PART I

The Seven Mysteries of the Stock Market

THE FIRST MYSTERY: STOCK PRICES ARE TOO VOLATILE

How Volatile Is *Too* Volatile?

Anyone who has paid any attention at all to the stock market knows that when you invest in stocks, you're likely in for a wild ride. The difference between investing in stocks and, say, investing in Treasury Bills is akin to the difference between the Rocket Coaster and the merry-go-round at your local amusement park.

But what does it mean to say that stocks are *too* volatile?

The fundamental support for the market price of any investment is the future cash flows that the investor expects to receive. In the case of a bond, these are the semiannual interest payments and the principal payment received at maturity. In the case of a stock, the cash flows are dividends.

If dividends are the fundamental basis of stock prices, it follows that, over the long term, the volatility of stock prices should be *consistent* with the volatility of dividends.

But they are not. The evidence points to the conclusion that the volatility of stock prices is much too high relative to variability in the dividend stream.

To understand clearly why the evidence points to this conclusion, we must first understand some basic concepts.

The Perfect Foresight Price

The first is called the *Perfect Foresight Price.* This is the price that God would agree is the fair value for the stock.

God knows what the future (inflation-adjusted) dividend payments are going to be for the stock. God also knows what real (inflation-adjusted) interest rates are going to be.

Once we've got a long history of stock dividend payments, we can go back and get a pretty good estimate of what God's price would have been in the past.

If we go back 50 years, we discount the actual dividend payments paid over the next 50 years by the interest, or discount, rates that prevailed when each dividend was paid.

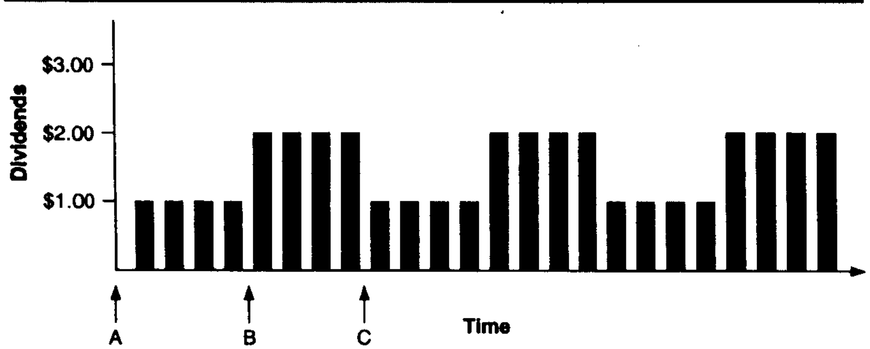
Consider God's price at the start of the 50 years. In the first year suppose that the inflation-adjusted first and second quarter's dividends are both $1.00. Suppose also that the current quarterly, risk-adjusted real interest rate is 1% and the quarterly rate that will prevail next quarter is 2%. The present value of the first dividend is $.99 = ($1.00/(1.01)) and the present value of the second is $.97 = ($1.00/(1.01)(1.02)).

If you think about it, you will realize that *the Perfect Foresight Price is not constant through time.*

God may not see a smooth or level dividend stream coming. As we move from one point in the past to another, the Perfect Foresight Price rises with an increase in the size of the near-term dividend payments relative to the payments received at the point in time when the Perfect Foresight Price was first calculated.

For example, consider the pattern of quarterly dividend payments depicted in Figure 1.1. In this hypothetical economy, we go from boom to bust every other year. In boom years, the quarterly dividend is $2.00. In busts, it falls to $1.00.

Now consider God's price as we move along in time from points *A* to *B* to *C*. The Perfect Foresight Price goes up in moving from *A* to *B*, because, at *B*, the next boom is upon us, while at *A*, it is a full year off. Assuming the rate of discount doesn't change over time, the present value of future dividends is larger



at *B*. God's price goes up. For similar reasons, it falls back as we go from *B* to *C*. At *C*, the next boom is, once again, a full year off.

Holding everything else constant, it should also be true that, as we move retrospectively into a period in which quarterly interest rates will be relatively low for a while, the Perfect Foresight Price will tend to increase. This is because the near-term dividends, which are most important to the present value, are being discounted at lower rates.

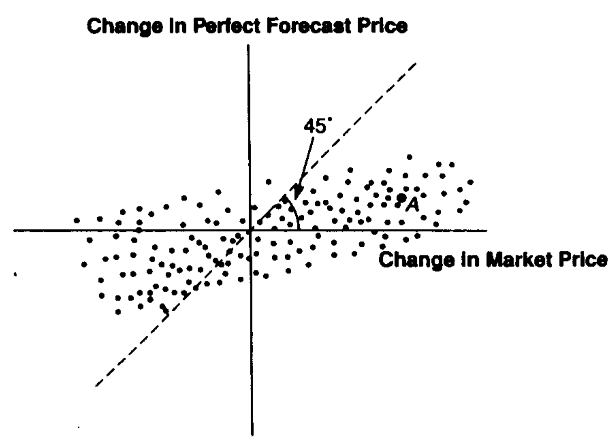
The Efficient Market Relationship between the Volatilities of the Perfect Foresight Price and the Market Price

If the market is efficient, what should the relationship be between the volatility of the Perfect Forecast Price and the volatility of the actual market price for the stock or stocks?

In Figure 1.2a, we plot changes in the Perfect Forecast Price on the vertical axis and changes in the actual market price on the horizontal. Each point shows the relationship between the two changes during a particular period of time.

The market of Figure 1.2a is overreactive.

Changes in the Perfect Foresight Price induce changes in the actual market price that are many times larger. For example, in Figure 1.2a, as we move into a period where near-term dividends are relatively large (like the periods



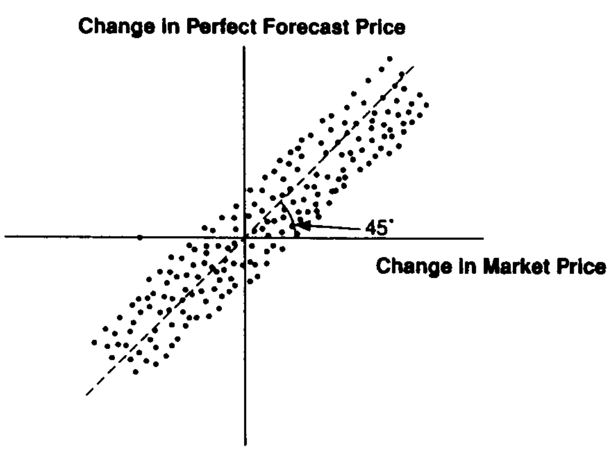
just before a boom in Figure 1.1), the Perfect Foresight Price rises, as it does at point *A*. But the corresponding increase in the market price, plotted horizontally, is four times as large. Based on the points in Figure 1.2a, we see that this market reacts in an exaggerated fashion to changes in the Perfect Forecast Price. When it goes up, market prices go up further. When it goes down, prices go down further.

In the context of Figure 1.1, the market price would move up and down from boom to bust by more than the changes occurring in the Perfect Foresight Price.

An efficient-markets person would say that smart investors would soon catch on to the overreactions in stock prices. They would sell into big advances in stock prices and buy into big declines.

If the market eventually corrected its tendency to overreact, the relationship between changes in the two prices would look like that in Figure 1.2b. Here, *on average,* changes in the two prices tend to be equal. The market doesn't get it right every time, but it gets it right *on average.*

We have drawn a line of best fit[1] through the scatter of Figure 1.2b. In the unbiased and efficient market of Figure 1.2b, the slope of this line is equal to 1.00. When the market reaches this state of efficiency in pricing, it can be shown that, if the market price and the Perfect Foresight Price are perfectly correlated, their *variances* (volatility squared) must be equal to each other. If the two prices are not perfectly correlated, the efficient market ratio of the Perfect Foresight variance to the actual market variance must be, at most, equal to the coefficient of correlation between the two prices.[2]



Because the maximum possible value for the correlation between the market and perfect foresight prices is 1.00, we now know that, *in an efficient market, the volatility of actual market prices must be less than or at most equal to the volatility of the Perfect Foresight Price.*

The Actual Relationship between the Market Price and the Current Forecast Price

Now let's look at the *actual* relationship between the volatility of stock market prices and the volatility of estimates of the Perfect Foresight Price.

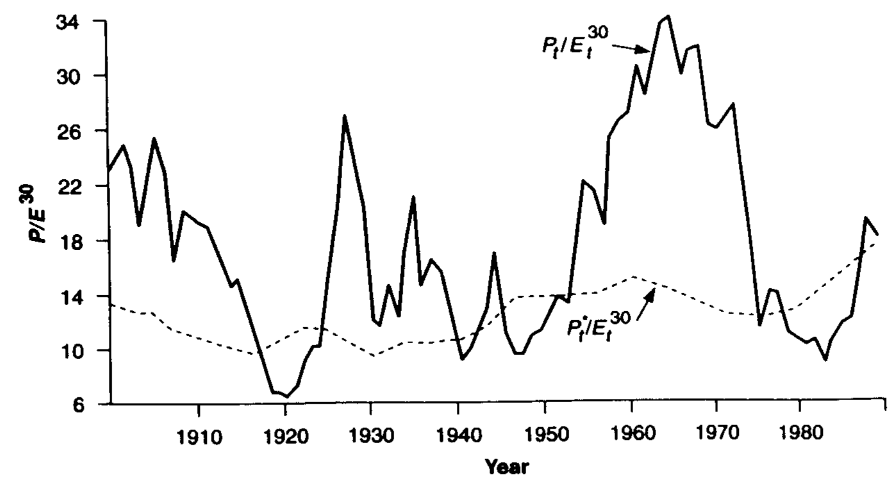
Figure 1.3 shows a plot constructed by a professor named Robert Shiller.[3] In the figure, Shiller plots (as the solid line) the time series of the ratio of (a) the inflation-adjusted value of the Standard and Poor's 500 Stock Index and (b) the 30-year moving average of inflation-adjusted earnings-per-share for the index.

Note that it is highly volatile.

Next, Shiller estimates the time series of Perfect Foresight Prices. He uses the equation for the Perfect Forecast Price, discounting inflation-adjusted dividends paid by the stocks in the index (from each point in time forward) by quarterly interest rates that are assumed to be constant and equal to approximately 2% each.[4] The estimates of the Perfect Forecast Prices are also divided by the 30-year moving-average earnings numbers, and the ratio is plotted as the broken line.

The efficient market limit to the market's variance is grossly violated.

Source: Shiller, Robert, *Market Volatility,* The MIT Press, Cambridge, MA, 1990, p. 78.



The market's variance is apparently not only not smaller than the variance of Shiller's Perfect Foresight Price; it is—based on this initial look—much, much larger.

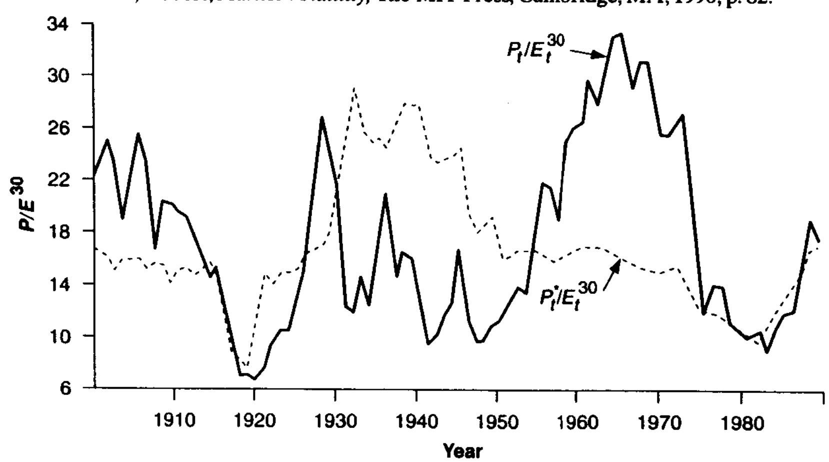
Knowing that interest rates are not constant over time, Shiller now uses the actual series of commercial paper rates that were in effect over the time-series.[5] He adds a constant risk premium to the commercial paper rates to obtain the quarterly discount rates used in the equation for the Perfect Foresight Price.[6]

Figure 1.4 shows the new series of Perfect Foresight Prices superimposed on the actual stock price series. The volatility of the actual series is still 44% *greater* than the volatility of the Perfect Foresight Price. Moreover, the correlation between the two series is only .047, indicating a gross violation of the level of price volatility consistent with the Efficient Markets Hypothesis.

Shiller's work has come under harsh criticism from supporters of the Efficient Markets Hypothesis.

Flavin, Kleidon, and Marsh as well as Merton[7] show that if you assume that firms pay dividends in such a way that a change in the dividend payment from quarter to quarter induces a corresponding change in all future expected dividends (for example, $1.00 or $2.00 forever after each boom or bust in Figure 1), simple violations of the variance limit should not be interpreted as obvious evidence against the Efficient Markets model. However, these papers still fail to explain the very dramatic violations of the bounds on rational volatility found by Shiller.[8]

Source: Shiller, Robert, *Market Volatility*, The MIT Press, Cambridge, MA, 1990, p. 82.



