Dear Panel,

My name is Chitra Marti and I am currently a third-year PhD student at New York University's Stern School of Business. I seek to attend the NBER Entrepreneurship Research Boot Camp.

Please find attached my CV and essay describing my research and motivation to attend. My letter of recommendation will be submitted separately by Prof. Christopher Conlon of NYU Stern.

Best,
Chitra Marti

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List of PhD Courses:
First Year:

- Macroeconomics I-IV
- Microeconomics I-IV
- Econometrics I-IV
- Math for Economics I

Field Courses:

- Advanced Macro I-II
- Industrial Organization I-II
- Empirical Industrial Organization
- Corporate Finance
- Macroeconomics and Market Power
- Trade
- Innovation (Applied Micro)

Chitra Marti

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EDUCATION

New York University, Stern School of Business Sep 2019 – May 2024 (Expected)

PhD, Economics (currently in Third Year)
Fields: Industrial Organization and Macroeconomics
Field Courses: Industrial Organization I and II; Empirical Industrial Organization; Advanced Macro I and II; Macroeconomics and Market Power; Corporate Finance; Innovation; Trade
Advisors: Christopher Conlon and Hanna Halaburda

Princeton University Sep 2013 – Jun 2017

A.B. Economics, *Magna Cum Laude*
Certificates (Minors): Computer Science, Statistics & Machine Learning

WORKS IN PROGRESS

"Who Gains from Variety?"
"Market Power, Networks, and Cybersecurity"

PUBLICATIONS

"Why is Inflation Low Globally?" with Òscar Jordà, Fernanda Nechio, and Eric Tallman. *FRBSF Economic Letter*. *FRBSF Economic Letter* 2019-19.

"Inflation: Stress-Testing the Phillips Curve" with Òscar Jordà, Fernanda Nechio, and Eric Tallman. 2019. *FRBSF Economic Letter* 2019-05.

"Does Ultra-Low Unemployment Spur Rapid Wage Growth?" with Sylvain Leduc and Dan Wilson. 2019. *FRBSF Economic Letter* 2019-02.

"Credibility and Conformity: The Effect of the Yelp Elite", *Princeton Undergraduate Research Journal*, Fall 2017 Issue.

CONFERENCE PRESENTATIONS

2019: **Western Economic Association Conference**
Invited to present "Does Ultra-Low Unemployment Spur Rapid Wage Growth?" and "Inflation: Stress-Testing the Phillips Curve" in two separate sessions.

HONORS AND FELLOWSHIPS

National Science Foundation Graduate Research Fellowship, Honorable Mention Mar 2021

Statistics and Machine Learning Independent Work Prize, Princeton University Jun 2017

RESEARCH EXPERIENCE

New York University Department of Economics New York, NY Jan 2020 – Present
Research Assistant for Sylvain Chassang, Chris Conlon, and Raluca Ursu

Federal Reserve Bank of San Francisco San Francisco, CA Jul 2017 – Jul 2019
Head Research Associate, Macroeconomics

Princeton University Department of Economics Princeton, NJ Mar 2015 – Jun 2017
Research Assistant for Sylvain Chassang and Ilyana Kuziemko

U.S. Securities and Exchange Commission Washington, D.C. May 2014 – Aug 2014
Research Intern in the Office of Markets, Division of Economic Risk and Analysis

OTHER PROFESSIONAL EXPERIENCE

Citigroup Global Markets Inc. New York, NY Jun 2016 – Aug 2016
Summer Analyst in Global New Products, Capital Markets Origination

Princeton University Writing Center Princeton, NJ Sep 2014 – Jun 2017
Fellow and Independent Work Mentor

OTHER

Programming Skills: LaTeX, Python, R, Stata, MATLAB, SAS, SQL, Java, C++, C
Processing Skills: Adobe Photoshop, Illustrator, and InDesign; Microsoft Office
Language Skills: English (Native), Spanish (Intermediate), Tamil (Intermediate)

Description of Research and Motivation to Attend

I would be grateful for the opportunity to attend the NBER Entrepreneurship Boot Camp. I am particularly excited to learn what other researchers consider the most pressing questions, both through the preparation literature and presentations at the workshop. I also look forward to the opportunity to meet my fellow students and hear what they are working on, which I have missed over the last two years. I am sure the experience would be invaluable at this stage in my career.

My research interests concern the increased risks and rewards of innovation in the digital economy, including the heterogeneous distribution of such effects.

My first project looks at how market concentration – both in terms of firm size and in the structure of firm-to-firm trade networks – affects a market's resiliency to cyber attacks. As I describe below, cyber risk is an indelible and unique feature of the digital economy but around which governments currently lack coherent policy. The spate of attacks over the last decade suggest cybersecurity is not merely a technical concern but also an economic one.

