(Dis)Information Wars

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The unprecedented growth in big data and big data technologies has vastly expanded information availability across the globe. An example of this trend is the wide access to social media across all countries. As such, different social media platforms are being prominently used to display dissidence during episodes of unrest in many countries. In turn, oppressive regimes have taken different approaches toward suppressing the spread of dissidence on social media. One commonly used approach is to limit access to the platform from within the country by controlling the internet. A second approach is to spread disinformation on the platform. This latter approach has a few advantages for the oppressive regime: It does not require excreting force, it is more difficult to trace, it disrupts the flow of information, and it deranges the opposition movement through multiple channels without apparent aggression. We call this approach a "*disinformation war*."

In this project, we plan to explore the disinformation war on Twitter Farsi in the context of current protests in Iran. We plan to identify accounts which engage in "government sock puppetry" by the government of IRI, i.e., state-sponsored internet propaganda, on Twitter during the recent wave of opposition and pinpoints the methods that they use most extensively the spread false claims.

On 16 September 2022, a 22-year-old Iranian woman named Mahsa Amini, died in a hospital in Tehran, Iran, after being arrested by the religious morality police of Iran's government, for not wearing the hijab in accordance with government standards. Eyewitnesses report that she died as a result of police brutality which was denied by Iranian authorities. Amini's death resulted in a series of widespread protests across Iran which persist until today. These protests are concentrated among the younger generation and are accompanied by a lot of activity on social media platforms including Twitter Farsi. The activity on Twitter Farsi started with hashtag #MahsaAmini and has extensively sprawled in the past twelve weeks.

At the same time, supporters of the Iranian regime engaged in spreading disinformation

on Twitter Farsi at unprecedented levels during the current wave of unrest. Pro-regime entities create numerous imposter Twitter accounts and use them to spread fabricated, misleading, and false information. They pretend to be among the dissidents by posting pro-revolt content and hashtags. Once they establish themselves as such and build a network among the protesters, they start spreading disinformation using various techniques to make the false information more convincing. Although they have not always been as successful in penetrating the network of opposition for different pieces of false news, they have managed to cause significant harm to the opposition movement as listed below.

We have classified Tweets that spread disinformation into five categories, depending on their objective:

1. **Discrediting the protest movement:** This is possibly the most toxic and disruptive type of disinformation as it mixes truth with lies and make it impossible to distinguish them. For instance, after death of a 15-year-old child, Asra Panahi, the regime claimed that she committed suicide. In order to make this claim believable to opposition and pro-regime crowd alike, they spread the news that another student at her school was also killed. After this news spread it turned out that the second student was actually not killed but committed suicide a while back.

2. **Spearing fear:** When the government attacked Sharif University, they spread the news that they had killed many students within the university. This was not true, and the main purpose was to spread fear.

3. **Spreading false hope and the ensuing disappointment:** There was disinformation about leaders of the regime and their families leaving the country.

4. **Vilifying the protesters:** News about protesters being helped by separatists or ISIS.

5. **Justifying the regime actions:** News related to police forces in other countries encountering protesters violently.

Our primary goal is to identify the accounts that engage in spreading disinformation and their strategies. In order to do so, we are taking the following steps

- We have obtained a number of Twitter academic accounts which allows us to listen and download the stream of Tweets as they are posted, subject to a limit (100 Tweets per second).

- We plan to obtain Tweeter data from September 16 2022 onward from a third party using this grant.

- We use Tweeter data to create a network of hashtags, followers, likes, and reTweets.
- We use Machine Learning techniques to identify the content commonly posted by imposter accounts.

Aside from data that we are gathering using our Twitter academic account, we plan to buy data from Pulsar, a social listening and audience insights tool. Their software provides three tools that are all extremely useful for our analysis. First, they have a social listening tool with many publicly available channels (TRAC). We specifically need their Twitter data. The second tool is audience mapping and segmentation (AUDIENCE). The analysis can be done using different criteria such as followers and target demographics using this tool. The third tool is a trend recognition tool (TRENDS), which allows us to see what is trending on a local or global level for each time period.