Moreover, Shiller's price volatility mystery is only the beginning. Stock prices aren't the only feature of stock market behavior that's too volatile.

As we shall see next, *volatility itself* is much too volatile!

THE SECOND MYSTERY: STOCK *VOLATILITY* IS TOO UNSTABLE

Volatility in the Efficient Market

If stock pricing were fully rational, prices would move only in response to new and unanticipated information about prospects for firms and changing general economic conditions. The volatility of price changes would be based on the intensity of the flow of new information.

For *individual firms*, one might expect the intensity of the inflow of new information about firm prospects and economic conditions to vary considerably over time. For example, uncertainty is likely to increase just before earnings announcement dates, during labor disputes, litigation, takeovers, competitive bidding for important contracts, and the introduction of new products and advances into new markets.

For the *market aggregate*, however, the occurrence and timing of these events are likely to be well diversified over the individual firms in the index. This being the case, if the only source of market volatility was real news, you would expect the volatility of the stock market to be relatively stable over time.

Volatile Volatility

But market volatility is not stable. It is, itself, highly volatile.

I know this to be true because, a few years ago, I participated in a study of market reactions to shifts in the level of market volatility with two other professors, Eli Talmor and Walter Torous. (The three of us will hereafter be referred to as HTT.)

HTT focused on the daily fluctuations of the Dow Jones Industrial Average over the period 1897 through 1988. The idea for the study came after the turmoil of the October 19, 1987, crash. The crash was accompanied by a sudden and dramatic *sevenfold* increase[9] in the level of volatility. It occurred to HTT that some changes in volatility might come in *shifts* rather than as a process of gradual evolution. HTT also noted that similar bursts in volatility had occurred in the immediate vicinity of other similar market events like the 1929 crash.

Might there be a causal connection between the burst in the level of volatility and the simultaneous drop in the level of stock prices?

To answer this question, HTT designed a procedure to measure the reaction of stock prices to shifts in the level of volatility.[10]

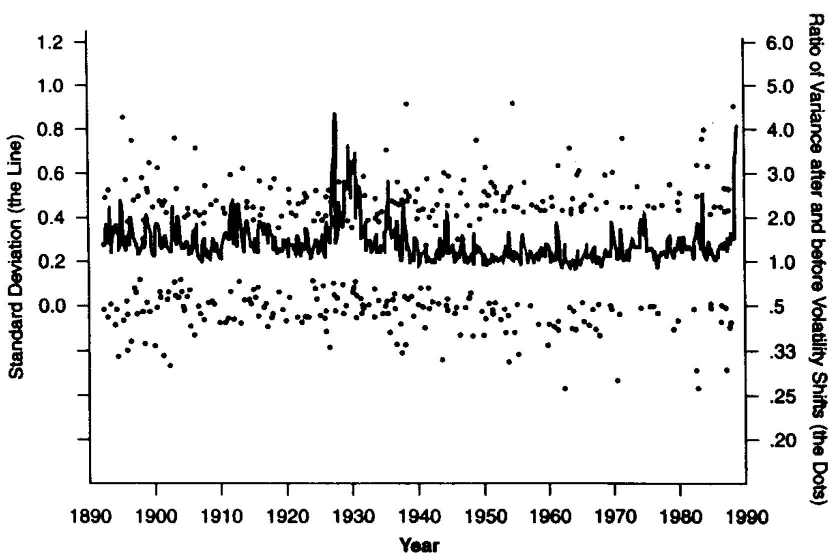
All the volatility shifts found by their method are plotted as dots in Figure 1.5. Each of the dots in the top part of the diagram indicates a volatility increase. The scale to the right indicates the ratio of the variances (as you may recall, that's the square of volatility) after and before the shift. Volatility decreases are shown in the bottom part of the diagram. The time-series of volatility measured over a moving four-week period is plotted in the center of the graph. The scale for this time-series is shown to the left.

It is obvious that the volatility shifts are common events, occurring, on average, *five times per year.*

Is it even remotely possible that the uncertainty associated with underlying business conditions is shifting this often? Is it really possible that changes in economic uncertainty are responsible for the apparent instability in the market volatility series at the center of Figure 1.5?

Table 1.1 shows the number of events by decade as well as the magnitude of the volatilities in the leading and trailing blocks. Note that the sizes of the

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance,* July 1991, p. 990, Figure 1.



Time Period	*Number of Events*	*Average Prior Volatility*	*Average Subsequent Volatility*
A: Volatility Increases			
1897–1988	205	.102	.230
1897–1899	6	.125	.295
1900–1909	28	.101	.234
1910–1919	28	.108	.222
1920–1929	23	.110	.243
1930–1939	24	.183	.404
1940–1949	27	.074	.171
1950–1959	23	.064	.141
1960–1969	20	.063	.133
1970–1979	10	.093	.215
1980–1988	16	.105	.291
B: Volatility Decreases			
1897–1988	197	.231	.110
1897–1899	5	.263	.129
1900–1909	32	.235	.107
1910–1919	24	.226	.107
1920–1929	21	.208	.103
1930–1939	32	.374	.196
1940–1949	28	.161	.075
1950–1959	18	.143	.067
1960–1969	18	.143	.064
1970–1979	9	.207	.101
1980–1988	10	.337	.125

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level o Stock Prices and Subsequent Expected Return," *Journal of Finance,* July 1991, p. 991, Table 1.

shifts are large; we are typically observing more than a doubling or a halving i volatility.

Reaction of Price Level to Volatility Shifts

Having identified the time-incidence of volatility shifts, HTT now examine th reaction of the *level* of stock prices to shifts in volatility.

Centering the two blocks at the point immediately before each shift de tected, they measure the total percentage change in the level of the market inde that occurs in the leading block. Presumably, as investors move into the event they become aware that volatility has changed. The "rules of the game" have sud denly changed. In the case of a volatility increase, the probability of large pric changes (up or down) occurring in a single day has increased. Investors may gai this awareness on the basis of the occurrence of some real event, such as the bombing of Pearl Harbor or, perhaps, simply by watching the day-to-day volatility of prices themselves.

In any case, they become aware that the risk associated with stock investments has changed. We know that most investors are risk-averse. If volatility has increased, they will want to earn a higher rate of return in the future on their stock investments. If nothing associated with the volatility shift has changed the prospects for future dividends, the only way future return will be higher is if the price you have to pay today for a stock is lower.

Thus, a volatility increase calls for a drop in the level of stock prices. And the bigger the increase in volatility and the longer the volatility increase is expected to "stick around," the larger the drop in stock prices should be.

The average percentage changes in the level of the market index in the four weeks preceding and following the beginning of a volatility increase is presented in Table 1.2a. The results are presented by decade, and the overall results are presented at the top of the table.

Overall, the price reaction to a volatility increase is negative.[11] Statistical analysis indicates a very low probability that the results are due to chance. This is confirmed by the fact that in all but one of the decades examined, the mean reaction is negative and statistically significant.[12]

Table 1.2b shows the corresponding results for volatility decreases. Here we see the opposite pattern, with the level of the index going up in nearly every decade, in response to a lowering of the required rate of return by investors.[13]

The time patterns of the price reactions to volatility increases and decreases, respectively, are shown in Figures 1.6a and 1.6b on pp. 13 and 14. The figures plot the average cumulative percentage changes in the value of the Dow from 20 days preceding the event to 30 days after it. Note that, for increases, the price decline dissipates after approximately 17 days. For decreases, the price advance continues for 21 days. There is also no evidence of a tendency of the market to correct its price adjustment.

Realization of the New Expected Returns

If prices are adjusting to provide higher (lower) returns to investors during a volatility increase (decrease), the higher (lower) expected returns should, on average, be realized during the period following the price adjustment.

Time Period	*Number of Events*	*Average 4-week Percentage Price Changes* — *Trailing Block (%)*	*Leading Block (%)*
Total Period	205	1.269	−2.622
		.001	.000
1890s	6	3.604	−6.596
		.040	.020
1900s	28	2.007	−2.837
		.046	.016
1910s	28	2.416	−2.068
		.023	.062
1920s	23	3.132	−3.048
		.016	.037
1930s	24	−.558	−4.395
		.769	.052
1940s	27	.727	−2.847
		.101	.013
1950s	23	1.580	−2.188
		.015	.001
1960s	20	−.079	−2.825
		.917	.006
1970s	10	−2.811	−2.618
		.020	.042
1980s	16	1.863	1.549
		.047	.474

Note: This table shows average four-week percentage price changes surrounding volatility increases. These results are presented for the entire sample period, as well as by decades. Directly below the mean return I provide the probability that the mean return is zero.

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance,* July 1991, p. 995, Table III.

To see if this happens, HTT look at the percentage changes in price during a third block of time. The block also covers 4 weeks.[14]

Following the price adjustment (in the leading block) accompanying volatility increases, the average (across all increases in all years) annualized percentage change in price is 4.57%. Following decreases it is −.0014%.[15]

We can say with 97% confidence that price returns following increases are greater than those following decreases.

Time Period	Number of Events	*Average 4-week Percentage Price Changes* Trailing Block (%)	Leading Block (%)
Total period	197	.472 .248	1.703 .000
1890s	5	–.0899 .803	3.157 .032
1900s	32	–.240 .738	1.499 .018
1910s	24	–.100 .925	1.762 .020
1920s	21	1.110 .323	3.161 .000
1930s	32	1.401 .377	1.672 .205
1940s	28	.413 .632	1.345 .010
1950s	18	–1.138 .184	2.832 .000
1960s	18	.765 .397	1.860 .001
1970s	9	2.661 .148	–1.284 .420
1980s	10	1.056 .729	–.106 .927

Note: This table shows average 4-week percentage price changes surrounding volatility decreases. These results are presented for the entire sample period, as well as by decades. Directly below the mean return I provide the probability that the mean return is zero.

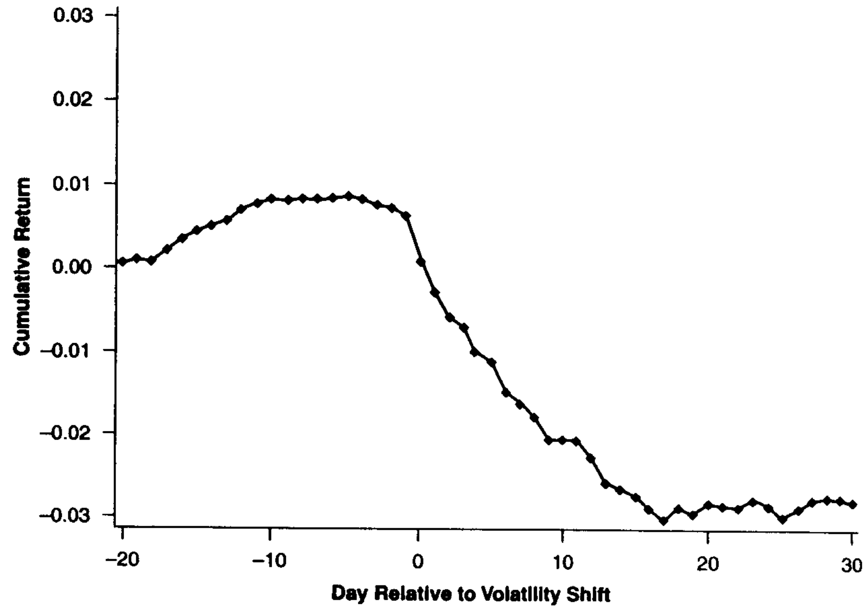
Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return, *Journal of Finance,* July 1991, p. 996, Table IV.

Investors evidently *require* a premium and they *are* being compensated for sailing through choppy waters. They are willing to accept a lower rate of compensation if the seas are tranquil.

The Crash Fits

If price adjustments following volatility shifts are, indeed, associated with changing required future returns, the magnitudes of the price adjustments in the leading block should be positively related to the size of the volatility shift. Interestingly, HTT find no significant link between price adjustment and the magnitude of volatility decreases. But they do find a strong relationship for volatility increases.

For increases, we can expect a downward price adjustment of 40 basis points for each multiple increase in the *variance.* Larger price adjustments can be ex-



Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance,* July 1991, p. 999, Figure 2.

pected to bring higher returns following the adjustment because investors require higher returns to sail through stronger storms.

And what about a hurricane?

