I first started asking economic questions in the car going to soccer games during middle school. Why were there such drastic visual differences between my neighborhood and those in South Dallas? Were these differences man-made or due to natural circumstances? Throughout my coursework in economics, mathematics, computer science, and the past two years working as a Research Analyst at the NY Fed, I sharpened these interests in preparation of pursuing a PhD in Economics to study similar questions in Macro and Quantitative Spatial Economics.

Intellectual Merit

At Carnegie Mellon University (CMU), I enrolled in a challenging mathematics curriculum to ensure that I would have the mathematical maturity to handle graduate school economics. Senior year, I took PhD Micro I and received an A in the class. After graduating from CMU, I've prepared myself to engage in research by taking graduate level classes at NYU. I took the first semester of the PhD Macro I sequence at NYU with Professors Thomas Sargent and Lars Ljungqvist and was within the highest six scoring students out of a class of 30 with an A-. In the spring, I also took a master's level real analysis course focused on measure theory and earned an A.

In addition to mathematics and economics I pursued a substantial education in Computer Science and Machine Learning. Not only did I TA for the introductory ML course for undergraduates and graduate students at CMU, but I've also been invested in the powerful tools that ML provides, its applications in economics. I am eager to be on the front end of the effects of quantum computing on economics. I graduated from CMU with University Honors and College Honors from both the Mellon College of Science and the Tepper Business School, awards offered to those who meet certain strict research and academic standards. I was also inducted into the 2023 CMU chapter of Phi Beta Kappa, an honor awarded to only 54 students out of our graduating class of more than 1500.

Outside of the classroom, I was engaged in substantial research endeavors. The spring of my freshman year, I was the only freshman to be awarded a paid research grant called the Porges Research Fellowship from the CMU Summer Undergraduate Research Fund. My project analyzed the price trends of a specific type of drugs called follow-on drugs: drugs that exist in the same pharmaceutical class as other patented drugs but are tweaked in a manner such that their pharmaceutical purpose is very similar, but they are different enough to bypass patent monopoly laws and be patented themselves. Despite being early in my college career, I developed a fixed effects model for each drug class and presented my results at CMU's annual undergraduate research symposium, Meeting of the Minds. I later worked as a research assistant for Professor Burton Hollifield on his research paper examining how banks choose idiosyncratic volatility and systematic risk. Although my main roles were to calibrate and test the risk models to identify the payoff structures, I spent much of my time also brainstorming with Professor Hollifield the payoff structures of a default as a portfolio of fiscal objects. This has helped hone my ability to creatively think about research questions. I believe that honing this creative ability in research is critical for my long-term career, so I currently maintain a blog [1]where I formalize fun economic research ideas.

At CMU, I wrote a senior thesis under the guidance of Professor Laurence Ales. It is a study into both predicting the location of slums (these are typically defined as a group of dense urban habitations with little to no formal land ownership or access to sanitation) in Kenya based on nighttime lights and population density data and analyzing economically how slums tend to form spatially over time within cities. This project was data-intensive, and I overcame several hurdles by writing web scrapers to map slums in Kenya and processing over 400 GB of satellite light data. On the empirical end, I built classification models using techniques across statistics and machine learning and created a weighted logit model that was able to identify slums in Kenya with 70% accuracy using primarily only population density and light output. I also created and estimated a housing discrete choice model for households

[1] https://pranay-gundam.github.io/blog/

choosing to live in slums in Kenya. Finally, I outlined a spatial general equilibrium setup with richness in the amenity sector, without estimating due to a lack of data, to discuss how the Kenyan government could influence the forces acting on households living in slums. This senior thesis introduced me to the subfield of Spatial Economics and has shaped my research interests since.

After having graduated from CMU, I spent the last 1.5 years working as a Research Analyst at the New York Fed with Dr. Marco Del Negro working with building, forecasting, and estimating Dynamic Stochastic General Equilibrium (DSGE) models and developing the DSGE.jl package to do so. I led significant changes to code in DSGE.jl regarding creating models, estimating, and automation code producing various policy products. Additionally, a team member and I created a new indicator to report the ten-year forward-looking expected rate gap, which we included in both internal and public forecasts. My team communicates these changes and publishes the forecast results in quarterly blog posts (Del Negro et al. September 2023).