The main idea is to use ex-post information revealed on credible media outlets to identify some disinformation Tweets. Once we identify a Tweet as false, we trace back the stream of reTweets to the account that posted the original Tweet starting this stream of false information. In order to do so, we need to listen to Tweets constantly as imposter accounts commonly delete the false information that they have tweeted in order to avoid being identified. We are hoping to be able to identify several core imposter accounts using this backward induction approach. Once these core accounts are identified, we use them to expand the set of recognized misinformation Tweets and imposter accounts.

We use at least two types of ML techniques to identify misinformation Tweets. The first method involves NLP (Natural Language Processing) approaches to identify the language of imposter tweets. Here we start from several accounts that we have identified as imposter accounts. We then use supervised learning based on the words and hashtags used by these accounts to identify other imposter accounts. The second method uses a variety of clustering approaches. This method closely interacts with our network analysis approach which we explain next.

For our network analysis, we build a coupled network which consists of multiple tiers. The first tier represents the reTweet network. The second tier is built using common hashtags used by different accounts. The third tier is the network of followers. The last tier is the network of likes. Superimposing these networks and establishing the common components gives us a more thorough picture of the imposter accounts, their internal network and the strategies they use to disseminate false information. It will further enable us to understand what types of disinformation are more effectively penetrating the broader network of Twitter.

Budget

Data acquisition: 30k

- We plan to use the grant to get access to the data from Pulser as explained in the proposal. This will cost us 30k per year. This grant will take us half way and we can use our personal research accounts for the rest of the cost for the first year.

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APPOINTMENTS

Jon D. Gruber Career Development Professor, MIT Sloan 2019-
NBER & CEPR, Faculty Research Fellow 2019-
Assistant Professor, MIT Sloan School of Management 2018-
Assistant Professor, Bendheim Center for Finance, Princeton University 2015-2018
Pyewacket Foundation Postdoctoral Fellow, Bendheim Center for Finance, Princeton University 2014-2015

EDUCATION

Ph.D., Joint Financial Economics, Booth School of Business and Department of Economics, University of Chicago 2009-2014
M.Sc., Economics, University of Texas at Austin 2008
M.Sc., Computer Science, University of Maryland at College Park 2006
B.Sc., Computer Engineering, Sharif University of Technology 2004

FIELDS

Intermediation, Economics of Data, Financial Economics, Network Economics

PUBLICATIONS

"Data and Markets" (with L. Veldkamp, 2022), Accepted, *Annual Review of Economics*

"Intermediation and Voluntary Exposure to Counterparty Risk" (2022), Acceped, *Journal of Political Economy*
(Best Finance Theory Award 2014)

"Heterogeneous Global Booms and Busts" (with P. Kondor), *American Economic Review*, July 2022, 112(7)

"The Emergence of Market Structure" (with G. Jarosch and R. Shimer), *Review of Economic Studies*, March 2022

"Where Has All the Big Data Gone?" (with A. Matray, L. Veldkamp, and V. Venkateswaran), *Review of Financial Studies*, 2022, 35(7): 3101–3138 (Lead article)

"Internal and External Effects of Social Distancing in a Pandemic" (with G. Jarosch and R. Shimer), *Journal of Economic Theory*, 2021, 196, 105293

"Long Run Growth of Financial Data Technology" (with L. Veldkamp), *American Economic Review*, August 2020, 110(8), 2485-2523

"Big Data and Firm Dynamics" (with R Mihet, T. Philippon, and L. Veldkamp), *American Economic Review P&P*, May 2019, 109, 38-42

"Big Data in Finance and Growth of Large Firms" (with J. Begenau and L. Veldkamp), *Journal of Monetary Economics*, August 2018, 97, 71-87

WORKING PAPERS

"Valuing Financial Data" (with D. Singal, L. Veldkamp, and V. Venkateswaran,

2022), *R&R, Review of Financial Studies*
(Swiss Finance Institute Outstanding Award Award 2022)

"Cleansing by Tight Standards: Rational Cycles and Endogenous Lending Standards" (with P. Kondor, 2022), *R&R, Journal of Financial Economics*

"A Model of the Data Economy" (with L. Veldkamp, 2022)

"Intermediation as Rent Extraction" (with G. Jarosch, G. Menzio, and U. Wirindiata, 2019), *R&R, Journal of Finance*