In the four weeks starting October 19, 1987, the market's *variance* (volatility squared) increased by nearly 43 times over the four weeks prior to the crash.[16]

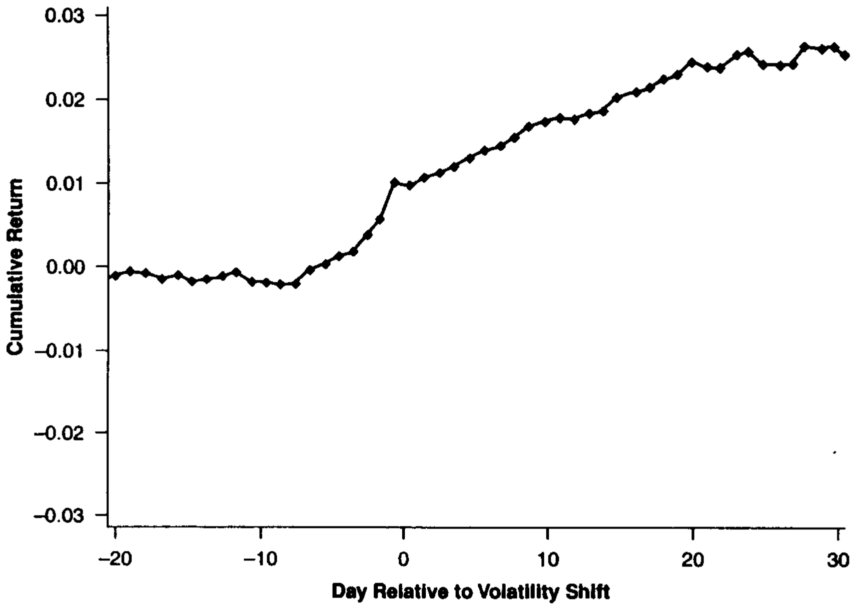
Based on HTT's measured relationship between the size of a volatility increase and the corresponding expected price response, we would have expected a price decline in the four weeks following the crash of over 17%.[17]

This is somewhat less than the drop actually experienced; however, much of the decline experienced on October 19 can be attributed to portfolio insurance, which exacerbated the market's reaction to the volatility increase.[18]

It would seem that the 1987 crash may have been related to a volatility shift.

The Events behind the Shifts

But what *caused* the shift?



[redacted]

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance*, July 1991, p. 999, Figure 2.

Indeed, what types of events, in general, trigger the ups and downs we see in price volatility? HTT attempted to answer this question by looking for major events reported in the media around the time of their volatility events.[19]

Clearly, based on what was happening to volatility, something extraordinary was happening in the stock market. Was anything extraordinary happening *in the world* that the market may have been reacting to?

Interestingly, in approximately 9 out of 10 cases, *nothing of significance can be found in the reports of the media.* In many cases following volatility increases, the focus was on the market itself and its strange behavior.

In those few cases where HTT find that something interesting *was* happening in the real world, an interesting dichotomy emerges between the types of events that are typically associated with volatility increases versus the types that are associated with decreases.

Table 1.3a lists all the real world events found in the vicinity of those volatility increases that could be linked to a real event.

[redacted]

Volatility Shift Date	*Event*	*Price Return in Second Block (%)*	*Variance Ratio*
02/14/1898	Battleship Maine explodes in Havana, effectively beginning Spanish-American War	−10.47	4.12
08/13/1898	Spanish-American War ends	2.52	4.05
04/15/1901	Philippine rebellion ended by proclamation	−4.92	13.45
09/06/1901	President McKinley shot in Buffalo	−14.02	5.73
12/05/1904	Monroe Doctrine strengthened and reasserted by Roosevelt	−3.17	8.88
08/29/1905	Treaty of Portsmouth signed	−1.01	6.73
04/18/1906	Major earthquake in San Francisco	−3.68	4.60
10/09/1907	Bank panic	−13.61	3.15
06/16/1916	U.S. invades Mexico	−6.75	4.00
02/01/1917	President Wilson informs Congress he has broken diplomatic relations with Germany	−2.27	4.16
08/01/1927	President Coolidge announces that he will not run for reelection	3.75	6.24
09/17/1931	Bank panic	−14.90	11.93
02/09/1933	Federal banking holiday	−.36	12.15
07/16/1934	The first general strike in U.S. history	−8.86	4.89
08/18/1937	Miller-Tydings Enabling Act	−13.36	13.37
08/16/1939	Germany invades Poland	9.60	5.67
05/10/1940	Germany invades Holland and Belgium	−21.36	31.37
12/02/1941	Japan bombs Pearl Harbor	−1.77	4.63
06/05/1944	D-Day	4.32	3.83
11/01/1948	President Truman upsets Dewey	−7.99	6.98
10/19/1951	President Truman signs tax increase bill	−4.72	4.69
09/22/1955	President Eisenhower's heart attack	−6.42	33.05
08/06/1956	National steel strike ends	−3.46	3.34
10/30/1963	President Kennedy's assassination	−1.13	12.03
11/01/1971	President Nixon's economic policy	.08	15.57
04/15/1983	U.S. Embassy in Lebanon blown up	5.09	15.52
02/03/1984	Soviet President Andropov dies	−3.36	8.58
03/27/1987	President Reagan announces 100% tariffs on Japanese electronics	−5.55	5.13
	Averages	−4.56	9.21

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance*, July 1991, p. 993, Table IIA.

The common element linking nearly all the events is *violence*. By a government. By an individual. Or even by an act of nature.

Table 1.3b is for the few decreases that could be linked to a real world event. The common element here seems to be political enactments or proclamations of one sort or another.

Apparently, when the government takes action, the market calms down.

Volatility Shift Date	*Event*	*Price Return in Leading Block (%)*	*Variance Ratio*
03/02/1901	Pratt Amendment adopted	2.49	.18
01/20/1902	U.S. buys Virgin Islands from Denmark	2.80	.30
10/10/1902	Commission named to settle coal miners' strike	−1.27	.35
08/01/1905	Peace conference opens to end Russo-Japanese War	6.71	.20
01/11/1909	U.S. and Great Britain sign U.S.-Canada boundary waters treaty	−.82	.26
07/01/1909	Congress proposes the adoption of income tax	4.24	.34
01/14/1932	Congress creates the Reconstruction Finance Corporation	−14.45	.32
05/15/1933	Tennessee Valley Authority is established	20.12	.36
06/16/1934	Securities Exchange Commission created	.43	.22
03/11/1941	President Roosevelt signs Lend-Lease Act	.02	.18
07/30/1941	President Roosevelt and Prime Minister Churchill sign Atlantic Charter	−2.02	.32
11/18/1942	President Roosevelt orders nationwide gas rationing	2.22	.35
09/20/1945	Coal mines close as strikes break out	3.27	.29
11/07/1946	President Truman removes wage, price, and salary controls	.96	.24
01/17/1963	Strike of East and Gulf Coast longshoremen ends	1.92	.18
09/08/1971	President Nixon discloses his intentions for Phase II of his economic program	−2.74	.06
04/23/1980	Iranian hostage rescue mission fails	5.44	.23
04/15/1988	U.S. and Iran clash in Persian Gulf	−1.82	.22
	Averages	1.51	.26

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *The Journal of Finance*, July 1991, p. 994, Table IIB.

Taking Stock

Before moving to the third mystery, we should take stock of what we have learned thus far:

- Stock prices are arguably too volatile, relative to the dividends and underlying cash flows that they are based upon.
- Stock volatility itself seems too unstable, shifting, on average, five times each year.
- The nature of price reactions accompanying volatility shifts seems consistent with adjustments to provide investors with higher (lower) returns to compensate them for staying in the market during choppy (tranquil) periods. This is confirmed by the significant differences between the realizations of return following the price adjustments associated with volatility increases and decreases.
- For volatility increases, the magnitude of the price adjustment tends to correspond to the magnitude of the volatility shift. The price reaction of October 1987 fits nicely with this pattern.
- No real economic, political, or other events of significance can be associated with the vast majority of volatility shifts.

THE THIRD MYSTERY: NOISE IN THE MARKET—SILENCE ON THE STREET

Do Economic/Financial Conditions Drive the Stock Market?

As we saw above, approximately 9 out of 10 shifts in volatility seem to be isolated events, occurring on their own, independent from any driver from the world outside the market.

Forget your inability to predict the *future* course of the market index. We shall see now that our ability to explain why the market has moved *in the past* is also shockingly low—at least when we attempt to explain market moves on the basis of changes in fundamental variables describing economic, business, and financial conditions.

The very large fraction of market volatility that goes unexplained has been alluded to by several of the leaders of academic finance,[20] but the important implications of this facet of the market's character have been largely, and conveniently, ignored.

In an interesting study, Cutler, Poterba, and Summers (CPS)[21] try to account for differences in the month-to-month rates of return to the market index[22] on the basis of unexpected changes[23] in the following economic and financial variables:

- Inflation-adjusted dividends paid to the index.
- Industrial production.
- Inflation-adjusted money supply.
- High-grade corporate bond yields.
- Treasury bill yields.
- Rate of inflation
- Daily stock price volatility within the month.

Over the period 1926 through 1986, CPS find that combined, unexpected changes in these important and closely watched economic and financial variables are able to explain only 18% of the differences in the monthly rates of return to the index. Fully 82% of the variability in return is attributable to unknown forces.

Increases in the first three variables have a positive effect on the market's return; the last four variables have a negative effect. However, only dividends, industrial production, and *volatility* have a statistically significant effect.

Note that volatility comes up significant again! If the market's volatility is high during a particular month, the return tends to be low.[24]

The low return may again be the result of the price adjustment required to provide investors with a higher future return during the period of high volatility in the following weeks or months.

Price Reactions to Historic Events

Surprised at the low power of these important economic variables at explaining market behavior, CPS now focus on the market's reaction to extraordinary, even historic, real world events that have taken place since 1941.[25]

The events are listed in Table 1.4a. The right-hand column lists the market's rate of return on each particular day.

The returns are large in absolute value, *but not that large.* The average absolute percentage change in the value of the index during these historic days is 1.46%.

To put this number in perspective, although it is approximately 2.6 times larger than the market's average percentage move across all days since 1941, the market's average absolute move in a single day is .56% with a standard deviation of .82%.

This means that for approximately one-third of the total number of days since 1941, the market's daily percentage change could be expected to exceed 1.38%

Event	Date	% Change
Japanese bomb Pearl Harbor	Dec. 8, 1941	–4.37
U.S. declares war against Japan	Dec. 9, 1941	–3.23
Roosevelt defeats Dewey	Nov. 8, 1944	–0.15
Roosevelt dies	Apr. 13, 1945	1.07
Atomic bombs dropped on Japan:		
Hiroshima bomb	Aug. 6, 1945	0.27
Nagasaki bomb; Russia declares war	Aug. 9, 1945	1.65
Japanese surrender	Aug. 17, 1945	–0.54
Truman defeats Dewey	Nov. 3, 1948	–4.61
North Korea invades South Korea	June 26, 1950	–5.38
Truman to send U.S. troops	June 27, 1950	–1.10
Eisenhower defeats Stevenson	Nov. 5, 1952	0.28
Eisenhower suffers heart attack	Sept. 26, 1955	–6.62
Eisenhower defeats Stevenson	Nov. 7, 1956	–1.03
U-2 shot down; U.S. admits spying	May 9, 1960	0.09
Kennedy defeats Nixon	Nov. 9, 1960	0.44
Bay of Pigs invasion announced;	Apr. 17, 1961	0.47
Details released over several days	Apr. 18, 1961	–0.72
	Apr. 19, 1961	–0.59
Cuban missile crisis begins:		
Kennedy announces Russian buildup	Oct. 23, 1962	–2.67
Soviet letter stresses peace	Oct. 24, 1962	3.22
Formula to end dispute reached	Oct. 29, 1962	2.16
Kennedy assassinated;	Nov. 22, 1963	–2.81
Orderly transfer of power to Johnson	Nov. 26, 1963	3.98
U.S. fires on Vietnamese ship	Aug. 4, 1964	–1.25
Johnson defeats Goldwater	Nov. 4, 1964	–0.05
Johnson withdraws from race, halts Vietnamese raids, urges peace talks	Apr. 1, 1968	2.53
Robert Kennedy assassinated	June 5, 1968	–0.49
Nixon defeats Humphrey	Nov. 6, 1968	0.16
Nixon imposes price controls, requests Federal tax cut, strengthens dollar	Aug. 16, 1971	3.21
Nixon defeats McGovern	Nov. 8, 1972	0.55
Haldeman, Ehrlichman, and Dean resign	Apr. 30, 1973	–0.24
Dean tells Senate about Nixon cover-up	June 25, 1973	–1.40
Agnew resigns	Oct. 10, 1973	–0.83
Carter defeats Ford	Nov. 3, 1976	–1.14
Volcker appointed to Fed	July 25, 1979	1.09
Fed announces major policy changes	Oct. 6, 1979	–1.25
Soviet Union invades Afghanistan	Dec. 26, 1979	0.11
Attempt to free Iranian hostages fails	Apr. 26, 1980	0.73

Event	*Date*	*% Change*
Reagan defeats Carter	Nov. 5, 1980	1.77
Reagan shot, NYSE closes early;	Mar. 30, 1981	–0.27
Reopens next day	Mar. 31, 1981	1.28
U.S. Marines killed in Lebanon	Oct. 24, 1983	0.02
U.S. invades Grenada	Oct. 25, 1983	0.29
Reagan defeats Mondale	Nov. 7, 1984	1.09
House votes for Tax Reform Act of 1986	Dec. 18, 1985	–0.40
Chernobyl nuclear reactor meltdown;	Apr. 29, 1986	–1.06
Details released over several days	Apr. 30, 1986	–2.07
Senate Committee votes for tax reform	May 8, 1986	–0.49
Greenspan named to replace Volcker	June 2, 1987	–0.47
Important Events		
Average Absolute Return		1.46
Standard Deviation of Returns		2.08
All Days since 1941		
Average Absolute Return		0.56
Standard Deviation of Returns		0.82

(.56% + .82%) in absolute value.[26] (For a bell curve, one standard deviation above and below the mean includes two-thirds of the expected observations.)