My second and third projects concern how consumers search and choose products when faced with many, many options – another feature of the digital economy. The first project will use clickstream data to examine the effect of social media and review aggregators on consumer search. The second looks at to whom the gains of variety accrue: which consumers are price-insensitive enough to benefit from the proliferation of highly specialized projects?

Market Structure and Cybersecurity Risk: U.S. President Joe Biden has warned that the next "real shooting war" the country enters will "more than likely" be a "consequence of a cyber breach" (Reuters). The consequences of such cyber breaches can range from the somewhat inconvenient – bagel shops in New York City panicked over a cream cheese shortage following a ransomware attack against Schreiber Foods (Wisconsin State Farmer) – to the terrifying – the NotPetya attack against Ukraine in 2017 brought down radiation monitoring systems at Chernobyl (BBC).

Though the final effect of a cyber attack is akin to that of a supply shock – reduced production, with spillover effects up and down the supply chain – cybercrime is not quite like a meteor falling out of the sky and destroying a plant. Rather, cyber attacks typically target large or well-connected firms with the explicit intention of causing as much disruption and destroying as much economic value as possible. Schreiber is the second-largest cream cheese manufacturer with only one large competitor, and was hit by the cyber attack just as its busy holiday season began – meaning the cream cheese market vulnerable due to high market concentration. The NotPetya attack exploited a vulnerability in M.E. Doc, a tax software used by over 90% of Ukrainian firms – meaning Ukrainian firms were vulnerable due to the tax software firm's large network. Whether state-sponsored or via ransomware, cybercriminals generally aim to extract as much value from firms and their networks as possible. It is thus important to understand the effect of cybercrime on the digital economy's structure and resilience.

As described above, market concentration and network structure clearly play a role in determining the full impact of cybercrime. Just as a supply shock at a large firm or a critical intermediate firm can have large spillover effects to the rest of the economy relative to a supply shock at a small or isolated firm, cyber attacks against large or well-connected firms should be considered in the context of the full market structure. To investigate the impact of market structure – in both firm size and concentration as well as network structure – on the digital economy's exposure to cybersecurity risk, I develop a theoretical model that captures three relevant mechanisms: (a) economies of scale, (b) economies of connection, and (c) contagion externalities.

I have solved a simple model with two potentially connected firms that makes clear the trade-offs inherent to the latter two channels: firms gain from connection but face worse odds in an arms race with a malicious attacker as threats can be transmitted through the network (e.g. M.E. Doc to other Ukranian firms).

I am working on incorporating the first channel, economies of scale, by adding a demand-side. The goal is to eventually take the model to data on firm-to-firm trade and conduct a "pre-mortem" analysis to show how

sectors with varying levels of market concentration and network density may weather a cyber attack. I also aim to evaluate the effect of commonly proposed policies such as risk disclosure to consumers, vulnerability disclosure to connected firms, and antitrust, on eventual possible losses from cyber attacks.

Search with Social Media: The consumer welfare gain from exposure to many product varieties – i.e. the increased welfare that is not explained by lower prices – have been estimated to be quite large (Brynjolfsson, Hu, and Smith 2003), but is likely the result of increased product specialization (Quan and Williams 2018). That is, increased variety actually means consumers are able to find more specialized products that appear to correspond more with their non-price preferences. Focus on non-price preferences may then lead to decreased price sensitivity and an increase in markups as consumers are more willing to pay for a specialized product (Brand 2021, Menzio 2021). Consumers who highly weight the specialization of a product then mechanically put less weight on price. Thus, if consumer search focuses on these highly specialized products, firms may actually be able to charge *higher* markups, despite the originally lower search costs.

Though targeted advertising is nothing new, the Internet has made the process easier, via the collection of data, and more subtle, as native advertising and influencers allow for micro-targeting. Consumers are increasingly exposed to products which may seem like a "perfect fit." Thus, search takes place not only over prices but also over idiosyncratic product characteristics. Firms may then be better able to engage in first-degree price discrimination if social media directs search towards more expensive but more targeted products (Menzio 2021). Are consumers who engage with social media or review aggregators less price-sensitive? Which may might causality flow?

I intend to use clickstream data for a panel of Spanish internet users provided by a marketing research firm. I am able to observe a user's full internet history, duration on each webpage, as well as final purchases for consumer electronics – extremely detailed data that allow us to observe a consumer's entire search process (I have access to the data through a separate project with Raluca Ursu). The first step will be to determine if social media use – or general exposure to targeted advertising – corresponds to a systematically different search process or final product choice. Then, depending on if and how search processes differ, I will seek to identify the effect of social media and targeted advertising on consumer welfare and search costs.

