Ph.D. Dissertation Defense

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Degree:	Doctor of Philosophy
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Date:	Thursday, April 18th, 2024
Time:	7:00 pm – 9:00 pm
Location:	Zoom: https://stevens.zoom.us/j/8862683910
Title:	Agent-based Modeling in Household Finance and Banking System
Chairperson:	Dr. Steve Yang, Financial Engineering, School of Business
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Abstract

Agent-based modeling (ABM) is a simulation approach that is increasingly used in studying household finance and banking systems. ABM allows for creating a virtual environment where agents (individuals or institutions) interact with one another and make decisions based on a set of rules and objectives. In this dissertation, we discuss three essays about ABMs in both household finance and banking systems.

The first essay focuses on ABM in household finance. We model households as economic agents making financial decisions through their life cycle. More specifically, in our life-cycle model, individuals facing uninsured labor income risks choose whether to participate in the stock market and decide on home ownership in an environment with a social safety net and retirement savings system. The model is motivated by the empirical finding that active stock market participation is associated with higher education and employment experience in the finance sector. The model exhibits a good fit for portfolio choice, home ownership, and consumption patterns in the cross-section and throughout the life cycle. Our finding is that the stock market access, approximated by a fixed entry cost and variable costs, is crucial in generating heterogeneous outcomes in agents' wealth accumulation, increasing wealth inequality.

In the second essay, we switch our modeling focus to the banking system, in which the interbank credit relations connect banks. We propose a simple dynamic learning agent-based model of an interbank system consisting of heterogeneous bank agents making multi-period lending and borrowing decisions. The model establishes bank credit connections with an Eisenberg-Noe type of central clearing system, allowing for a partial recovery rate on default banks. We initialize the bank's balance sheet using the FFIEC data for the U.S. banks. We model the endogenous formation of interbank credit relationships and bank agents' belief formation about the chances of getting loan approval from other banks and determine the borrowing target based on this belief. This belief would be reinforced whenever a credit connection between two banks is established. Conditioning on that the credit connections are borrower-initiated, such endogenously formed lending and borrowing networks exhibit the well-known core-periphery structure observed in the actual bank credit network, where large core banks serve as the money center, lending heavily to each other, and small periphery banks are less connected, and capital flows among small banks are relatively small. We conduct statistical analysis on the belief network and compare it with highly stylized network structures, including Ring-Type and Full-Connected networks. We show that this reinforcement learning feature shapes a network construction that exhibits more stable and realistic features in the multi-step network evolution process. This feature resembles how the bank builds credit relations and allocates liquidity most efficiently.

The third essay discusses the banking system's exposure to the drastic changes in the current interest rate environment. We observe the significant changes in the banks' balance sheets. Building on top of the modeling setup from the second essay, we study the effect of the emerging trend of banks' significant reclassifying securities to Held-To-Maturity (HTM). Our model shows that "hiding" losses under the HTM accounting policy, compounded with a tightened credit environment, could serve as a channel for stress buildup and increase the likelihood of bank failures through inter-bank contagion and sharp asset losses. We further experiment with forcing market-to-market accounting to HTM securities and demonstrate that this proposed policy would allow the banking system to gradually absorb similar shocks and significantly decrease the probability of bank failures. This study raises potential systemic risk concerns under the current high-interest rate regime and proposes a possible solution to mitigate such a structure risk. Finally, we present the finding that the quarterly published policy guidance (The dot plots) from the FOMC meeting could indirectly impact the interbank funding stress. In times of stress, funding markets can freeze if participants perceive greater liquidity risk. We conclude by suggesting future modeling directions.