In this context, a 1.46% rate of return doesn't seem extraordinary at all.

Ordinary market reactions to truly extraordinary real world events.

The Events Associated with Big Price Reactions

If the market isn't reacting to (a) changes in important economic variables and (b) historic events, just what *is* it reacting to?

To help find an answer to this question, CPS now examines the events behind the market's largest single-day moves.

In Table 1.4b they list, in order of absolute magnitude, the 50 largest 1-day percentage changes in the S&P Index. Listed, along with the percentage changes, is the *New York Times* account of the fundamental factors responsible for the change.

These are some of the most extraordinary events in the history of the stock market.

Yet, for the most part, they don't seem to be connected to extraordinary events happening in the real world!

	Date	*% Change*	New York Times *Explanation*[a]
1	Oct. 19, 1987	–20.47	Worry over dollar decline and trade deficit, fear of U.S. not supporting dollar.
2	Oct. 21, 1987	9.10	Interest rates continue to fall; deficit talks in Washington; bargain hunting.
3	Oct. 26, 1987	–8.28	Fear of budget deficits; margin calls; reaction to falling foreign stocks.
4	Sept. 3, 1946	–6.73	"No basic reason for the assault on prices."
5	May 28, 1962	–6.68	Kennedy forces rollback of steel price hike.
6	Sept. 26, 1955	–6.62	Eisenhower suffers heart attack.
7	June 26, 1950	–5.38	Outbreak of Korean War.
8	Oct. 20, 1987	5.33	Investors looking for "quality stocks."
9	Sept. 9, 1946	–5.24	Labor unrest in maritime and trucking industries.
10	Oct. 16, 1987	–5.16	Fear of trade deficit; fear of higher interest rates; tension with Iran.
11	May 27, 1970	5.02	Rumors of change in economic policy. "The stock surge happened for no fundamental reason."
12	Sept. 11, 1986	–4.81	Foreign governments refuse to lower interest rates; crackdown on triple witching announced.
13	Aug. 17, 1982	4.76	Interest rates decline.
14	May 29, 1962	4.65	Optimistic brokerage letters; institutional and corporate buying; suggestions of tax cut.
15	Nov. 3, 1948	–4.61	Truman defeats Dewey.
16	Oct. 9, 1974	4.60	Ford to reduce inflation and interest rates.
17	Feb. 25, 1946	–4.57	Weakness in economic indicators over past week.
18	Oct. 23, 1957	4.49	Eisenhower urges confidence in economy.
19	Oct. 29, 1987	4.46	Deficit reduction talks begin; durable goods orders increase; rallies overseas.
20	Nov. 5, 1948	–4.40	Further reaction to Truman victory over Dewey.
21	Nov. 6, 1946	–4.31	Profit taking; Republican victories in elections presage deflation.
22	Oct. 7, 1974	4.19	Hopes that President Ford would announce strong anti-inflationary measures.
23	Nov. 30, 1987	–4.18	Fear of dollar fall.
24	July 12, 1974	4.08	Reduction in new loan demands; lower inflation previous month.
25	Oct. 15, 1946	4.01	Meat prices decontrolled; prospects of other decontrols.
26	Oct. 25, 1982	–4.00	Disappointment over Federal Reserve's failure to cut discount rates.
27	Nov. 26, 1963	3.98	Confidence in Johnson after Kennedy assassination.
28	Nov. 1, 1978	3.97	Steps by Carter to strengthen dollar.
29	Oct. 22, 1987	–3.92	Iranian attack on Kuwaiti oil terminal; fall in markets overseas; analysts predict lower prices.

	Date	% Change	New York Times Explanation[a]
30	Oct. 29, 1974	3.91	Decline in short-term interest rates; ease in future monetary policy; lower oil prices.
31	Nov. 3, 1982	3.91	Relief over small Democratic victories in House.
32	Feb. 19, 1946	–3.70	Fear of wage-price controls lowering corporate profits; labor unrest.
33	June 19, 1950	–3.70	Korean War continues; fear of long war.
34	Nov. 18, 1974	–3.67	Increase in unemployment rate; delay in coal contract approval; fear of new Middle-East war.
35	Apr. 22, 1980	3.64	Fall in short-term interest rates; analysts express optimism.
36	Oct. 31, 1946	3.63	Increase in commodity prices; prospects for price decontrol.
37	July 6, 1955	3.57	Market optimism triggered by GM stock split..
38	June 4, 1962	–3.55	Profit taking; continuation of previous week's decline.
39	Aug. 20, 1982	3.54	Congress passes Reagan tax bill; prime rate falls.
40	Dec. 3, 1987	–3.53	Computerized selling; November retail sales low.
41	Sept. 19, 1974	3.50	Treasury Secretary Simon predicts decline in short-term interest rates.
42	Dec. 9, 1946	3.44	Coal strike ends; railroad freight rates increase.
43	June 29, 1962	3.44	"Stock prices advanced strongly chiefly because they had gone down so long and so far that a rally was due."
44	Sept. 5, 1946	3.43	"Replacement buying" after earlier fall.
45	Oct. 30, 1987	3.33	Dollar stabilizes; increase in prices abroad.
46	Jan. 27, 1975	3.27	IBM wins appeal of antitrust case; short-term interest rates decline.
47	Oct. 6, 1982	3.27	Interest rates fall; several large companies announce increase in profits.
48	July 19, 1948	–3.26	Worry over Russian blockade of Berlin; possibility of more price controls.
49	Nov. 30, 1982	3.22	"Analysts were at a loss to explain why the Dow jumped so dramatically in the last two hours."
50	Oct. 24, 1962	3.22	Krushchev promises no rash decisions on Cuban missile crisis; calls for U.S.-Soviet summit.

[a]Per the financial section or front page.

Source: Cutler, David, James Poterba and Lawrence Summers, "What Moves Stock Price?" *Journal of Portfolio Management,* Spring 1989, pp. 144–147, Tables 3 and 4.

The Events Associated with the Big Bursts in Volatility

In their paper, Haugen, Talmor, and Torous do a similar analysis for the largest volatility shifts.

Table 1.5 lists the 20 largest volatility increases in the period 1897 through 1988. Once again, as discussed earlier, HTT search the media for real-world events that might be responsible for the extreme chaos occurring in the market.

As indicated in Table 1.5, for most of these truly historic *financial* events, the market seems to be acting of its own accord, with no stimulus from the outside.

For most of these events, the market doesn't seem to be reacting to an external signal coming from the real world.

Is it possible that the signal is coming from within the market itself?[27]

What is this fundamental driver behind the market's behavior?

Orange Juice

Interestingly, the stock market isn't the only speculative market for which it is difficult to explain fluctuations in prices on the basis of fluctuations in those fundamental factors that, rationally, should play a dominant role in price determination.

Event Period	Increase in Volatility (%)	Release of Extraordinary Economic Information
12/04/1899–01/02/1900	402	None
04/15/1901–05/14/1901	267	None
05/18/1903–06/15/1903	213	None
03/04/1907–04/01/1907	305	None
01/13/1910–02/09/1910	250	None
10/05/1929–11/06/1929	300	None
09/17/1931–10/15/1931	245	Bank panic
02/09/1933–03/21/1933	249	Federal banking holiday
08/18/1937–09/15/1937	266	None
05/10/1940–06/08/1940	460	Germany invades Holland and Belgium
07/26/1943–08/21/1943	221	None
06/28/1945–07/31/1945	238	None
08/27/1946–09/30/1946	239	None
06/05/1950–07/07/1950	329	Korean war begins
09/22/1955–10/19/1955	475	President Eisenhower's heart attack
10/30/1963–11/29/1963	247	President Kennedy's assassination
07/27/1971–08/23/1971	295	President Nixon's economic policy
04/15/1983–05/12/1983	294	None
06/27/1983–07/25/1983	331	None
10/06/1987–11/02/1987	478	None

[a]In this table, volatility is measured by standard deviation of returns.

Source: Haugen, R. A., E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance,* July 1991, p. 1003, Table VII.

Take the commodity market, for example.

Orange Juice.

What should be the driver behind the price of frozen orange juice futures contracts?

The price of orange juice should be determined by the intersection of supply and demand, as in Figure 1.7. I have drawn the figure on the assumption that the demand for orange juice is somewhat sensitive to its price. If there is a significant increase in the price of orange juice, some of us will want to switch to grapefruit or pineapple. This represents movement up and down the demand curve.

Shifts in the demand curve mean that people would want to buy more or less orange juice *at a given price.* What would cause that in the short-term?

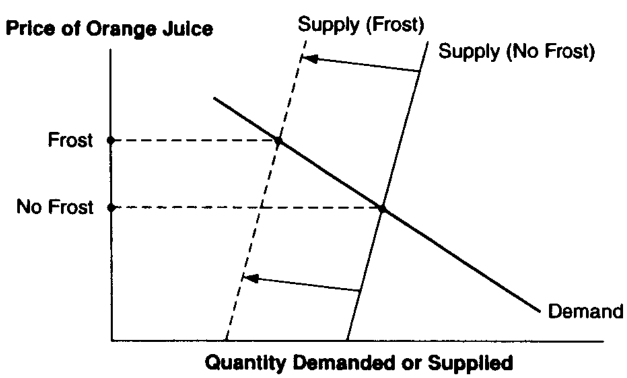
A change in our tastes.[28] Suddenly, significant numbers of us want to drink more or less of it. But this isn't likely to happen. In the short-term, the demand curve for orange juice is likely to be relatively stable.

What about the supply curve?

Producers can supply more orange juice by planting more trees. But this isn't likely to affect the supply of the juice in the near-term. Orange trees take from 5 to 10 years to reach maturity.

What will change supply in the near-term?

Weather.



The combination of temperature and precipitation can produce a vintage year or a disaster over a growing season. Weather can move the supply curve causing growers to supply more or less at a given price. For example, a major frost in Florida can result in a backward shift in the supply curve to the broken line, resulting in an increase in the price of orange juice.

Weather should be the *major* determinant of the price of orange juice.

Does Weather Drive the Price of Orange Juice?

To see if this was true, Richard Roll studied the determinants of the prices of orange juice futures contracts.[29]

Noting that more than 98% of U.S. production is concentrated in the central Florida region around Orlando, he concentrates on the effect of weather in this location on the price.

Roll finds that percentage changes in orange juice futures are significantly related to temperature, especially cold temperatures, in the Orlando area. He even finds a statistically significant relation between percentage changes in the price of orange juice futures and *subsequent* errors in the forecasts of temperature made by the National Weather Service.

Roll finds that the futures market actually seems to be out-forecasting the national weather service. However, Roll finds no relationship between changes in orange juice futures prices and unexpected rainfall.

He also looks at energy related factors (which could affect the costs of distribution and operating farm equipment), the return to the stock market index, the Canadian dollar exchange rate (which may affect the demand for U.S. orange juice on the part of the largest foreign consumer), news stories that are related to orange juice in various ways, as well as the prices for substitute products.

He finds a real puzzle. He can explain less than 10% of the percentage changes in the futures price on the basis of *all* these factors.

But what accounts for the remaining 90% of the price fluctuations?

Because Roll seems to have exhausted the potentially important external drivers to the futures price of orange juice, the major driver may, once again, be internal to the futures market itself.

But what *is* this driver of stock and futures prices?

THE FOURTH MYSTERY: THE SILENCE AFTER THE CLOSING BELL

Prices Still Move After the Market Is Closed

Security *values* change even when the securities themselves are not traded.

Those who have participated in the Southern California housing market know this all too well. Most are well aware of the fact that the market value of their individual homes has moved up and down like a roller coaster, although many haven't called the moving van out even once.

Trading isn't a *requirement* for price volatility. After the exchange closes, *things still happen.* In the economy. In politics. In foreign affairs. In other markets.

Even after the closing bell, the prices of stocks should still be responding to events as they happen. And the difference between today's closing price and tomorrow's opening price should collectively reflect these responses.

If stock market pricing is efficient and rational, the difference between the market's volatility when it is closed and when it is open should reflect the rate at which investors receive fresh information about their investments.

Measuring Volatility When the Market Is Closed

If we can't see the prices move, how can we tell how volatile stock prices are when the market is closed?

