Systemic Risk in Financial Networks

PhD Dissertation Defense

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Abstract: I have used the network model based approach to study systemic risk in financial networks. In particular, I have worked on generalized extensions of the Eisenberg-Noe [2001] framework to account for realistic financial situations. I present formulas for the valuation of debt and equity of firms in a financial network under comonotonic endowments. I demonstrate that the comonotonic setting provides a lower bound to the price of debt under Eisenberg-Noe financial networks with consistent marginal endowments. Special consideration is given to the setting in which firms only invest in a risk-free bond and a common risky asset following a geometric Brownian motion. Next, I develop a framework for price-mediated contagion in financial systems wherein banks are forced to liquidate assets to satisfy a risk-weight based capital ratio requirement. I consider the case of multiple illiquid assets and develop conditions for the existence and uniqueness of equilibrium prices. I show that the sensitivity analysis of these prices with respect to the system parameters can be written as a fixed point problem and prove the existence and uniqueness of a solution to this problem. I also develop a methodology to quantify the cost of regulation faced by different banks in this setting. Numerical case studies are provided to study the application of this model to data. Furthermore, I extend the network model of financial contagion to allow for time dynamics in both discrete and continuous time. Emphasis is placed on the continuous-time framework and its formulation as a differential equation driven by the operating cash flows. I provide results on existence and uniqueness of firm wealths under the discrete and continuous-time models and discuss the financial implications of time dynamics. In particular, I focus on how the dynamic clearing solutions differ from those of the static Eisenberg-Noe model. Finally, I study the implications of contingent payments on the clearing wealth in a network model of financial contagion. I first consider the problem in a static framework and develop conditions for existence and uniqueness of solutions as long as no firm is speculating on the failure of other firms. In order to achieve existence and uniqueness under more general conditions, I introduce a dynamic framework and demonstrate how this setting can be applied to problems that are ill-defined in the static framework.

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