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Minimal returns and the breakdown of the price–volume relation

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Abstract

We look at stock-market prices and transaction volume on the day of minimal (the minimum for that year) daily returns, from 1885 to 1990. We find that large (in absolute terms) minimal returns show little correlation with transaction volume.

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1. Introduction and motivation

In his review of the empirical and theoretical evidence on the price–volume relation, Karpoff (1987) quotes the Wall Street adage that: "It takes volume to make prices move." In fact, 13 out of 14 studies reviewed find a positive correlation between absolute stock-price changes and transaction volume. At a theoretical level, the studies reviewed argue that each transaction brings new information to the market; hence, the larger the volume is, the more opportunities there are for prices to change.

While the studies reviewed in Karpoff (1987) focus on 'normal' market conditions, the stock-market crash of 19 October 1987 suggested that large price declines may occur when the price–volume relation suddenly changes. Brennan and Schwartz (1989), for example, note that on the day of the crash the market dropped by more than 20%, while the combined trading in NYSE-listed stocks and the S&P500 futures contract was of the order of only 2% of

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the value of the underlying stocks. Gennotte and Leland (1990) also note that the $6 billion stock sales triggered by portfolio-insurance strategies represented less than 0.2% of the value of NYSE stocks at the beginning of the day.

The apparent lack of liquidity of the U.S. stock market prompted several explanations for the crash. The papers by Gennotte and Leland (1990) and Donaldson and Uhlig (1991) argue that the crash may have resulted from misinterpreted, uninformed trading. When there is uncertainty as to the extent of stop-loss strategies (as in 1929), portfolio insurance (as in 1987), and other positive-feedback trading strategies, sell orders by feedback traders may be interpreted as informed trades.[1] Rational traders may then mistakenly infer that a substantial change in fundamental values has taken place. One implication of this hypothesis is that during a crash the *same* trading volume may lead to very different price changes, depending on how it is interpreted by market participants.

This paper investigates the relationship between stock-market prices and transaction volume when price declines are 'large'. Namely, we look at minimal (the minimum for that year) daily returns, and associated NYSE-trading volume, for the 1885–1990 period. While the existing literature on market crashes mainly focuses on the 1929 and 1987 episodes, our data set allows us to study *several* large price declines.

The main contribution of the paper is the following stylized fact: when a minimal return is small (in absolute terms), its size shows a strong correlation with transaction volume. This finding is consistent with the empirical and theoretical evidence reviewed in Karpoff (1987), and with more recent empirical investigations of NYSE daily returns and volume, such as Gallant et al. (1992). However, the price–volume relation is very weak for minimal returns of large, absolute size, 'crashes': a given trading volume may translate into quite different price declines. This second finding is consistent with the 'misinterpreted-trade' hypothesis of stock-market crashes of Gennotte and Leland (1991) and Donaldson and Uhlig (1991).

The paper is organized as follows. Section 2 describes the data set, while Section 3 discusses the stylized fact.

2. The data

The data set concentrates on minimal daily returns on a portfolio of U.S. stocks for each year from 1885 to 1990; by minimal return we mean the lowest logarithmic daily percentage return (capital loss) over each calendar year.[2] The stock-return data set is an updated version of that used by Schwert (1990): the portfolio is a composite of the Dow Jones Industrial and Railroad averages for the 1885–1927 period; from 1928 onwards, returns are computed on the S&P portfolio.[3] *Large* price declines, or crashes, are defined to be those daily returns that lie

[1] Positive-feedback traders are investors who buy securities when prices rise and sell them when prices fall; see De Long et al. (1990).

[2] In practice, each minimal return is the lowest within a window of 279 observations, which is the average number of trading days in a calendar year, during the 1885–1990 period.

[3] We thank William Schwert for kindly making his data set available to us.

more than four standard deviations away from the mean (less than −4.09%), where both standard deviation and mean are computed from *all* daily returns for the 1885–1990 period. On the basis of this criterion, 31 minimal returns are classified as crashes, while 75 are classified as non-crashes. Transaction-volume data are the number of shares traded daily on the NYSE. As in other recent papers, we normalize transaction volume to account for its trending behavior: each transaction-volume observation is the ratio between the daily volume and the average volume for that year, times 100.[4] These data have been collected directly from the *New York Times* for the 1885–1927 period. For the 1928–1962 period, NYSE transaction-volume data are available from Standard & Poor's (1986), while data for the 1963–1990 period are from the CRSP data tape.

3. The stylized fact

We computed the correlation coefficient between minimal returns and transaction volume; we have −0.06 for *crashes*, −0.39 for *non-crashes*, and −0.52 for *all* minimal observations. Also, we estimated the simple regression model,

$$\mathrm{Vol}_i = a + bR_i + e_i \,, \tag{1}$$

where Vol_i is the standardized transaction volume corresponding to the minimal return, R_i, observed during year i. The slope coefficient b equals −2.71 for crashes, −30.00 for non-crashes, and −15.79 for all minimal returns, with t-statistics of −1.16, −3.31 and −3.72 respectively.[5] Table 1 summarizes the results of these simple tests.