Fortunately, the hour-to-hour changes in stock prices are pretty random.[30] This feature, as it turns out, provides us with a fairly good indicator of the action going on when the market is shut down.

If stock prices change randomly, the variance of return is proportional to the length of time over which the return is measured. For a given stock, or for the market index, the variance of 2-day returns should be twice as large as the variance of 1-day returns. Likewise, the variance of annual returns should be 12 times as large as the variance of monthly returns.

Orange Juice on Weekends

Just how volatile are prices on weekends when the exchange is closed?

Three days span the period from Saturday through Monday. If the volatility is the same on Saturday and Sunday as it is on a weekday, the variance of returns from the close on Friday through the close on Monday should be three times as great as the variance of return from the close on Thursday through the close on Friday.

Think about orange juice. As we discussed in the previous section, the major determinate of the price of orange juice futures is weather. Mother Nature doesn't know weekends from weekdays. The weather and forecasts of the weather go on unabated. This being the case, there should be nearly as much information being generated about orange juice on the weekend as on any other day.

In looking at close-to-close percentage changes in orange juice futures prices, Roll noticed that the variance of the percentage change from Fridays through Mondays was only 54% greater than the variance on the other weekdays.

If the variance on Saturday and Sunday were the same as on weekdays, it would have been 300% greater than the variance on weekdays. The fact that it was only 54% greater means that, on average, the variance on Saturday and on Sunday is only 27% as great as the variance on the other days.

Mother Nature doesn't rest on weekends.

And for weather-dominated orange juice, the major difference between Saturday and Sunday and the other days is the fact that juice futures aren't being traded on the futures exchange!

Common Stock on Weekends

This result apparently intrigued Roll. A short time later, he conducted a similar study with Ken French on the volatility of stock returns during different days of the week.[31]

They looked at daily close-to-close returns for individual stocks on the New York and American exchanges over the period 1963 through 1982.

Averaging over stocks and time, they found that the variance of Saturday through Monday's return was only 11% greater than the variance on other days. Again, this would imply that the variance on Saturday and Sunday was only 5.5% of the variance on the other days.

But it got *much* worse than that!

French and Roll (FR) calculated the difference in the variance in the *hours* when the exchange was open and when it was not.

During the time period FR studied, in the Saturday through Monday span, there were 66 closed hours and 6 open hours. On each of the other weekdays, there were 18 closed hours and 6 open hours.

FR found that the ratio of the variance over the total time (closed and open) on Saturday through Monday to the variance over the total time on the other days was 1.11.

We can now solve for the ratio of the market's variance when it is open to the variance when it is closed.[32] It is approximately 70.

What???

The variance of stock returns is 70 times greater when the exchange is open than when it is closed!

Volatility on Election Days and Exchange Holidays

Can it be that the flow of information coming in from the real world is this much more intense when the exchange is open?

FR also looks at the market's variance over holidays. On one-day holidays, the variance (over the total 24-hour period) is 11% of the 24-hour periods spanned by days when the exchange is open. For 2-day holidays, each of the two days has about 12% of the variance.

We know, however, at least in the far less global U.S. economic environment spanned by FR's study, that the flow of economic information is highly likely to slow down at night and on weekends and holidays. On average, in the hours when the market is closed, there will be a reduced flow of new information feeding into the reacting stock market.

But *70 times* more variance in the open hours?

To see if the difference in variances is related to differences in the flow of information, FR focused on election holidays and exchange holidays.

In their study period, there were many election days during which the stock exchanges were closed. One would expect that, on these days, the intensity of the flow of new information would be similar to (or greater than, in the case of political information) the flow on other days.

And what is an exchange holiday?

In 1968, the New York Stock Exchange was experiencing a backlog in its paperwork. A decision was made to close the Exchange on Wednesdays during the second half of the year in order to catch up.

On the exchange holidays, *everything* was running as usual *except for the New York Stock Exchange.*

So if we see a dramatic decline in stock price volatility during exchange holidays, this should tell us something very important: The major driving force behind the volatility of NYSE stocks is truly coming *from within the exchange itself!*

FR's evidence is presented in Table 1.6.

The table shows the average variance of return across the exchange and election holidays as a percent of the variance on other days. The results are shown for all stocks as well as for groups of different sizes in which the stocks are grouped on the basis of total market capitalization and split into equally weighted 20% size groupings.

On exchange holidays, for all stocks, the variance is only 14.5% of its value on other weekdays.[33] For election holidays, it is 16.5% of its value on other weekdays.

Note also that the variance ratio is larger for the larger stocks.

		Daily Variance Ratios					
		All Stocks	*Smallest Quintile*[a]	*2*	*3*	*4*	*Largest Quintile*
Exchange holidays in 1968	Average ratio[b]	1.145	1.077	1.043	1.180	1.239	1.274
	Number of firms	2083	597	455	374	342	315
Election holidays	Average ratio[c]	1.165	1.131	1.073	1.186	1.159	1.332
	Number of firms	2026	572	426	367	347	314

[a]Firms are sorted into quintiles based on their relative total market capitalization.
[b]Average variance ratio comparing two-day exchange holiday returns with single-calendar-day returns.
[c]Average variance ratio comparing two-day election holiday returns with single-calendar-day returns.
Source: French, K. and R. Roll, "Stock Return Variances: The Arrival of Information and the Reaction of Traders," *Journal of Financial Economics*, 1986, pp. 5–26.

We can apply the same type of analysis used above to obtain an estimate of the ratio of the hourly variance when the exchange is open to the variance when it is closed.[34]

The market's variance, when it is open, is 25 times its variance when it is closed. This is less than the 70-fold difference found for weekends, but the generation of new information is likely to be much less on weekends than it is on exchange holidays.[35]

THE BEAST

We should also take note of the big differences between the estimates for small and large firms.

For the largest 20%, the variance is 12 times larger when the exchange is open.

For the smallest 20% the variance is nearly 50 times larger.

Whatever is causing the difference in volatility has a bigger impact on small firms than on large ones.[36] We should remember this when we look for its impact on other features of the market.[37]

We shall call this driver THE BEAST.

And we know now that it lives in the stock exchange.

The Pathetic Private Information Hypothesis

But French and Roll don't much believe in beasts. They think there's another reason for their finding that the market's variance is anywhere from 13 to 100 times larger when the exchange is open then when it is closed.

They believe that investors have more incentive to gather private information when the market is open than when it is closed.

You see, when the market is open, you can act on the gem of information that you find under the "stone" immediately. You don't have to wait until tomorrow when the stock exchange opens.

After all, if you wait until then, someone else may have found it. You may be waiting in line to buy or sell with a whole flock full of other investors ready to act on *their* gems. So you spend *much* more time (13 to 100 times more variance) looking for gems when the market is open.

Because of this, investors feel that *much* more information is revealed when the market is open than when it is closed.

This hypothesis is called the *Private Information Hypothesis.* It goes something like this . . .

The surface temperature of the Cross leather pad on Sandra Preston's antique cherry desk cooled yet another degree after baking most of the morning under the sun rising above Lake Michigan.

She had a great view of the lake across Michigan Avenue. Her father's investment advisory firm occupied the tenth and eleventh floors of the prestigious Hampton Towers, and she had the corner office on the tenth floor.

She was in charge. And she was ready. *Armed with an MBA from the University of Chicago! Her professors from Chicago knew how the markets worked and they had taught her very well.*

Yes. She was ready.

Through the northern glass wall of her office she watched Jim Foley talking on the phone to one of the telecommunications companies he followed. To his left was Jane Carrey. She was screening firms to find those that matched the firm's value requirements.

Preston and Grier was a value investment management firm. They looked for firms that were in reasonably sound financial condition, but selling at even less than reasonable prices.

Over on the western side of the office, the investment committee was debating the relative merits of the current list of candidate value stocks, trying to come up with this week's buys and sells for their composite portfolio.

Sandra looked at the matching cherry clock on her desk. 3:00 P.M. The market was now closed in New York. Time to put into action some of the things she learned at the university.

Her University of Chicago professors had taught her well about the relative value of information when the market is closed.

This firm could use an increase in efficiency!

She walked out of her office and confronted Foley. "Jim, please hang up the phone now.*"*

Foley looked confused. "Sandra, I'm talking to the CEO of Allied Communications. I've been trying to connect with this guy for weeks. What's the problem?"

"The problem is the market's closed. *Think about that. If he tells you something valuable* now, *you won't be able to act on it until* tomorrow. *Now hang up the phone and tell him you'll call back tomorrow at 8:30 A.M."*

"What the hell are you talking about? Do you think I can talk to this guy whenever I want? You must be joking. Right?"

"Sure Jim. I'm joking!*" Now hang up the phone!*

Sandra didn't care at all *for his defiance of her authority. She walked over to his desk, took the receiver and promptly hung it up* for him.

"The market is closed, and when the market is closed, we stop gathering information at Preston and Grier, because we want to be efficient!*"*

Now she marched to the desk of Jane Carrey. "Please turn off your computer, now*!"*

Carrey was actually startled. "But I've got to get the new value stock population to the investment committee by 4:00. I was late last week. If I'm late again, it could cost me my job!"

Sandra smiled. "Don't worry. I'm the one who determines that now. *Turn off your computer. The market is closed."*

"What do you mean the market is closed? What does that have to do with me?"

Sandra knew that she was going to have to deal with naiveté. If only everyone *was trained at Chicago. "Listen to me. The market is closed. What if you find something useful? Don't you see you won't be able to act on it until tomorrow? By then someone else may have found out about it. To be efficient, you shouldn't search for information until the market is* open. *That way you can act as soon as you find out about it."*

Carrey seemed perplexed. "Act? Do you mean trade*? I don't trade. I just report to the investment committee. Anything I find doesn't get acted upon for at least a week. They always want confirmation and* more *confirmation."*

"We'll see about that."

Sandra Preston walked to the west conference room where the investment committee was in heated debate. She opened the door and walked in.

"This discussion must stop immediately."

Her father, Jeffery Preston, chairman of the committee, immediately stopped talking. "Sandra, what's the problem?"

"The market is closed."

"So what?"

"What do you mean, 'So what?' If you people come to any decision here this afternoon, you will have to wait until 8:30 tomorrow morning to act on it. You should talk tomorrow. You're wasting your time *talking now."*

Frank Grier, the firm's Chief Investment Officer broke in, "Wait a minute. We're trying to determine the week's buys and sells to be executed tomorrow at the opening bell. If we don't come to a decision now, we can't act tomorrow morning."

Sandra smiled. "The investment business is highly competitive. You know that. Much of this business is a process of discovery. When you discover things you must act quickly. *You must act before your competitors do. How can you act when the market is closed? See? To be efficient, you should only look for information when the market is open. This makes all the sense in the world to me. Why doesn't it make sense to all of you as well?"*

Grier: "What makes sense to me is that, if we stop searching for information when the market is closed, our competitors will find it before we do. I want my people looking 16 hours a day. *I want to find it first, damn it! Who cares if we have to wait for the bell to trade?"*

Jeffery Preston interjected, "Wait a minute, Frank. We can't be stuck in the past! We've got to be open to new ideas. Sandra's full of interesting new ideas from the University of Chicago. I think we should give them a chance."

Jeff Preston rose from his chair, and walked out of the conference room. He cupped his hands to his mouth and yelled.

"Everyone! Stop whatever you are doing and leave immediately! The market is closed. *I don't want to see anyone around here until 8:30 A.M. tomorrow.* From now on we're running a 6½-hour day!"

THE FIFTH MYSTERY: GOING GLOBAL EXTENDS THE LENGTH OF YOUR TRADING DAY AND THE RISK OF YOUR STOCK

Cross-Listed Stocks

If volatility goes down when the number of trading hours in a week decreases, the converse ought to be true as well. Volatility should become *greater* as the number of hours is *extended.*

But how to find a case of an increase in trading hours?

What about stocks that become cross-listed on the London Stock Exchanges? For these stocks, when the closing bell rings in New York, trading continues in London.

Several years ago, two University of Pittsburgh professors named Makhija and Nachtmann (MN) wrote a very interesting paper on the effects of cross-listing on stock volatility.[38] The paper was written when it was still gauche for financial economists to present evidence *against* the Efficient Market Hypothesis. This, in my view, is the likely reason this solid study, like many other papers providing evidence conflicting with the basic doctrines of Modern Finance, never saw the light of day and joined the others filling academic filing cabinets throughout the world.

If you would like a second opinion, Ken French (of FR) formally discussed the paper following its presentation by Makhija at the 1990 meetings of the Western Finance Association. Although expressing some chagrin over the nature of the findings, he could find little reason to fault the methodology.

Because the paper was never published, and is therefore largely unavailable to you, I'm going to spell out much of its detail in the footnotes.

