

Longin F. (November 1993) “Booms and crashes: application of extreme value theory to the U.S. stock market,” IFA Working Paper 179-93, Institute of Finance and Accounting, London Business School.

“Stock market crash”: a magic expression, which will definitely attract the attention of every financial investor. Although all market participants would certainly care about such extraordinary events, no research work has ever attempted to give a rigorous quantification of its meaning.

The contribution of this paper is to introduce extreme value theory to provide some **quantitative results on extreme price movements** and especially stock market booms and crashes. A first issue is the definition of such events. According to extreme value theory, an extreme price movement is defined as the minimal (or maximal) return over a given time-period. If a crash certainly corresponds to a minimal return over a given time-period, the reverse is not true: a minimal return is not necessarily a crash. This raises a natural question: how to define a crash? To answer this question, I propose two classifications of minimal returns between crashes and non-crashes observations. I then tests if heterogeneity in the distribution of the minimal returns could explain the classification between crashes and non-crashes. In other words, crashes and non-crashes may be drawn from the same unconditional distribution of extremes. In the quantitative classification, an observation of minimal return is a crash if the minimal return falls below a given level. To classify the crashes the level can be fixed arbitrarily or determined using a statistical measure such as a multiple of the standard deviations of daily returns. This classification insists on the quantitative aspect of the phenomenon. A crash corresponds surely to a sharp, brief decline of the market, but the reverse appears to be false. In the qualitative classification, an observation of minimal return is a crash if it is recognized by market participants (investors, brokers, regulators, etc.) as a crash. This information is found in the comments reported in the New York Times (the only daily newspaper covering the entire period 1885-1990 of the database) on the day following the drop in the stock market. If the words *crash* or *to crash* appear in the newspaper, the observation of the minimal return is asterisked as a crash. The quantitative and qualitative classifications for the minimal returns are quite different. Although the two sets of crashes approximately contain almost the same number of observations, the overlap is not perfect.

The main result of this research is that for the two classifications the results do not lead to a rejection of the null hypothesis of the homogeneity of the distribution of the extremes. No significant differences are found between the parameters estimated from the subsample of the crashes and from the subsample of the other minima. In sum, the results show that the distribution of the extremes is homogenous. The crashes and non-crashes are likely drawn from the same unconditional distribution of extremes. From a statistical point of view, no difference between both types of minimal returns is found. There is no heterogeneity, which could have explained the classifications of minimal returns. The conclusion is that crashes are simply bad draws and not special or abnormal statistical events. Such a result justifies the use of the extreme value distribution to provide quantitative results about stock market crashes.