Who Gains from Variety?: The second project is motivated by the behavioral literature on the differential "toll of scarcity" poor households seem to face. Poorer households remember prices better but may make worse decisions regarding quality (Shah et al. 2018, Rosa-Diaz 2004) and are generally more price-sensitive (Goldin and Homonoff 2013). All households also tend to buy more private-label and sale products in a recession (Nevo and Wong 2014, Dube et al 2015), suggesting macro-conditions also affect price sensitivity. As the gains from variety depend on the extent to which consumers value price over non-price characteristics – with increased gains should consumers be more willing to buy products on the basis of specialization in non-price characteristics – one would then expect that the gains from variety should differ both across households and over the business cycle.

To evaluate potential heterogeneity in the gains from variety, I use Nielsen Retail Scanner and Consumer Panel data. After constructing a measure of novelty, I was able to document that the number of varieties purchased within a category, their average price, their average novelty, and the number of newly introduced products purchased each increase with income, suggesting that richer households change products more often and are perhaps more willing to experiment regardless of price. The next step is to formally measure the gains from variety for consumers in different income brackets and at different stages in the business cycle by applying the model of Quan and Williams 2018. Next, I seek to verify if the result of Neiman and Vavra 2019 – "niche" (specialized) consumption increases product concentration at the household level but decreases aggregate concentration – holds for households across income brackets. Though the project does not directly address the economics of digitization, it can speak to who gains from the proliferation of variety enabled by the digital economy.

NYU STERN

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January 20, 2022

This is a **confidential** letter written in support of **Chitra Marti** for the *NBER Entrepreneurship Boot Camp*.

I've known Chitra since we admitted her into our PhD program at NYU Stern, she also took my PhD course Empirical Industrial Organization as a second year student, and has worked on and off as a research assistant for me since arriving at Stern. She also took my colleague Petra Moser's PhD course on innovation (which as one might expect focuses mostly on historical aspects and patents and inventors). Each week I also meet with a group of around ten PhD students of various years who are interested in IO or related topics, which she attends.

Chitra's research interests are a little bit unusual in that they don't fit in a conventional field box, at least not here at NYU. Her second year fields were IO and Macro, which is a fairly unusual combination. While we are relatively strong in both fields, we don't really have much in the way of faculty working at the intersection of blending micro evidence with macro implications. I would describe her as an empirical economist who is primarily interested in "firms", but not necessarily in typical IO questions. I think this is where the boot camp would really be helpful in broadening her exposure to other ways in which researchers think about firms that don't fit nicely into the conventional Macro or IO box.

She has two projects that I think are both promising and somewhat different from one another. The first looks at product market variety and innovation using a large amount of Scanner Data from Nielsen. The idea was to look at how the degree of innovation varied with the business cycle (it decreased), with the hopes of disentangling whether the cause was likely to be supply (firms reducing investment) or demand side factors (households becoming more risk averse in trying new products). The project blended recent approaches from empirical macro (Neiman and Vavra 2019 and Granja and Moreira 2021) with those from IO (Quan and Williams 2019). The idea was to construct relevant measures of product novelty not just in the space of products (such as brands or UPCs) but also in the space of product characteristics. The project involved doing things at pretty large scale and handling a ton of data - I think this is where Chitra really excels even relative to our other students. The project came together surprisingly quickly with honestly minimal input from faculty. For a project like this I could see some real advantages to being exposed to the work of folks like: Nick Bloom, Shai Bernstein, and John Haltiwanger.

The second project is a bit more speculative and open-ended but looks at the economic implications of cybersecurity risk. This is a growing problem faced by many firms (both small and large) that is substantial and will only grow in coming years. In many ways I think the theory here has parallels to the the theory of venture capital and entrepreneurship (but perhaps in reverse). What firms

are mostly doing is buying insurance against an unlikely, but extremely costly risk. There is a competitive aspect in that mitigating the risk is not so much about outspending the criminals but about making oneself a less attractive target than other firms. This is a project where seeing the kinds of work done by folks like Scott Stern, Antoinette Schoar, or Bill Kerr is likely to provide some inspiration.

Chitra was a Princeton undergraduate and worked at the San Francisco Fed before starting her PhD. She is very bright, she asks good questions, she presents very well (much better than most students in their third year). I like her a lot. As a research assistant, she is very careful, I trust her work. Right now, I would say she is my go-to graduate student for projects when I need help. She is very reliable and extremely fast. She's really solid at executing projects, but I think she's in search of some inspiration from a broader set of scholars than she is exposed to here at NYU, and I'm hoping she can find that at the Entrepeneurship Boot Camp.

I think she is great and would benefit tremendously from your program.

Best regards,



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