"Normal Divergence: Information in the Shape of the Return Distribution" (with A. Jafarian, 2021)

"The Hidden Costs of Strategic Opacity" (with A. Babus, 2021)

"Optimal Revenue Maximizing Mechanisms in Common-value Position Auctions" (with A. Jafarian, 2014)

WORK IN PROGRESS

"Data Markets and Digital Platforms" (2022)

"Tell Me Your Type: Information Asymmetry and Credit Allocation Through Consorcios" (with B. Doornik, J. Skrastins, and D. Schoenherr, 2021)

OTHER

Comments on "Network Reactions to Banking Regulation" (by Selman Erol and Guillermo Ordonez), *Journal of Monetary Economics*, August 2017, 89, 68-70

HONORS AND AWARDS

Swiss Finance Institute Outstanding Award Award, JFRAP Award MIT Sloan	2022
SCOR-PSE inaugural annual Young Researcher Award	2019
Goldman Sachs GMI academic fellowship	2016
Review of Economic Studies Tour, Top Finance Graduate Award, Best Finance Theory Paper Award, John Leusner Fellowship	2014
Macro Financial Modeling Dissertation Fellowship, Stevanovich Fellowship	2013
Deutsche Bank Doctoral Fellowship	2012
Bradley Fellowship	2011
Sherwin Rosen Fellowship, Department of Economics, University of Chicago	2010
Bita Daryabari Scholarship, HAND Research Foundation	2009
Best Second Year Paper Award, Department of Economics, UT Austin	2008

PROFESSIONAL ACTIVITIES

Summer School
"*The Big Data Revolution*": Finance Theory Group Summer School 2023; MFR Summer Session, University of Chicago (2022)
"*Mechanism for Contagion in the Financial System*": Advancing Macro Finance Workshop - BFI (2021)
"*Financial Networks and Intermediation: Network and Search Tools*": Princeton Initiative (2015-2017); MFM Summer Session (2017)

Speaking
Nobel Symposium: Covid-19 and the Economy (2022)
"*The Big Data Revolution*": IIES/SNS International Policy Talk, Stockholm (2022); SQA and CFA NY 5th Annual Data Science in Finance (2022); IMF (2019)

Organization

Organizer: ABFR (AI & Big Data in Finance Research) Forum (2021-); Virtual Finance Workshop (2020-21); 15th Finance Theory Group Meeting (Oct 2016); 2022 SED Session, 2023 AFA Meeting Session
Program Committee: SFS Cavalcades 2020, 2021; FIRS 2018, 2021; GSU/RFS FinTech Conference 2020; International Conference on Finance & Technology (ICFT) 2022; OFR Rising Scholar Conference on the Future of Financial Stability
Board Member: Covid Economics: Vetted and Real-Time Papers (2020-2021)

Referee
Econometrica, AER, JPE, QJE, ReStud, JF, JFE, RFS, PNAS, JET, TE, JEL, EJ, IER, Operations Research, Management Science, Science, NSF, European Commission Grant

Discussant
Nber Summer School, NBER Financial Market Regulation, Nber CEME, Red Rock Finance Conference, Barecelona GSE, Conference in Honor of Bengt Holmstrom (Stanford), Regulating Financial Markets Conference (Bundesbank), Carnegie Rochester NYU conference, WFA, Wharton Conference on Liquidity and Financial Crisis, SFS Cavalcades, Stanford GSB junior conference, LSE 4^{th} Network Conference

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Employment History

2016 - : Assistant Professor of Economics, Tepper School of Business, Carnegie Mellon University
2012 - 2016: Assistant Professor, Economics Department, The Ohio State University
2015 - 2016: Visiting Assistant Professor, NYU Stern School of Business
Summer 2014 - 2016, 2018, 2021: Visiting Scholar, EIEF

Education

2006 - 2012: PhD in Economics, University of Minnesota
2004 - 2005: MA in Economics, University of British Columbia
2000 - 2004: B.S. in Mechanical Eng., Sharif University of Technology