I was also involved in several briefings prepared for NY Fed president John Williams. For the first briefing, two RAs and I produced counterfactuals by testing different time varying policy targeting rules within the NY Fed DSGE model and published our results in a blog post on Liberty Street Economics (Crump et al. Nov 2023). I later worked with simulating scenarios for a HANK model to analyze the distributional effects of changing the interest target rate to respond to inflation. We found that, when facing demand shocks, stabilizing inflation and real activity go hand in hand, with very large benefits for households at the bottom of the wealth distribution. The converse is true however when facing supply shocks: stabilizing inflation makes real outcomes more volatile, especially for poorer households. The full results are also published in a blog post on Liberty Street Economics (Del Negro et al. July 2024). Currently I am working on a briefing to understand the transmission of inflation shocks throughout a network of interconnected business sectors. For this project on the data side, I've formed concordance tables between BLS CPI and PPI data and BEA industries. In terms of modeling, I've used our DSGE.jl package to create and estimate this DSGE model with richness in the sectoral distribution of firms. In addition to these briefings, I co-authored a paper comparing the historical forecast performance of the NY Fed DSGE model and Bluechip forecasts which was published in AEA Papers and Proceedings (Del Negro et al. 2024).

Working on the frontier of macroeconomics this past year and a half has exponentially increased my economic maturity; I know what questions economists are thinking about and the tools that they use to address them. My involvement in the frontier of research in macroeconomics has advanced my economics skillset and puts me in a position to prosper during graduate school.

Broader Impacts

I have been involved in volunteerism in my community from a young age from working at food donation drives to volunteering with the Red Cross at the highest level of youth involvement being on the National Youth Council during college. My dream has always been to combine my drive to make a substantial social impact with my academic passions and it is this dream that underscores my academic intentions. I aim to study questions in the budding field of quantitative spatial economics which have relevant applications in public policy. Place based policies and the spatial effects on income mobility are an understudied topic in economics but are quite clear in the data (Chetty et al. 2014). I aim to conduct research in Quantitative Spatial Economics to assist policymakers address inequality, housing shortages, or mobility issues in underserved areas.

In addition to conducting research myself, I am passionate about becoming a good educator and empowering others within economics. I was on the executive board of the Economics Research Club at CMU during my sophomore and junior years in which I organized research paper discussions and talks with professors to help members get more exposure to economics research. I also served on the executive

board for the Quant Club at CMU during my junior year in which I organized various mathematics and market trading competitions. In the classroom, I've taught in two different class environments as a teaching assistant for differential equations and machine learning. I was a teaching assistant for differential equations for three semesters during my sophomore and junior years and created supplemental material such as weekly notes that acted as a parallel resource to lectures while also holding extra review sessions for exams. When I was a teaching assistant for a joint masters and undergraduate machine learning class, I taught about concepts such as logistic regression and techniques in reinforcement learning. Working as a teaching assistant helped me impart my passion for math and economics but also equipped me well for the teaching requirements of a graduate student. Upon graduation, I was awarded CMU's Student Leadership Award for my involvement in clubs and my teaching roles. At my position at the NY Fed, I mentored four interns and one junior research analyst teaching concepts in macro-econometrics and coding principles. I will use these experiences to foster a more inclusive academic environment during graduate school and beyond.

Beyond my academic roles, I strongly advocate for open-source practices to enhance reproducibility and transparency in economics, and I have integrated this belief into my work. I firmly hold that these practices are critical to disseminate to a wider audience both considering several fraudulent data scandals within economics and due to the field's trajectory towards data and computationally intensive papers. In my role at the NY Fed and through personal projects, I actively contribute to the open-source community. I maintain, and assist others with using, open-source packages in Julia for DSGE models and Sequential Monte Carlo algorithms. You can find my public repository for my research statement, and navigate to any other personal project, with the link below[2].

I believe that my economic training and life experiences have prepared me well for a career in academia that I will use to benefit society. Support from the National Science Foundation Graduate Research Fellowship Program will assist me with my academic pursuits, which I can use to research my interests in Macro and Quantitative Spatial Economics.

References

Chetty, Raj, Nathaniel Hendren, Patrick Kline, and Emmanuel Saez. 2014. "Where is the Land of Opportunity: The Geography of Intergenerational Mobility in the United States." Quarterly Journal of Economics 129 (4): 1553-1623.

Del Negro, Marco, Keshav Dogra, Aidan Gleich, **Pranay Gundam**, Donggyu Lee, Ramya Nallamotu, and Brian Pacula. 2024. "The NY Fed DSGE Model: A Post-COVID Assessment." AEA Papers and Proceedings, 114: 95–100.

Del Negro, Marco and **Gundam, Pranay** and Lee, Donggyu and Nallamotu, Ramya and Pacula, Brian, The New York Fed DSGE Model Forecast— September 2023 (September 22, 2023).

Crump, Richard K. and Del Negro, Marco and Dogra, Keshav and **Gundam, Pranay** and Lee, Donggyu and Nallamotu, Ramya and Pacula, Brian, The New York Fed DSGE Model Perspective on the Lagged Effect of Monetary Policy (November 21, 2023). Liberty Street Economics

Del Negro, Marco and Dogra, Keshav and **Gundam, Pranay** and Lee, Donggyu and Pacula, Brian, On the Distributional Consequences of Responding Aggressively to Inflation (July 03, 2024). Liberty Street Economics

[2] https://github.com/pranay-gundam/NSF-2024