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Financial contagion in the laboratory: The cross-market rebalancing channel

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ABSTRACT

We present the results of the first experimental study of financial markets contagion. We develop a model of financial contagion amenable to be tested in the laboratory. In the model, contagion happens because of cross-market rebalancing, a channel for transmission of shocks across markets first studied by Kodres and Pritsker (2002). Theory predicts that, because of portfolio rebalancing, a negative shock in one market transmits itself to the others, as investors adjust their portfolio allocations. The theory is supported by the experimental results. The price observed in the laboratory is close to that predicted by theory, and strong contagion effects are observed. The results are robust across different market structures. Moreover, as theory predicts, lower asymmetric information in a ("developed") financial market increases the contagion effects in ("emerging") markets.

1. Introduction

Financial crises in one country often spread to other, unrelated economies, a phenomenon known as financial contagion. Given the pervasiveness of the phenomenon in recent years, a lot of theoretical and empirical work has been devoted to its understanding.

The theoretical literature on contagion in financial markets has identified several channels of contagion.[1] In King and Wadhwani (1990), informational spillovers lead traders to trade in one market on the basis of the information they infer from price changes in another. Informational spillovers are also present in Cipriani and Guarino (2008), in which contagion occurs because trading activity in one market creates an informational cascade in another. In Calvo (1999), correlated liquidity shocks – which occur when agents, hit by a liquidity shock in one market, need to liquidate their position across markets in order to meet a margin call – generate contagion across markets (see also Yuan, 2005). In Kyle and Xiong (2001), financial contagion is due to wealth effects. In Fostel and Geanakoplos (2008) financial contagion arises as a result of the interplay between market incompleteness, agents' heterogeneity and margin requirements. In Kodres and Pritsker (2002), contagion happens through cross-market rebalancing, when traders hit by a shock in one market need to rebalance their portfolios of assets. Consider an economy with three markets: *A*, *B* and *C*; assume that *A* and *B* share exposure to one macroeconomic risk factor, whereas *B* and *C* share exposure to a different macroeconomic factor. A shock in market *A* may prompt investors to rebalance their portfolios in market *B* (because of their common risk exposure), which in turns prompts investors to rebalance their portfolios in *C*. As a result, the shock transmits itself from *A* to *C*, although the two markets do not share exposure to the same risk factor (i.e., their fundamentals are independent).

The purpose of this paper is to analyze the cross-market rebalancing channel of contagion in a laboratory. We do so in order to understand whether rebalancing motives are not only theoretically interesting, but also able to generate contagion effects with human subjects.

Kodres and Pritsker (2002) study cross-market rebalancing in a rational expectations, CARA-Normal model. Their model builds on Grossman and Stiglitz (1980), extending it to a multi-asset economy. To implement their model in the laboratory would be difficult, given that agents are assumed to have a CARA utility

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[1] We focus on contagion in financial markets, and do not discuss here contagion due to linkages among financial institutions (like in, e.g., Allen and Gale, 2000).

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function, the asset values are distributed according to normal distributions, and there are three types of traders.

Instead of trying to design the experiment to replicate Kodres and Pritsker (2002) literally, we used a different strategy. We constructed a model that still requires agents to rebalance their portfolios, but in a much simpler set-up that subjects could easily understand. We implemented the model in the laboratory with three treatments. In the first two treatments,which we label the "baseline treatments", subjects trade three assets with an automaton representing a fringe of uninformed traders. The assets' fundamental values are independent of each other. Portfolio rebalancing motives arise because subjects' payoffs depend not only on the return to their investment, but also on the composition of their portfolios. Optimal portfolio weights are exogenously imposed by the experimenters to create meaningful contagion effects. In the third treatment, we studied the rebalancing channel with a different market mechanism. In particular, subjects with the same payoff function as in the previous treatments traded in a multi-unit double auction market. They exchanged the assets among themselves, some of them being informed traders and others being uninformed traders.

The results from our experiment are very encouraging for the theoretical analysis. In all the three treatments, the prices that we observe in the laboratory are very close to the equilibrium ones. As a result, very strong contagion effects are observed between the two periphery markets. Therefore, the experimental analysis lends credibility to the idea that the rebalancing channel is an important element in creating cross-market contagion.