Published and Accepted Papers

Reputation and Regulations: Evidence from eBay, with Xiang Hui, Neel Sundaresan and Zeqian Shen, Management Science Vol. 62.12, pp. 3604-3616, 2016

Adverse Selection or Moral Hazard, An Empirical Study, with Xiang Hui and Neel Sundaresan, The Journal of Industrial Economics, Vol. 66, Issue 3, pp. 610-649, 2018

Reputation and Adverse Selection, Theory and Evidence from eBay, The RAND Journal of Economics, Vol. 50, pp. 822-853, 2019

Raising the Bar: Certification Thresholds and Market Outcomes, with Xiang Hui, Giancarlo Spagnolo, Steven Tedalis, Forthcoming, AEJ, Micro

Optimal Information Disclosure and Market Outcomes, with Hugo Hopenhayn, Forthcoming at Theoretical Economics

Working Papers

Dynamic Value Shading, with Hugo Hopenhayn

Bid Shading in Dynamic Auctions, with Hugo Hopenhayn

Optimal Simple Ratings, with Hugo Hopenhayn

Optimal Rating Design, with Ali Shourideh

Impact of Increasing Hospital Price Transparency: Collusion, Search, and Equilibrium Price, with Elena Prager, Robert Town

Work in Progress

Recommender Systems as Dynamic Bayesian Persuasion Mechanisms, with Yikang Shen and Ali Shourideh

Market Power in Complex Networks: The Case of Natural Gas Pipelines, with Majid Mahzoon,

Ali Shourideh, Thomas Youle
Ramesy Pricing across Time and Space, with Arash Asadpour, Ali Shourideh
Optimal Regulation of Ride Sharing Platforms: A Mechanism Design Approach, with Arash Asadpour, Ali Shourideh
Optimal Communication Design, with James Best, Daniel Quigley, Ali Shourideh

Honors and Awards

Most Innovative Paper Award, NBES conference 2022
EQT Foundation and the Scott Institute Seed Grant, 2020-2022
Best Paper Award, Workshop on Information Systems and Economics (WISE), 2017
Wimmer Faculty Fellows, Carnegie Mellon University, 2017-2018
Berkman Faculty Development Fund, Carnegie Mellon University, 2017
Second ALDE Prize for Young Researchers, Applied Economics Meeting, Granada, 2013
Gross Fellowship, Department of Economics, University of Minnesota, 2010
Graduate Research Partnership Program Fellowship, Graduate School, University of Minnesota, 2010
Third Place, Hardy Third Year Paper Competition, University of Minnesota, 2009
A.D. Scott Fellowship in Economics, Department of Economics, University of British Columbia, 2005
University Graduate Fellowship, Department of Economics, University of British Columbia, 2004
Second Prize, International Mathematical Competition, Czech Republic, 2001
Gold Medal, National Mathematical Olympiad, Iran, 1999

Teaching

Statistical and Decision Making, Tepper School of Business, Spring 2022
Graduate Industrial Organization, Tepper School of Business, Spring 2019
Firms, Market Structures, and Strategy, Tepper School of Business, Spring 2019, Fall 2019, Fall 2020
Designing the Digital Economy, Tepper School of Business, Fall 2017, Spring 2019, 2021, 2022
Intermediate Microeconomics, Tepper School of Business, Spring 2017, Fall 2017
Microeconomics, NYU Stern School of Business, Spring 2016
Competitive Analysis, NYU Stern School of Business, Spring 2016
Graduate Industrial Organization, The Ohio State University, Spring 2014, 2015
Intermediate Microeconomics, The Ohio State University, Spring 2014, 2015
Game Theory, The Ohio State University, Autumn 2012
Intermediate Microeconomics, The Ohio State University, Autumn 2012
Grader, Writing Intensive Course, University of Minnesota, Spring 2011
Instructor, Graduate Numerical Methods, University of Minnesota, Summer 2009
Teaching Assistant, Principles of Microeconomics, University of Minnesota, 2006-2007
Teaching Assistant, Honors International Microeconomics Analysis, 2005
Teaching Assistant, Empirical Problems in Economics, University of British Columbia, 2005
Teaching Assistant, Applied Economics, University of British Columbia, 2004

