Sovereign Credit Risk Contagion: a Dynamical Systems Approach

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Abstract:

We build an agent-based model for a multi-economic system to investigate and analyze the eurozone sovereign credit crises. The agents are large aggregates of a subeconomy (country), and the global economy is a collection of subeconomies. We use well-known constructs of the theory of dynamical systems to represent a financial crisis as the breakage of a financial equilibrium and investigate contagion of a crisis from one subeconomy to another. We give a quantitative definition of contagion using the market instability indicator—the spectral radius of the Jacobian matrix of a dynamical system of both the subeconomies and the global one, which can be computed by estimating the elasticities of flows of funds between agents. High leverage and borrowing capacity constraints increase elasticities and make the market unstable.

Sovereign obligations of developed countries had long been considered riskless, but the eurozone crisis has changed that belief. Furthermore, a monetary union makes it impossible for member countries to devalue their own currency, which otherwise is a key tool to stimulate economic growth through increased exports. Global investments and trades connect countries inside and outside the eurozone, and even a default by a relatively small economy can trigger a global financial crisis through contagion. Using a mathematical model, we investigate and analyze the interconnectedness of the economies inside and outside the eurozone, track the routes of risk transmission, and suggest methods to prevent contagion. Our contribution is to provide a mathematical model to show how subeconomies can be isolated from the global one by controlling the elasticities of inter-agent flows of funds.