Volatility and Cross-Listing

Makhija and Nachtmann studied 81 multinational firms, which were cross-listed on the London Stock Exchange over the period 1969 through 1982.[39]

As shown in Table 1.7a, the firms ranged in size from $40 million to $48 billion in total market capitalization (number of shares outstanding times market price per share). The average size was $2.15 billion and the median was $782 million. On average, a cross-listed firm represented 0.25 percent of the total market value of all firms on the New York and American stock exchanges.[40]

Considering the typical size of companies during the period of their study, these were, for the most part, large and well-established companies.

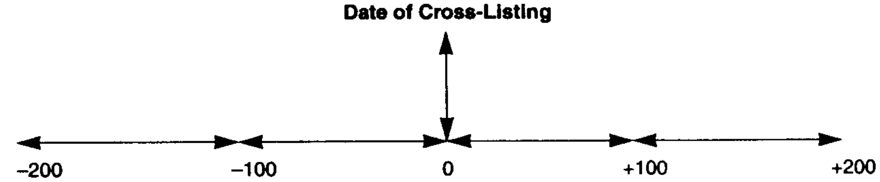
[redacted]

	Stock Value[a]	
	$	*% of Market*
Mean average	$2.149 billion	.248
Maximum	$48.360 billion	4.449
Minimum	$.040 billion	.004
Median	$.782 billion	.093

[a]Stock value is computed for individual firms as the product of shares outstanding and the closing price on date admitted to the LSE. Percent of market is computed for each stock as the ratio of the market value of the company's stock to the value of all stocks on the New York and American Stock Exchanges date of admission to the LSE.

Source: Adapted from Makhijan, A., and R. Nachtmann, 1989, "Empirical Evidence on Alternative Theories of Stock Return Variances: The Effect of Expanded Trading Time on NYSE–LSE Cross-Listed Stocks," unpublished manuscript, University of Pittsburgh.

Makhija and Nachtmann compute the variances of the daily rates of return to the stocks over the following time line:[41]



The first panel of Table 1.7b shows the average and median variances for the stocks in the periods ranging over 100 days prior to the cross-listing and from the cross-listing date to 100 days after. Note the rather dramatic increases in the variances of return.[42] In the second panel, the average and median variances are shown for the periods (–200 to –101) and (+101 to +200).

Again, note the substantial increases. Interestingly, variance continues to increase over the periods (0 to +100) and (+101 to +200).

Are these changes statistically significant? The first panel of Table 1.8 shows the average and median changes in the stocks computed over periods of 50, 100, and 200 days surrounding the cross-listing date. Statistical analysis indicates that the probability that cross-listing tends to be followed by a variance increase is astronomically high. The same is true for the medians.[43] Note also

[redacted]

	Interior Intervals		Exterior Intervals	
	-100, -1	*+1, +100*	*-200, -101*	*+101, +200*
Mean average	3.55	4.53	3.57	5.31
Maximum	11.97	14.98	14.43	19.35
Minimum	.81	.68	.81	.74
Median	2.95	3.53	2.66	3.94

[a]Reported statistics on daily variance measures are computed for the interior times indicated using daily close-to-close NYSE rates of return.

Source: Adapted from Makhijan, A., and R. Nachtmann, 1989, "Empirical Evidence on Alternative Theories of Stock Return Variances: The Effect of Expanded Trading Time on NYSE-LSE Cross-Listed Stocks," unpublished manuscript, University of Pittsburgh.

[redacted]

	CHANGES IN FIRM VARIANCE					
	% Change in Variance			*% Change in Variance Relative to Market*		
No. of Days Used to Compute Variance	*200*	*100*	*50*	*200*	*100*	*50*
Mean average	57[a]	35.77[a]	33.82[a]	32.14[a]	20.26[a]	21.81[b]
No. positive	60	57	52	53	52	45
No. negative	21	24	29	28	29	36
Median	39.05	20.15	8.54	15.48	13.18	8.97

[a]Significant with 99% confidence.
[b]Significant with 95% confidence.

Source: Adapted from Makhijan, A., and R. Nachtmann, 1989, "Empirical Evidence on Alternative Theories of Stock Return Variances: The Effect of Expanded Trading Time on NYSE-LSE Cross-Listed Stocks," unpublished manuscript, University of Pittsburgh.

that there are many more individual cases of variance increases following cross-listing than variance decreases.

Perhaps the trend in the level of volatility was upward during their study. Can we somehow abstract from movements in the general level of volatility and focus specifically on the effect of cross-listing?

The second panel of Table 1.8 shows the increases in the variances net of any increases in the variance experienced by the individual stocks comprising the market index.[44] Again the probabilities that cross-listing is associated with a *net* variance increase is extremely high.[45]

The Return of the Preposterous Private Information Hypothesis

Makhija and Nachtmann admit that these results might be explained away by advocates of the efficient markets on the basis of the so-called "private information hypothesis," which we discussed under the Fourth Mystery.

You see, public information includes items like earnings announcements and court decisions. As soon as it is announced, such information affects prices and causes volatility. Private information, on the other hand, is a product of the analysis of "informed traders." Private information doesn't affect prices until informed traders act on it and trade.

So how are Makhija and Nachtmann's results to be explained away by the efficient markets types? Before cross-listing, informed traders had to wait until the following morning to act on the private information their analysis produced after the NYSE had closed. Since cross-listing on the LSE began, they can get in there at 4:30 A.M. EST and trade like crazy! Because of the great new opportunity offered by cross-listing, those who believe in the private information hypothesis believe that informed traders will have an incentive to produce more "private information" for cross-listed stocks, thereby driving up their volatility!

Somehow, this seems pretty far-fetched to me.[46] But when you attack the Efficient Markets Hypothesis, you've got to be prepared for counterattacks by the "Efficient Markets Police" from *every* possible direction.

Cross-Listing Makes the Market More Overreactive

To fend off the "private information" interpretation of their results, Makhija and Nachtmann extend their study to an analysis of variance ratios.

As I previously discussed under the Fourth Mystery, if successive percentage changes in stock prices are truly random and unconnected, volatility increases proportionately with the time interval over which the percentage changes are measured. The variance of annual returns will be 12 times as large as the variance of monthly returns.

However, if stock markets are populated by traders who overreact to incoming information, successive changes in stock prices will *not* be random.

Suppose a positive piece of information comes into the market. Prices go up, but by too much. This overreaction is then corrected by a fall in prices.

If traders are overreactive, we should see reversal patterns in stock prices. Positive changes in price will tend to be followed by negative changes. The presence of reversal patterns will prevent variance from increasing proportionately with the return interval.

To see this, consider that if stock prices had *momentum,* rather than reversals, a gain would tend to be followed by another gain, a loss by another loss. Prices potentially could fluctuate over a wide range if you observe the stock over longer periods—*or if you measure the cumulative return over longer periods.*

With inertia, variance increases more than proportionately with the return interval. The variance of annual returns should be *more* than 12 times the variance of monthly returns.[47]

On the other hand, with reversals, gains tend to be corrected by losses, which narrows the possible range of performance if you observe, or compute the return, over longer periods of time.

In the presence of overreactive traders and reversal patterns, the variance increases *less than* proportionately with the length of the return interval. The annual variance should be less than 12 times the monthly variance.

Makhija and Nachtmann compute the variance of their stocks before cross-listing, using intervals ranging from 5 to 45 days to compute the return. For each interval, they compute a variance ratio, which is the variance as computed over the n-day interval divided by n times the stock's daily variance.

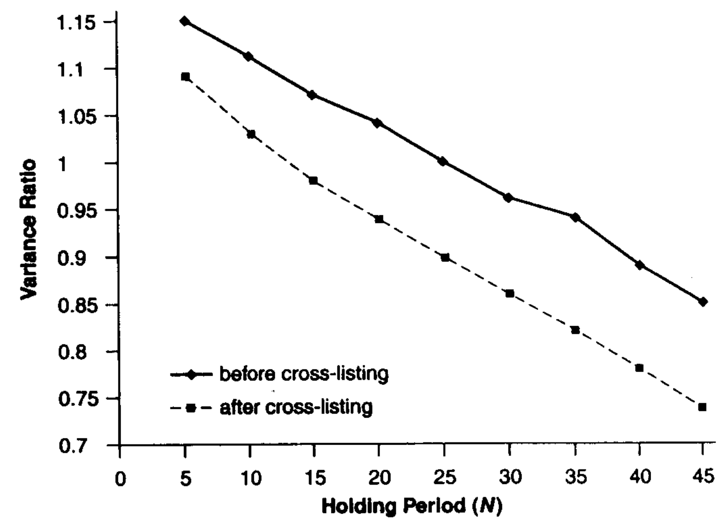
Thus, they would begin by computing each stock's variance over a 5-day interval, and then they would divide this variance by five times the stock's daily variance. If the ratio is less than 1.00, we have evidence of reversals in the pattern of returns. The average variance ratio across all the stocks, prior to cross-listing, is presented as the solid line in Figure 1.8.

Note that we observe some evidence of statistically insignificant momentum in the very short term. (The variance ratios are greater than 1.00.) However, as we go to intervals in excess of 25 days, we see evidence of overreaction and reversals. (The variance ratios are now less than 1.00.)

Now look at the *broken* curve. This curve shows the variance ratios *after* cross-listing.

The variance ratios are all *lower* than before.

Clearly indicating the presence of stronger reversal patterns, which can be associated with *more* correcting of overreactive pricing.



This seems odd *if the market is simply overreacting to pieces of information coming in from the real world.* All that has happened between the two curves is that we have given investors 5 hours of additional time to overreact.[48]

But what if the market is not merely overreacting to *real-world* information? What if it is overreacting to *itself?* Overreacting to its *own* price changes.

Then the 5 hours of additional trading time will give the market that much more information to overreact to. This seems to be a more plausible explanation for the striking results of Figure 1.8.

We see the tracks of THE BEAST in this figure. It *does* live inside the stock exchange, but when a firm's stock goes global, THE BEAST travels the world!

Taking Stock Again

It's time, once again, to take stock of what we have learned thus far.

- Stock volatility is too big and too unstable.
- When volatility goes up, stock prices go down, so as to increase the size of the risk premium in the market's aggregate future expected returns.
- The size of the price reaction increases with the size of the volatility shift.
- Most of the largest changes in price and volatility are unconnected to real-world events.

- When the number of trading hours per week declines, stock volatility goes down; when the number of trading hours increases, stock volatility goes up.
- When the number of trading hours per week rises, evidence of short-term overreaction becomes more pronounced.

By the way, do you see *any* good reason why MN's paper is locked away in a filing cabinet in Pittsburgh, Pennsylvania?

Papers locked away in filing cabinets don't have to be dealt with or responded to.

THE SIXTH MYSTERY: THE CASE OF THE VANISHING VOLATILITY

More Debt, Less Risk?

Highly leveraged transactions such as leveraged buyouts (LBOs) and leveraged recapitalizations were very popular in the 1980s. An interesting and largely overlooked feature of these types of transactions is that they are associated with a *reduction* of the risk of the firm as a whole. You might ask: "How can this be? I would think that a heavy use of debt in a transaction would *increase* risk, not *reduce* it."

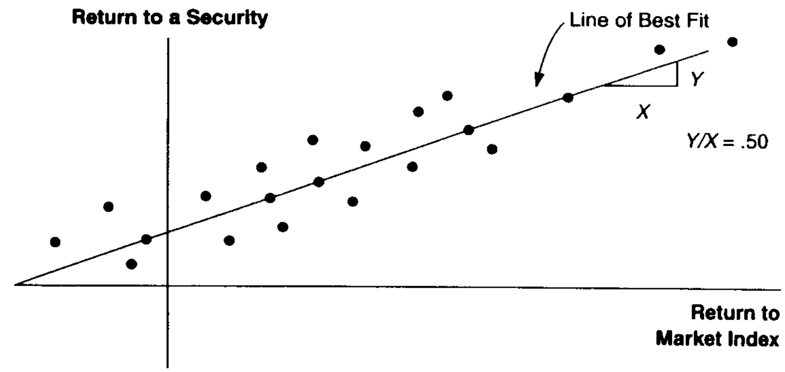
According to modern finance, the amount of debt in a firm's capital determines the sharing of total firm risk among the capital contributors. With more debt and less stock, the firm's few remaining stockholders will bear the lion's share of the risk. Given the fixed nature of the debt claim and the residual nature of the stock claim, we would expect that the stock, standing last in the line of claims to profits, would be highly volatile indeed.

Unless there's some connection to the management of the firm's assets, however, the amount of debt employed in financing shouldn't materially affect the *aggregate* risk of *all* the firm's claims—debt as well as equity.

The distribution of risk among the claims in highly leveraged transactions was recently investigated by Kaplan and Stein,[49] professors from the University of Chicago and Massachusetts Institute of Technology, respectively.

Leverage and Beta: Theory

Kaplan and Stein measure risk by beta. The beta factor for a security (stock or bond) measures the sensitivity of its returns to changes in the returns to the market index. Figure 1.9 plots the rate of return to the security on the vertical scale. Rates of return to the market index are plotted on the horizontal scale. Each point on the diagram represents a pair of returns to the security and to



the index over a particular period of time—say, a month. A line of best fit is passed through the scatter plot. The slope of this line is the beta factor for the security. This particular security has a beta of .50. This means that if the return to the market index was to increase by 1%, we would expect the return to the security to rise by half that, or 0.5%.

