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Information-based contagion and the implications for financial fragility

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ABSTRACT

This paper explores a *global game* model of information-based financial contagion. By revealing information on a common fundamental factor and thereby affecting the behavior of creditors, the failure of a single firm can trigger the failure of another firm. The model provides a unique equilibrium framework to assess the consequences of contagion and yields some hitherto unnoticed insights. While contagion increases the correlation among the financial failures of different firms, its impact on the incidence of failure is ambiguous. I consider an analytically tractable version of the model in which the effect on the ex ante failure probabilities is exactly zero. Moreover, the impact of contagion increases with the relevance of a common underlying fundamental, but is limited to firms near the brink of success or failure.

1. Introduction

It is hard to overstate the attention which has been given to financial contagion by both academics and policymakers in recent decades. Laeven and Valencia (2008), for example, identify 124 episodes of systemic banking crises over the period from 1970 to 2007. Financial contagion can hinge either upon direct capital connections between firms or on the reaction of market participants to news about financial distress. The focus of this paper is on the latter channel of propagation. If bank creditors lack precise information on how the failure of a particular bank is related to their own institutions, they may initiate a run as well, thereby sweeping away sound and unsound banks alike. Likewise, investors might withdraw their funds from a country if they observe financial turmoil elsewhere. Thus a crisis can spread from one country to others.

There is ample empirical evidence of information-based contagion in the wake of financial crises.[1] Contagious runs are also a major concern behind taking regulatory measures such as adopting deposit insurance or capital controls. In a recent example, when depositors started a run on UK bank Northern Rock in September 2007, fear of contagion led the British government announce that it would guarantee all deposits of banks in trouble if required. Nonetheless, this propagation channel has rarely been explored in a rigorous model. A major impediment in analyzing contagion is the presence of multiple equilibria in bank run models in the style of Diamond and Dybvig (1983) and in models of self-fulfilling currency crises as in Obstfeld (1996). Remaining silent about what may trigger a run, mere sunspot models fail to come up with a

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[1] Park (1991), Calomiris and Mason (1997), and Gorton (1988) find strong empirical evidence of information-based bank contagion, while Ahluwalia (2000), Basu (2002) and Shortland et al. (2006) provide examples on information-based contagion across countries.

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compelling rationale for contagion. If failures are driven by sunspots unrelated to fundamentals, how should investors assess which firms or countries, if any, have become more fragile?

Therefore, to circumvent the pitfall of indeterminacy, I draw on the *global games* equilibrium selection technique initiated by Carlsson and van Damme (1993) and further advanced by Morris and Shin (1998). Global games assume that the involved agents privately observe noisy signals of an underlying state of fundamentals. In combination with strategic complementarities, this departure from common knowledge incorporates sufficient structure into the beliefs of agents to select a unique equilibrium in many coordination failure settings.[2] In this paper, I extend a model in the style of Morris and Shin (2004) to include two firms A and B and two types of fundamental variables. Each firm runs a project that is financed by a distinct continuum of creditors. At an intermediate stage, creditors individually decide whether or not to abandon their investment before the project matures. If they withdraw, investors forego a potentially higher payoff for the sake of a smaller but safe one. Yet in so doing, they also compromise the chances of the firm being successful. The return of each project further depends on two states of fundamental, the first of which affects exactly one firm and the second of which influences both firms. Before deciding whether to withdraw, creditors observe noisy signal of the fundamental which specifically affects their own firm. In addition, the creditors of firm B can observe if there has been a run on firm A.

The model has a unique equilibrium in which firm B is more likely to fail if firm A fails, even if one controls for the state of the common fundamental. This key finding of financial contagion rests on the following mechanism: In equilibrium, the fundamentals determine to what extent creditors withdraw early and whether or not a firm fails. A collapse of firm A is a signal which reveals adverse—albeit imperfect and sometimes misleading—information on the common fundamental. By virtue of updating their beliefs in a Bayesian manner, and since their project also depends on the common factor, creditors of firm B hence become more inclined to withdraw their funds. Their increased willingness to withdraw in turn may induce the failure of firm B, provided the latter is already on the brink of collapse. That said, it is important to recognize that by the same mechanism, a favorable result of firm A can rescue firm B. This notion of "positive contagion" has not received any attention in the literature so far. Thus the main impact of contagion is to increase the underlying fundamental correlation between firms, whereas the impact on the incidence of failure is ambiguous.

The present work is related to a number of recent contributions on contagion and global games. Dasgupta (2004) develops a global game model in which contagion emerges from capital connections between financial institutions. In Cifuentes et al. (2005), mark-to-market accounting combined with regulatory solvency constraints may force banks to dispose of illiquid assets after an initial adverse shock. By depressing asset prices, this may dictate further disposals and amplify the impact of the original shock. Goldstein and Pauzner (2004) explore a global game in which contagion emerges due to wealth effects. In their model, a crisis in one country reduces investors' wealth, which makes them more inclined to withdraw their investments from the other country. Goldstein (2005) shows that strategic complementarities between creditors and currency speculators can reinforce the underlying correlation between banking crises and currency crises. In his model, agents in the credit and in the foreign exchange market have a direct impact on returns in the other market, while there is no such connection between the firms considered here.

Another related paper is Calvo and Mendoza's (2000) informational frictions approach to modelling contagion, who argue that instead of collecting costly information, many investors may rather respond to noisy information involved in the trades of informed specialists. Similarly, Chen (1999) provides a model where bank runs can be contagious because *uninformed* depositors conclude that *informed* depositors have withdrawn their funds, which reveals bad prospects for the banking industry. I explore a similar propagation mechanism, albeit in a different model which assumes that all creditors are imperfectly informed instead of distinguishing between informed and uninformed creditors. Moreover, unlike in Chen (1999), the discussion in this paper rests on a unique equilibrium framework. It is a generalization of an earlier version in Manz (2002), which is, to my knowledge, the first unique equilibrium model of information-based contagion.[3] Section 2 of the paper introduces the model and derives the main result of financial contagion. In Section 3, I contemplate the implications of financial contagion in more detail. Section 4 concludes.

2. The model

2.1. Basic setup

There are two firms indexed by $j \in \{A, B\}$. Each firm runs a project that is financed by a distinct continuum of creditors normalized to one. Creditors maximize expected utility $E[u(C_i)]$, where C_i denotes the payment accruing to creditor i, and $u(\cdot)$ is a continuous, increasing and (weakly) concave utility function with $u(0) = 0$. While the initial lending decision is not explicitly modelled, loan conditions are assumed to be such that it is rational to become a lender when the project begins. However, at an intermediate stage of the project, creditors receive an opportunity to rethink their investment and individually decide if they roll over their loans or if they withdraw before the project matures. Creditors who withdraw

[2] Global game models of financial distress in a one firm or one country setup include Goldstein and Pauzner (2005), Heinemann and Illing (2002), Hubert and Schäfer (2002) and Morris and Shin (2004). Heinemann et al. (2004) show that experimental evidence is in line with threshold-triggered equilibrium strategies and with comparative statics predicted by global games.

[3] A similar model to Manz (2002) is provided by Vaugirard (2004) in a cross-country context. Moreover, there is an extensive related literature on information-based bank runs as e.g. Chari and Jagannathan (1988). Their framework, however, does not address contagion.