firm, while the predictability of the local directly-linked firms is weak. A long-short strategy using the indirect links yields a risk-adjusted monthly alpha of 198 (164) basis points with equal (value) weights. We further find that (i) the indirect citation links are much more complex than direct ones, (ii) the magnitude of cross predictability increases with the degree of link complexity, (iii) institutional investors don't adjust their positions in a stock with complex links, but in one with simple links immediately, (iv) firms with more complex links receive more public attention, are much larger in size, and exhibit less idiosyncratic volatility than those with simple links.

5. **Networks, Long-Run Risk, and Asset Pricing** (come out soon, draft available)

**Papers on Machine Learning:**

6. **Semi-supervised Learning in Networks** (with Junhui Cai (Wharton Stats), Dan Yang (HKU), Linda Zhao (Wharton Stats)) (JSM 2021, American Statistical Association)
7. **Identifying Underlying Links and Cross Predictability.** (with Junhui Cai (Wharton Stats), Linda Zhao (Wharton Stats), in progress)

**Papers on Equity-holding Networks:**

8. **Ownership Networks and Firm Growth – What do 5 Million Firms Tell us about Chinese Economy?** (with Allen Franklin, Junhui Cai, Xian Gu, Jun "QJ" Qian, Linda Zhao) (AFA 2021, NBER China Workshop 2020, 6th Annual Network Conference 2020, MFA 2020, FMA 2020, 2nd Annual USYD Financing and Banking Research (Sydney,2019), Bank of Finland 2019)
9. **State-Owned Enterprises in China Revised** (with Junhui Cai, Xian Gu, and Linda Zhao, come out soon, draft available)

**Quantitative Courses Taken (all PhD Level):**

Deep Learning in Theory, Optimization in Machine Learning, Non-Parametric & Machining Learning, Data Mining, Econometrics I, Bayesian Econometrics II, Econometrics IV, Continuous Time Asset Pricing, Asset Pricing, Empirical Methodology of Asset Pricing, Empirical Corporate Finance, Probability Theory, Stochastic Process I, Stochastic Process II, Measure Theory, Real Analysis, Financial Market and Macro Finance.