An important implication of the Kodres and Pritsker (2002) model is that the degree of asymmetric information in a (developed economy's) financial center affects the severity of contagion effects across emerging markets. Lower asymmetric information, by making the price less elastic, decreases the costs of rebalancing; as a result, the transmission of shocks from one periphery market to the other is more pronounced. Therefore, as markets in developed economies become more transparent (i.e., as the degree of asymmetric information decreases), contagion effects among emerging markets become stronger. We tested this prediction in the laboratory, by running treatments with different price elasticities in the financial center. The experimental results support the theory: as the price in the financial center becomes less elastic, contagion effects in the periphery become more pronounced.

The structure of the paper is as follows. Section 2 describes the theoretical framework and its predictions. Section 3 presents the experiment. Section 4 illustrates the results. Section 5 concludes. The Appendix contains the instructions and some robustness checks.

2. The theoretical framework

2.1. The portfolio rebalancing channel

Our experiment, inspired by the work of Kodres and Pritsker (2002), aims to test experimentally the "cross-market rebalancing" channel of financial contagion. In Kodres and Pritsker (2002), because traders need to rebalance their portfolios, contagion arises even when traditional channels of contagion (such as correlated information, correlated liquidity shocks or wealth effects) are absent. We give the intuition behind their result through a simple example (taken from Kodres and Pritsker, 2002).

There are three assets traded in the economy, *A*, *B* and *C*, whose liquidation values take the form

$$V_A = \theta_A + \beta_A f_1 + \eta_A$$
$$V_B = \beta_{B,1} f_1 + \beta_{B,2} f_2$$
$$V_C = \theta_C + \beta_C f_2 + \eta_C$$

where f_1 and f_2 represent shared macroeconomic risk factors; β_A,β_B and β_C are the risk factors' marginal effects on the assets; θ_A and θ_C represent country-specific private information; and η_A and η_C country-specific risk factors (on which private information is not available). All the random variables are independently distributed.

Note that countries *A* and *C* (which Kodres and Pritsker interpret as emerging, periphery economies) share no common macroeconomic factor; moreover, they are not linked by either correlated information, or by correlated liquidity shocks. Nevertheless, one can show that investors' need to adjust their portfolios leads to shocks transmitting themselves from one periphery market to the other. This happens because, although *A* and *C* share no risk factors, they are both linked to *B* (which Kodres and Pritsker interpret as a developed financial market), and *B* acts as a conduit for shock transmission.

Suppose that informed traders receive information that makes them decrease their expected value in market *A*; that is, there is a negative information shock in market *A*. Their optimal response is to sell asset *A*, thus lowering their exposure to risk factor f_1 below its optimal level. Optimal portfolio considerations will lead them to increase their exposure to f_1 by buying asset *B*, thus raising its price. This, however, increases their exposure to risk factor f_2 above its optimal level, thus leading them to sell asset *C*. As a result, the price in market *C* will drop. Therefore, a negative shock in market *A* leads to an increase in the price of asset *B* (the financial center) and to a decrease in the price of asset *C* (the other periphery economy).

Note that informational asymmetry in market *B* plays a crucial role in the transmission of the shock. If there is more informational asymmetry in *B*, its price increases by more with the order flow and cross market rebalancing becomes more expensive.[2] Because of this, there will be less rebalancing from *A* to *B* and from *B* to *C*. This reduces market *C* sensitivity to shocks in market *A*, that is, the severity of contagion. In contrast, a decrease in informational asymmetry in market *B* makes contagion more severe. Kodres and Pritsker (2002) comment that "steps that reduce information asymmetries in developed markets may have the unintended consequence of enhancing developed market's role as a conduit for contagion among emerging markets".

As we mentioned in the Introduction, Kodres and Pritsker (2002) use a rational expectations, CARA-Normal model (which extends Grossman and Stiglitz, 1980) with three types of traders. Because implementing their model in the laboratory would be difficult, we developed a simple model, which captures the same intuition, but is amenable to experimental testing. We describe this model in the following section.

2.2. The model structure

We present a simple model of portfolio rebalancing that can be easily brought to the laboratory. In our model, there are three markets – labeled, as above, *A*, *B* and *C* – where traders trade three assets denoted by the same letters. The three markets open sequentially. First traders receive information about the fundamental value in market *A* and adjust their position accordingly. Then, they adjust their portfolio by trading first in market *B* and afterwards in market *C*.[3]

[2] Intuitively, noise traders interpret the order flow in market *B* (e.g., a high demand) as having informational content. As a result, they respond more to changes in the order flow (because it affects their conditional expectation of the asset value).

[3] We preferred to have markets open sequentially rather than simulatenously, so that subjects in the experiment could concentrate on one market at a time. One concern one can have with the sequential structure is that it requires solving a backward induction problem, making the game perhaps more complicated. We will comment more on this when discussing our results.