Invited Seminars, Discussions, and Conference Presentations

2011: eBay Research Labs

2012: The Ohio State University, Carnegie Melon University, The Arizona State University, SUNY at Stony Brook, Google Inc., Charles River Associates, Revolution Analytics Inc., UCLA

2013: AEA winter meetings, International Industrial Organization Conference, Midwest Economics, Applied Economics Meeting, Applied Micro Workshop at Minnesota, eBay Economist seminar series

2014: University of Arizona, International Industrial Organization Conference, EIEF, The Economics of Information and Communication Technologies Conference, Econometric Society Summers Meetings, Joint Digitization and IO NBER summer institute, European Association for Research in Industrial Economics Conference, Federal Reserve Bank of Cleveland, Indiana University, UTDT 3rd Annual Conference

2015: Utah Winter Business Economics Conference, Midwest Economic Theory Meetings, International Industrial Organization Conference, Canadian Economic Theory Conference, The Economics of Information and Communication Technologies Conference, Society of Economic Dynamics, EIEF, European Summer Symposium in Economic Theory, SITE, Dynamic Games, Contracts, and Markets Session, eBay, Econometrics Society World Congress, Northwestern Economics Department, UCLA mini conference, Universidad de Chile, Workshop in Industrial Organization (Toi 8)

2016: Econometrics Society Winter Meetings, Dartmouth Winter IO Conference, NYU Stern, Center of Research in Applied and Theoretical Econometrics, SED, Tilburgh University, Reputation symposium, the Oxford University Centre for Corporate Reputation, LSE, UCL, University of Edinburgh, NBER Market Design Meeting, UCLA

2017: Midwest Economics, International Industrial Organization Conference, SED, Summer Institute in Competitive Strategy, AFE 2017, FTC Microeconomics Conference

2018: AEA, Econometrics Society Winter Meetings, NBER IO winter meetings, Drexel Economics seminar, Northwestern IO seminar, Seoul National University, Sungkyunkwan University, Queen's University, Stanford GSB

2019: Digital Economics Conference, Toulouse, IIOC, CIREQ Montreal Applied Economics Conference, Ashecon, SAET, European Summer Symposium in Economic Theory, Platform Economics

2020: NBER Digitization Winter Meetings, Canadian Economic Theory Conference, The Pennsylvania State University, Economics of Platforms Seminars, CEPR VIOS Seminar

2021: Pennsylvania Theory Conference, APIOC (Invited Chair)

2022: NBES conference, University of Michigan, Annual Theory Conference at ASU

Services to the Department

Carnegie Mellon University, Undergraduate Economic Education Affairs Committee, 2017-present

Carnegie Mellon University, Recruiting Committee, 2017-2018, 2020-2021

Carnegie Mellon University, Seminar Organizer, 2017-present

Ohio State University, Seminar Organizer, Spring 2014

Ohio State University, Graduate Committee, 2013-2014

Ohio State University, Undergraduate Committee, 2012-2013

Advisitng

Yikang Shen, CMU, Co-advisor
Apoorva Havanur, CMU, Honors Thesis Advisor
Majid Mahzoon, CMU, Co-advisor
Kole Redding, CMU, Co-advisor
I-Ta Yang, CMU, Co-advisor
Erica VanSant, CMU, Committee Member
Xiang Hui, OSU, Main Advisor, Assistant Professor, Marketing, Olin Business School, University of Washington in St. Louis
Hyewon Kim, OSU, Committee Member
Junqiushi Ren, OSU, Committee Member, Southwestern University of Finance and Economics, 2017
Garrett Senney, OSU, Committee Member, Office of the Comptroller of the Currency, 2016
Chao Ma, OSU, Committee Member, Xiamen University, 2015
Dhiranjit Kundu, OSU, Committee Member, Ernst and Young, 2014

Referee

Games and Behavioral Economics, JPE, Rand Journal of Economics, Journal of Economics and Management, Journal of Industrial Organization, European Economics Review, Journal of Economic Behavior & Organization, Journal of Neuroscience, Psychology, and Economics, Econometrica, Journal of Industrial Economics, Management Science, Review of Economic Studies, AEJ Micro

-Grant Assessment

Social Sciences and Humanities Research Council of Canada