Fig. 1 plots standardized transaction volume against minimal stock returns, together with the 'fitted' values from the regression model (1), which is estimated separately for crashes and non-crashes.

Fig. 1 further illustrates how volume and returns are strongly (negatively) correlated only when we look at non-crash minimal returns; when we look at crashes, the price–volume relation breaks down.

Our results for non-crash price declines are consistent with the literature surveyed by Karpoff (1987), which finds a positive correlation between transaction volume and absolute stock-price changes. However, we also find that large price declines differ from smaller ones in that their correlation with transaction volume is essentially nil.

This finding is consistent with an explanation of stock-market crashes which attributes the large price decline to misinterpreted positive-feedback trades. In the presence of portfolio insurers or stop-loss strategies, an initial price decline mechanically triggers sale orders, which may then be interpreted as informed trades by other investors. This, in turn, leads to even

[4] This is by no means the only method of normalization; Gallant et al. (1992), for example, estimate a quadratic trend from volume data and use the fitted values for normalization.

[5] Our results are robust to the elimination of the 1987 data point. The correlation coefficient for crash observations reduces to −0.04, while the slope-coefficient estimate, −1.94, remains non-significant, with a t-statistic of −0.28.

Table 1
Transaction volume–return relation

$\rho_{Vol,R}$	Crashes	Non-crashes	All min. obs.
	−0.06	−0.39	−0.52
a	52.34	82.07	129.11
	(28.50)	(20.95)	(14.94)
b	−2.71	−30.00	−15.79
	(2.34)	(9.06)	(4.24)
$\bar{R}^2$	−0.03	0.14	0.26

We compute the correlation coefficient between the standardized transaction volume, Vol_i, corresponding to the minimal return, R_i, observed during year i, and R_i. Also, we estimate the model $Vol_i = a + bR_i + e_i$. The conditional variance of transaction volume is likely to change across minimal returns, and standard errors on the estimates of a and b (in parentheses) are adjusted for heteroskedasticity in the residuals e_i (see White, 1980).

larger price declines. The information content mistakenly attributed to informationless trades depends on investors' beliefs. In a market where the extent of positive-feedback trading is grossly underestimated, even a small amount of uninformed trading may lead to large price declines. Conversely, if the amount of positive-feedback trading is well known, only intense trading will move prices. As a result, the relationship between large price changes and transaction volume should be quite flat, which is what we found.

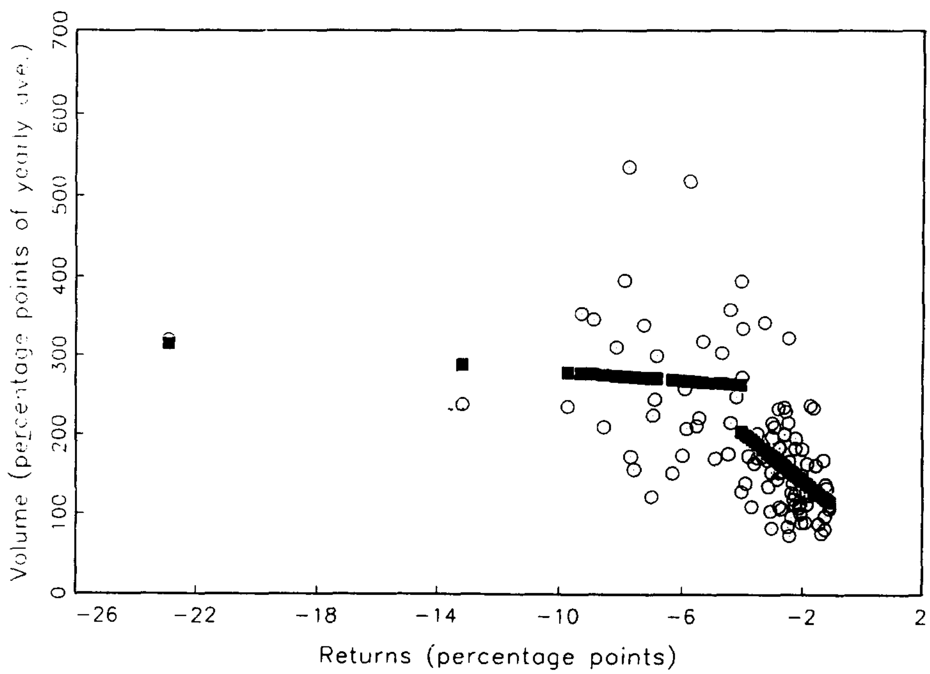

Fig. 1. Transaction volume–return relation: ○, actual; ■, fitted.

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