Kaplan and Stein do a good job of explaining the effect of increasing financial leverage on beta:

> Imagine that XYZ Corp. is initially all equity-financed. And has a market value of $100 and an equity beta of 1.00. Now suppose that XYZ undertakes a recap, borrowing $85 from the bank and lower-grade bond lenders, and using the cash to pay an $85 dividend to shareholders. If there are no taxes or other sources of gains, the total market value of the company must still be $100. Thus, the "stub" equity component is worth $15. If the post re-capitalization debt has no systematic risk (beta), and then conservation of systematic risk implies that the stub equity must have a new beta of 6.67—the asset beta of 1.00 divided by the smaller equity to total capital ratio of 0.15. Suppose, however, that we measure the stub's beta and find it to be only 2.22, or one-third of 6.67. This must mean that the remaining two-thirds of total company risk is now borne by the debt-holders. If so, the debt has an implied beta of 0.78—the missing .67 of the asset beta divided by the 0.85 ratio of debt to total capital.[50]

If the debt has a beta of 0.78 and the stock has a beta of 2.22, the weighted average beta of all the claims will be 1.00—the original beta of the firm's assets.

$$\begin{array}{ccccccccc} \text{Asset Beta} & = & \%\ \text{Equity} & \times & \text{Equity Beta} & + & \%\ \text{Debt} & \times & \text{Debt Beta} \\ 1.00 & = & .15 & \times & 2.22 & + & .85 & \times & .78 \end{array}$$

We see that, when the risk of the assets stays constant (in this case at 1.00), if a company reduced its equity while increasing its debt, its equity beta should rise dramatically unless there is a significant increase in the beta of its debt.

Leverage and Beta: Reality

Kaplan and Stein study 12 companies that recapitalized, moving from mostly equity to mostly debt, in the years 1985 through 1988. The characteristics of the 12 companies, before and after the transactions, are shown in Table 1.9. We see that, on average, the firms went from an average of 74% equity in their capital structures to only 15.5%.

KS compute the betas for the stocks using daily data over the 6 months prior to the recap announcement. They find that the firms have an average beta of 1.01 during this period. Next, they compute the betas in the 6 months following the completion of the recap. The betas now average 1.38. Naturally, there is an increase, but not nearly the increase that KS expected. In fact, the betas of four of the companies actually went down!

Table 1.10 shows the risk of these firms before and after the leveraged transactions. The pre-recap *asset* betas are computed using the equation above, the pre- and post-recap percentages for equity and debt, the statistical

[redacted]

		Pre-recapitalization			
Company	*Recap Completed*	*Debt (%)*	*Preferred (%)*	*Common (%)*	*Total Capital ($M)*
1. Colt Industries	10/08/86	11.3	0.0	88.7	1,527
2. FMC	05/29/86	14.6	0.0	85.6	1,916
3. Fruehauf	12/24/86	41.6	0.0	58.4	1,245
4. Harcourt Brace Jovanovich	07/28/87	27.7	0.0	72.3	2,488
5. Holiday	04/22/87	49.5	0.0	50.5	2,640
6. Interco	12/23/88	26.6	0.0	73.4	2,083
7. Kroger	12/05/88	28.7	6.1	65.2	4099
8. Multimedia	10/02/85	8.6	0.0	91.4	611
9. Owens Corning Fiberglass	11/06/86	27.2	0.0	72.8	2,085
10. Shoney's	08/04/88	1.7	0.0	98.3	762
11. Swank	03/01/88	31.9	0.0	68.0	83
12. USG	07/14/88	37.0	0.0	63.0	2,301
Average		25.5	0.5	74.0	1,824
Median		27.5	0.0	72.5	2,025

estimates of equity beta, and an assumption that the debt betas are all equal to 0.15.[51]

Note the numbers for the post-recap *asset* betas. They are also computed using the equation above, the computed equity beta for the post-recap period, and an assumption that the beta for the debt is zero.

Examine this table carefully. Note that, *in each and every case,* the risk of these firms went down *substantially.* On average, the risk associated with the assets of these firms falls to *less than a third* of its value prior to the recap.

Something very interesting happened to the risk of these firms. It disappeared!

Where did it go?

Are the Bonds Bearing the Risk?

To try to explain the puzzle, Kaplan and Stein make the rather bold assumption that the recaps result in a reduction in the *fixed* costs to the firm.[52] In fact, they assume that all the increase in firm value observed in the vicinity of the recap

[redacted]

		Post-recapitalization			
Company	*Recap Completed*	*Debt (%)*	*Preferred (%)*	*Common (%)*	*Total Capital ($M)*
1. Colt Industries	10/08/86	84.0	0.0	16.0	2,103
2. FMC	05/29/86	74.4	0.0	25.6	2,554
3. Fruehauf	12/24/86	83.6	13.9	2.6	1,916
4. Harcourt Brace Jovanovich	07/28/87	70.2	13.0	16.7	3,656
5. Holiday	04/22/87	88.2	0.0	11.8	3,364
6. Interco	12/23/88	84.7	11.2	4.1	2,955
7. Kroger	12/05/88	87.8	0.0	12.2	6,286
8. Multimedia	10/02/85	81.1	0.0	18.9	1,115
9. Owens Corning Fiberglass	11/06/86	84.3	0.0	15.7	2,929
10. Shoney's	08/04/88	72.9	0.0	27.1	1,041
11. Swank	03/01/88	74.8	0.0	25.2	94
12. USG	07/14/88	89.4	0.0	10.6	3,495
Average		81.3	3.2	15.5	2,626
Median		83.8	0.0	15.9	2,742

Source: Kaplan, S., and J. Stein, "How Risky Is the Debt in Highly Leveraged Transactions?" *Journal of Financial Economics,* September 1990, p. 220.

[redacted]

Company	Pre-recapitalization Equity Beta	Pre-recapitalization Implicit Asset Beta	Post-recapitalization Equity Beta	Post-recapitalization Implicit Asset Beta
1. Colt Industries	0.63	0.57	1.29	0.21
2. FMC	0.88	0.77	1.09	0.28
3. Fruehauf	0.76	0.51	0.73	0.12
4. Harcourt Brace Jovanovich	1.85	1.38	1.68	0.50
5. Holiday	0.75	0.46	1.65	0.20
6. Interco	0.93	0.72	1.96	0.30
7. Kroger	1.20	0.90	1.41	0.17
8. Multimedia	0.75	0.70	1.22	0.23
9. Owens Corning Fiberglass	1.10	0.84	1.86	0.29
10. Shoney's	0.76	0.75	1.45	0.39
11. Swank	1.14	0.83	0.84	0.21
12. USG	1.37	0.92	1.36	0.14
Average	1.01	0.78	1.38	0.25
Median	0.91	0.76	1.38	0.22

Source: Kaplan S., and J. Stein, "How Risky Is the Debt in Highly Leveraged Transactions?" *Journal of Financial Economics,* September 1990, p. 228.

can be attributed to a fixed cost reduction that reduces the firm's *asset* betas proportionately.[53]

Assuming that this is the case, we get a revised set of numbers in Table 1.11.

Same basic result. Where did the risk go? Perhaps it's being borne by the firm's bondholders. However, as we shall see, the bonds of these firms simply don't carry that much systematic risk.[54]

Kaplan and Stein can get weekly prices for the bonds of eight of their companies. They compute the betas of these bonds directly, by statistically relating their returns to the returns to the market index in the manner of Figure 1.9. The estimated betas are displayed in Table 1.12 along with the debt betas needed to keep asset risk intact. The implied debt betas are those required to keep the risk of the assets "intact" under two assumptions: (a) the recap lowers fixed costs and (b) it does not.[55]

If the bonds of these firms are found to carry substantial levels of systematic risk, then we will have found the missing risk—imbedded in the bond returns.

[redacted]

Company	Pre-recapitalization Equity Beta	Pre-recapitalization Asset Beta Adjusted	Post-recapitalization Equity Beta	Post-recapitalization Asset Beta
1. Colt Industries	0.63	0.42	1.29	0.21
2. FMC	0.88	0.70	1.09	0.28
3. Fruehauf	0.76	0.36	0.73	0.12
4. Harcourt Brace Jovanovich	1.85	0.96	1.68	0.50
5. Holiday	0.75	0.40	1.65	0.20
6. Interco	0.93	0.55	1.96	0.30
7. Kroger	1.20	0.59	1.41	0.17
8. Multimedia	0.75	0.40	1.22	0.23
9. Owens Corning Fiberglass	1.10	0.61	1.86	0.29
10. Shoney's	0.76	0.63	1.45	0.39
11. Swank	1.14	0.65	0.84	0.21
12. USG	1.37	0.65	1.36	0.14
Average	1.01	0.58	1.38	0.25
Median	0.91	0.60	1.38	0.22

Source: Kaplan S., and J. Stein, "How Risky Is the Debt in Highly Leveraged Transactions?" *Journal of Financial Economics,* September 1990, p. 231–232.

However, Table 1.12 clearly shows that the actual risk of the bonds is insufficient to account for the missing risk. For the risk of the total firms to be constant across the recap, the risk of the new bonds would have to be approximately two to four times what the statistical estimate of the bonds' risk actually turn out to be.

Who Stole the Risk?

What happened here? Twelve companies decide to dramatically increase the amount of debt in their capital structures. Bonds are simply exchanged for stock. Remarkably, in each and every case, the companies behind these securities become less risky.

Much less risky.

The total risk of the firms is cut by *one-half* to *two-thirds,* depending on what you assume about fixed costs.[56]

Why?

Company	DIRECT BETA ESTIMATES: Beta of Bonds	IMPLICIT BETA ESTIMATES: Constant Asset Risk, Lower-grade	IMPLICIT BETA ESTIMATES: Reduced Asset Risk, Lower-grade
1. Colt Industries	0.30	0.59	0.34
2. FMC	0.26	0.90	0.77
3. Fruehauf	0.18	0.65	0.40
4. Holiday	0.60	0.35	0.28
5. Interco	–0.21	0.70	0.42
6. Kroger	0.24	1.17	0.68
7. Owens Corning Fiberglas	0.32	0.84	0.49
8. USG	0.30	1.16	0.75
Average	0.21	0.80	0.52
Median	0.28	0.77	0.46

Source: Kaplan, S., and J. Stein, "How Risky Is the Debt in Highly Leveraged Transactions?" *Journal of Financial Economics,* September 1990, p. 242.

If you can answer the following question, then you will know.

How big is THE BEAST that lives in the bond market?

THE SEVENTH MYSTERY: STOCKS SELLING CHEAP—THE STRANGE BEHAVIOR OF CLOSED-END INVESTMENT COMPANIES

What Is a Closed-End Fund?

Closed-end investment companies are similar to mutual funds. The basic difference between the two is how you buy or sell them. With a mutual fund, you buy and sell shares from the mutual fund itself at the net asset value of the fund (the total market value of all its investments divided by the number of shares that the fund has outstanding). You buy shares in a closed-end investment company as you would buy shares in any common stock—by sending your broker to the stock exchange or wherever the fund is traded to buy them from another investor who wants to sell them.

The closed-end fund is, therefore, priced in the market like any other stock.

You would think that valuing this stock would be a "lay-up," even for the *inefficient* market. After all, the total market value of the investments owned by the fund is reported weekly in the financial press.

It seems, however, that the stock market has a difficult time even sinking lay-ups.

The Discount

Think of this. You decide to form your own closed-end fund. Your Uncle Louie is an investment banker, and he is willing to help you sell a $1 million block of stock for no fee. Louie floats a million shares at $1.00 per share. Fortunately, Aunt Emma is a stock broker, and she's going to let you buy shares of stock for free. So you have her buy $1 million of AT&T. The shares of your new closed-end investment company are being traded on the New York Stock Exchange.

A few days later, you check the price of AT&T and find that it has increased slightly. At the same time, you check the price of your closed-end fund and find that it has gone *down.* The price has dropped from $1.00 per share to $.80! Your fund is now selling at a *discount.*

Much to your consternation, although the magnitude of the discount changes from day to day, your fund continues, on average, to sell at a bargain price.

Puzzled, you call a financial consultant to ask why. The consultant gives you several possible explanations.

First, he says, "You may be charging too much for your services as the manager in the fund."

"What's too much?" you ask.

"More than your value-added as a stock picker and portfolio manager," he says.

"But my salary is tiny relative to the size of the discount, and my salary doesn't change from day to day, but the discount does. Besides, I've checked into it, and I don't see any relationship between the size of the discounts on different funds and their expense ratios."[57]

The consultant offers another explanation. "Well, some closed-end funds invest in privately placed securities, which aren't very liquid. They may appraise the value of their illiquid investments too high in computing net asset values."

