Modeling financial contagion using mutually exciting jump processes ☆

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ABSTRACT

We propose a model to capture the dynamics of asset returns, with periods of crises that are characterized by contagion. In the model, a jump in one region of the world increases the intensity of jumps both in the same region (self-excitation) as well as in other regions (cross-excitation), generating episodes of highly clustered jumps across world markets that mimic the observed features of the data. We develop and implement moment-based estimation and testing procedures for this model. The estimates provide evidence of self-excitation both in the US and the other world markets, and of asymmetric cross-excitation, with the US market typically having more influence on the jump intensity of other markets than the reverse. We propose filtered values of the jump intensities as a measure of market stress and examine their out-of-sample forecasting abilities.

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1. Introduction

Despite the predictions of standard continuous-time asset return models, financial crises seem to happen every decade or so. Indeed, large drops in asset markets are very unlikely to occur under standard Brownian-driven statistical models, at least with volatility variables calibrated to realistic values. Even more unlikely would be crashes that happen in not just one, but multiple markets around the world at nearly the same time. And, even more unlikely would be further large price moves that happen in close succession over the following days, like earthquake aftershocks.

Figs. 1 and 2 illustrate two examples of such patterns, which took place in February 2007 and October 2008,
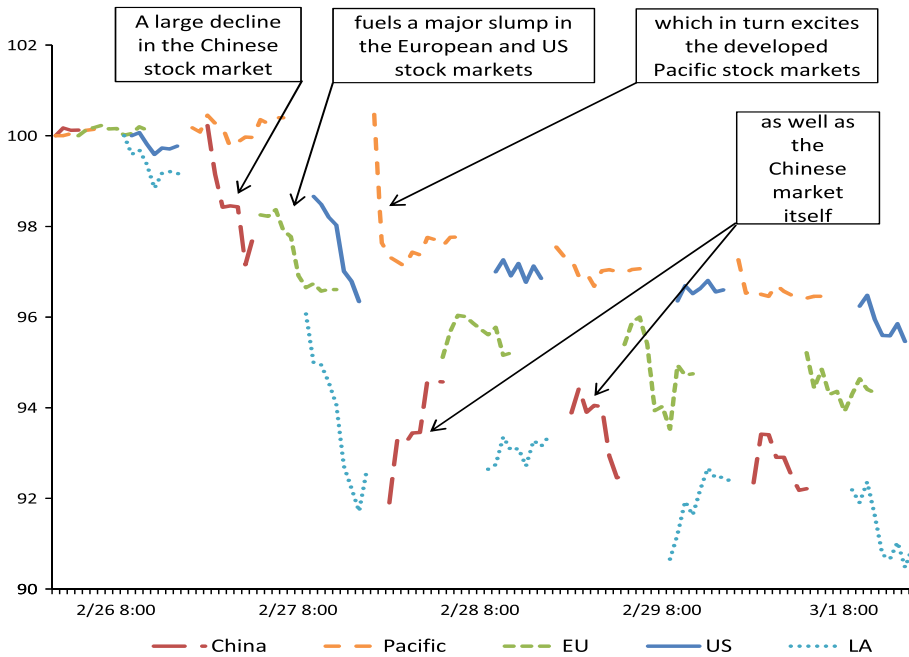
Fig. 1. Mutual excitation: Example I. This figure plots the cascade of declines in international equity markets experienced between February 26, 2007 and March 1, 2007 in the US; Latin America (LA); developed European countries (EU); China; and developed countries in the Pacific. Data are hourly. The first observation of each of the price index series is normalized to 100 and the following observations are normalized by the same factor. Source: MSCI MXRT international equity indexes on Bloomberg.
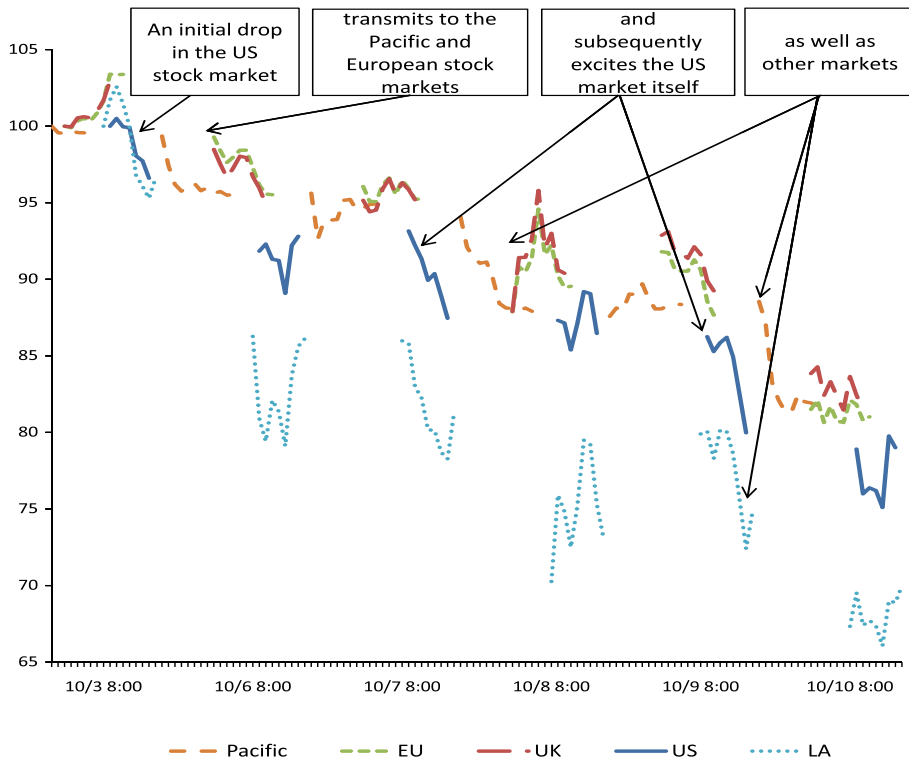

Fig. 2. Mutual excitation: Example II. This figure plots the cascade of declines in international equity markets experienced between October 3, 2008 and October 10, 2008 in the US; Latin America (LA); UK; developed European countries (EU); and developed countries in the Pacific. Data are hourly. The first observation of each of the price index series is normalized to 100 and the following observations are normalized by the same factor. Source: MSCI MXRT international equity indexes on Bloomberg.