



ELSEVIER

Available online at www.sciencedirect.com

ScienceDirect

Journal of Economic Dynamics & Control 32 (2008) 137–155

JOURNAL OF
Economic
Dynamics
& Control

www.elsevier.com/locate/jedc

Stock market crashes as social phase transitions

Moshe Levy^{a,b,*}

^aAnderson School of Management at UCLA, 110 Westwood Plaza, Los Angeles, CA 90095, USA

^bHebrew University of Jerusalem, Israel

Received 1 May 2005; received in revised form 1 December 2006; accepted 26 January 2007

Available online 21 March 2007

Abstract

Stock market crashes are traumatic events that affect the lives of millions of people around the globe and have tremendous economic implications. Crashes are not only dramatic, but often completely unexpected. The 1987 crash, for example, was not induced by any obvious trigger. Even after the fact, it is hard to find the reason for the crash – Why did the market crash in October rather than in September or December? Why did it crash at all? To this day, we lack satisfactory answers. This paper shows that spontaneous market crashes can be explained by a ‘social phase transition’ mechanism similar to statistical mechanics phase transitions. Investors’ heterogeneity plays the role of ‘temperature’, and is key in determining the possibility and magnitude of the crash. The analysis suggests that dramatic crashes are a robust and inevitable property of financial markets. It also implies that market crashes should be preceded by an increase in price volatility, as empirically observed. Thus, market crashes, like earthquakes, are a fundamental and unavoidable part of our world. However, we can develop early warning systems that may help minimize the damage.

© 2007 Elsevier B.V. All rights reserved.

JEL classification: G10; D70; C0

Keywords: Market crashes; Phase transitions; Conformity effects

*Corresponding author at: Anderson School of Management at UCLA, 110 Westwood Plaza, Los Angeles, CA 90095, USA. Tel.: +1 310 825 4083.

E-mail address: moshe.levy@anderson.ucla.edu.

0. Introduction

The daily fluctuations of the S&P500 index have a standard deviation of approximately 1%. On October 19, 1987, this index fell by more than 20%, a very dramatic event notoriously known as the '87 crash. If the crash would have been a response to a 9/11 type of catastrophe, it would not have been an economic puzzle. However, no significant event triggered the crash. It appears to have been spontaneous. This phenomenon is very difficult to explain with standard economic models (see [Roll, 1988a](#)).¹

In statistical mechanics, phase transitions where a very small parameter change leads to a dramatic change in the system's macroscopic properties have been extensively studied (see, for example, [Stanley, 1987](#); [Anderson, 1997](#)). Thus, in searching for an explanation for market crashes, it is natural to look for analogies between stock markets and statistical mechanics systems. Indeed, stock market systems have some fundamental features in common with statistical mechanics systems, such as a system of spins in a magnet. Both systems are composed of many interacting elements (investors or spins) that have an inclination to conform with one another. For spins, this 'inclination' is driven by the magnetic force. Investors also have various economic and psychological reasons to conform with each other. For instance, investors may take the 'average investor behavior' as an informational signal: If an investor observes a buying 'frenzy', he may interpret this as everybody else having some positive information, which may lead him to join the frenzy (and the opposite for selling; see [Welch, 2000](#); [Bikhchandani et al., 1992](#)).² Investors may also rationally choose to conform with the actions of their peers in order to hedge against changes in consumer prices that may decrease their buying power ([DeMarzo et al., 2004](#)). Psychological and social reasons, such as peer pressure, may also drive investors to conform ([Duflo and Saez, 2002](#); [Hong et al., 2003](#); [Madrian and Shea, 2000](#)). We show here that just as the magnetic interaction plays a key role in spin system phase transitions, the conformity effects play an analog central role in market crashes.

The idea of modeling social interactions in a way similar to interactions in many-body statistical mechanics systems has fascinated many researchers, and has led to important insights. Some of the main studies taking this approach are [Weidlich \(1972, 1991\)](#), [Föllmer \(1974\)](#), [Haken \(1977\)](#), [Topol \(1991\)](#), [Brock \(1993\)](#), [Lux \(1995, 1997\)](#), [Durlauf \(1999\)](#), and [Brock and Durlauf \(2001\)](#). Most of these studies typically model the social system investigated as a system of identical interacting 'particles' or 'spins' with stochastic dynamics. While this approach has proven extremely useful, it has been criticized on the grounds that spin systems and financial markets are fundamentally different in some key aspects ([Hors and Lordon, 1997](#)). Spins are

¹For several possible explanations of market crashes, see [Genotte and Leland \(1990\)](#), [Topol \(1991\)](#), [Levy et al. \(1994\)](#), and [Lux \(1995\)](#).

²The profitability of such 'momentum' trading strategies versus the opposite 'contrarian' strategies has been empirically found to depend on the investment horizon, with momentum trading being advantageous for relatively short horizons and contrarian trading being more profitable for longer horizons. See, for example, [Jegadeesh and Titman \(1993\)](#), [Grinblatt et al. \(1995\)](#), and [Balvers et al. \(2000\)](#).

متن کامل مقاله

دریافت فوری ←

ISIArticles

مرجع مقالات تخصصی ایران

- ✓ امکان دانلود نسخه تمام متن مقالات انگلیسی
- ✓ امکان دانلود نسخه ترجمه شده مقالات
- ✓ پذیرش سفارش ترجمه تخصصی
- ✓ امکان جستجو در آرشیو جامعی از صدها موضوع و هزاران مقاله
- ✓ امکان دانلود رایگان ۲ صفحه اول هر مقاله
- ✓ امکان پرداخت اینترنتی با کلیه کارت های عضو شتاب
- ✓ دانلود فوری مقاله پس از پرداخت آنلاین
- ✓ پشتیبانی کامل خرید با بهره مندی از سیستم هوشمند رهگیری سفارشات