You reply: "Look. I only own AT&T. Is that liquid enough? Besides, I see lots of other funds out there holding only liquid investments, and they're selling at discounts too."

Backing into a corner, the consultant offers up yet another explanation. "Well, maybe you've got an accrued capital gain on your investment. Any new investor who buys your fund now would be buying into a tax liability right from the start."

But this also doesn't seem plausible. You've noticed that AT&T *has* gone up a bit, but not nearly enough to explain the size of the discount. Besides, you've noticed that the size of the discount gets *larger* when stock prices go *down* and *smaller* when they go *up*. If the tax argument held water, the opposite would happen.

So you fire your consultant, and continue on, still perplexed.

The Discount as an Index of Investor Sentiment

Don't feel bad. Financial economists have puzzled over these discounts for a *long time.*

Recently, however, three professors named Lee, Shleifer, and Thaler (LST) have shed some light on the issue.[58]

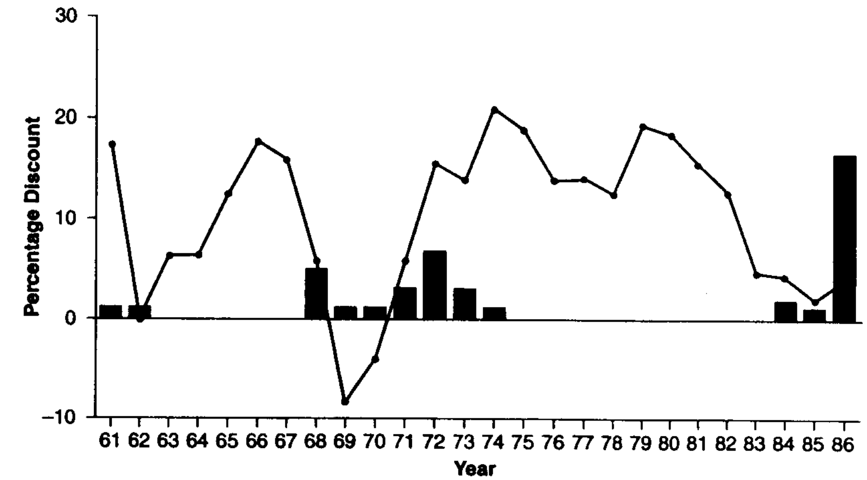
They studied 20 closed-end funds in the period 1965 through 1985. They collect monthly net asset values for the funds. Then they calculate the size of the monthly discounts on each fund. The individual monthly discounts are then aggregated, based on the total size of each fund, to form a *discount index.*

The behavior of the discount index over time is shown in Figure 1.10. The number of new funds started in each year is also shown in the figure. We see that the discount is highly variable over time, and new funds tend to be formed when the discount is relatively small.

The latter finding implies that the discounts on individual funds tend to be positively correlated. LST find that, in fact, they are, with an average correlation coefficient between funds being .53.

These researchers offer the hypothesis that, *since the magnitude of the discount is both big and variable over time,* investing in a closed-end fund is more risky than a direct investment in the portfolio of stocks owned by the fund. Because of this, risk-averse investors want a higher expected return on the fund. The only way to get a higher return in the future is to discount the price of the fund today.

They take the size of the discount to be an index of *investor sentiment* about future returns on closed-end funds and other securities.[59] They predict that, as investors become more optimistic, security prices overall will go up. With increased



[redacted]

Source: Lee, C., A. Shleifer, and R. Thaler, "Investor Sentiment and the Closed-End Fund Puzzle," *Journal of Finance,* March, 1991, p. 80.

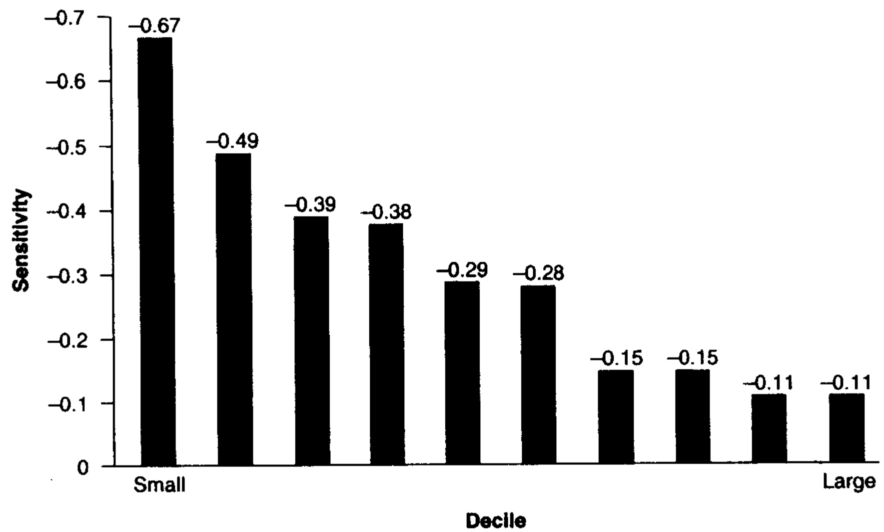
pessimism, they should go down. Taking the discount index as a barometer of investor sentiment, there should be a negative relationship between changes in the size of the discount index and rates of return to stocks in general.

An *increase* in the size of the discount index should mean *lower* returns to common stocks.

Lee, Shleifer, and Thaler rank the stocks in their study by the size of the company. Then they form the stocks into equally weighted size deciles. Figure 1.11 shows the sensitivities of stock returns to changes in the value of the discount index. These "betas" relate changes in the discount index to stock returns to different portfolios of common stocks. All of the betas are statistically significant at very high levels of confidence.

The beta for the smallest stocks is –0.67. How to interpret this? Note from Figure 1.10, that the size of the discount fell by about 18 percentage points in the first year. Given the beta for the smallest decile in Figure 1.11, we would expect the returns to these stocks to be 12 percentage points higher because of what happened to the discount index.

A substantial effect. And we see that the effect becomes smaller as we go from the smallest stocks to the largest.[60]



Source: Adapted from Lee, C., A. Shleifer, and R. Thaler, "Investor Sentiment and the Closed-End Fund Puzzle," *Journal of Finance*, March, 1991.

Do you remember the study by French and Roll?

They find that volatility was 50 times larger for small stocks when the exchange was open—but only 12 times larger for large stocks.

THE BEAST has a bigger impact on small companies.[61]

The Final Inventory

Let's itemize what we've learned one last time:

- Stock volatility is much too big and much too unstable.
- When volatility goes up, stock prices go down, apparently to increase the size of the risk premium in the market's aggregate future expected returns.
- The size of the price reaction increases with the size of the volatility shift.
- In the market's history, most of the largest changes in price and in volatility are unrelated to real-world events.
- When the number of trading hours per week gets smaller (exchange holidays), stock volatility goes down; when the number of trading hours gets larger (cross-listing), stock volatility and short-term reversal patterns become more pronounced.
- When more debt is issued, firm risk decreases.
- The discounts on closed-end funds become larger when the stock returns get smaller.

None of these effects are small. They are all *major* anomalies. And they all can be explained in a single stroke.

Notes

1. A line of best fit is the unique line passed through the scatter such that the *sum* of the squared vertical distances of each plot point from the line is *minimized*.
2. The slope of the line of best fit is given by: the product of (a) the volatility of the perfect forecast price and (b) the correlation between the two prices divided by the volatility of the market price. As discussed earlier, if the market is efficient, the slope for the relationship between changes in the Perfect Foresight Price and changes in the market price should be 1.00. This being the case, the ratio of the volatility of the market price to the volatility of the Perfect Foresight Price should equal the correlation coefficient between the two. (For the original derivation, see R. Shiller, 1981, "Do Stock Prices Move Too Much to Be Justified by Subsequent Changes in Dividends?" *American Economic Review*, pp. 421–435.)
3. See R. Shiller, *Market Volatility* (Cambridge, MA: MIT Press, 1990), p. 78. Also see S. LeRoy and R. Porter, 1981, "The Present Value Relation: Tests Based on Implied Variance Bounds," *Econometrica*, pp. 555–574.
4. Shiller assumes that the present value of dividends to be received after 1988 is equal to the 1988 price.
5. R. Shiller, *Market Volatility* (Cambridge MA: MIT Press, 1990), p. 82.
6. You may recall from the discussion that the perfect foresight pricing equation calls for real (inflation-adjusted) discount rates. It is likely that the real rate is more stable than the nominal commercial paper rate used by Shiller. Thus, Shiller's estimate of the volatility of the Perfect Foresight Price series is, for this reason, upward biased.
7. See M. Flavin, 1983, "Excess Volatility in the Financial Markets: A Reassessment of the Empirical Evidence," *Journal of Political Economy*, pp. 921–956; A. Kleidon, 1986, "Variance Bounds Tests and Stock Price Valuation Models," *Journal of Political Economy*, pp. 953–1001; and T. Marsh and R. Merton, 1986, "Dividend Variability and Variance Bounds Tests for the Rationality of Stock Market Prices," *American Economic Review*, pp. 483–498.
8. Ackert and Smith argue that if all cash flows received by common shareholders are considered, stock prices are not too volatile to be explained by the discounted value of total cash flows. However, a very significant portion of their nondividend cash flows is payments received in corporate takeovers. This seems strange because Shiller argues that stock prices are too volatile relative to the cash flows from the operations of the firm. Many takeovers are motivated by assessments that the assets of the target are undervalued. Apparently, Ackert and Smith feel there is a fundamental difference between noncorporate investors driving an undervalued stock up in price and a corporate raider doing the same thing. In the case of the former, it is seen as a part of the excess volatility anomaly. In the case of the latter, it is seen as a volatile component of the cash flow that "resolves" the anomaly. Regardless, nondividend "cash flows" have been of significant size relative to dividends only in the last two decades. Are we to conclude that their appearance has resolved the excess volatility problem documented over the century? Is the stock market to be seen as too volatile (and therefore inefficient) in the first 8 decades of the century and not too volatile (and therefore efficient) over the last

2? See L. Ackert, and B. Smith, 1993, "Stock Price Volatility, Ordinary Dividends, and Other Cash Flows to Shareholder," *Journal of Finance*, pp. 1147–1160.

9. The market's assessment of its own volatility can be obtained by observing the relationship between the cash price for the S&P 100 Stock Index and the corresponding price for options written on the index. The most important determinant of the value of those options is the volatility of the index. Given the terms of the option (exercise price and maturity), the level of the risk-free rate, and the prices of the options and the index, it is possible to back out the level of index volatility that is consistent with the option price at any given point in time. Based on this methodology, we can say that there was about a 7-fold increase in volatility in the week between Monday the twelfth and Monday the nineteenth. See R. A. Haugen, E. Talmor, and W. Torous, "The Effect of Volatility Changes on the Level of Stock Prices and Subsequent Expected Return," *Journal of Finance*, July, 1991, pp. 985–1007.
10. HTT pass two contiguous blocks of time through their series of daily percentage changes in the market index. Each block spans 4 weeks. Call the first block the "leading block" and the block following behind the "trailing block." They calculate the variance (the square of the volatility) of the daily percentage changes in each block. At any given point in time, they take the ratio of the variance 4 weeks ahead to the variance 4 weeks behind. As we move the blocks forward toward a volatility increase, the leading block will begin to enter the high-volatility period. The variance of the leading block will begin to grow, as will the variance ratio. The ratio reaches its peak when the leading block is fully into the event and the trailing block is fully out of it. As we continue to move forward, the trailing block enters the event, and the variance in the denominator of the ratio begins to increase as well. The variance ratio now begins to fall, leaving its *peak* as the identifier of the time-incidence of the beginning of the volatility event.

    HTT run the moving blocks through their time-series of percentage changes in the market index from 1897 through 1988. When the variance ratio reaches a level at which they can say with 99% confidence that there has been an upward or downward shift in volatility, HTT mark the spot and begin looking for the peak or the trough in the ratio that marks the beginning of the event. (See D. Wichern and R. Miller, 1976, "Changes in Variance in First-Order Autoregressive Time-Series Models—With an Application," *Journal of the Royal Statistical Association*, pp. 248–256.)
11. This result is reinforced by Black, who finds a negative relationship between stock returns and changes in volatility. It is also confirmed by the results of French, Schwert, and Stambaugh, and by those of Duffee, who finds that changes in volatility are negatively related to stock returns. See F. Black, "Studies of Stock Price Volatility Changes," *Proceedings of the 1976 Meetings of the American Statistical Association, Business and Economics Section*, pp. 177–181. Also see K. French, W. Schwert, and R. Stambaugh, 1987, "Expected Stock Returns and Volatility," *Journal of Financial Economics*, pp. 3–29, and G. Duffee, 1995, "Stock Returns and Volatility: A Firm Level Analysis," *Journal of Financial Economics*, pp. 399–420.
12. In a differently designed test, French, Schwert, and Stambaugh show that the rate of return to the market index in any given month is negatively related to the unexpected change in market volatility during the month. See K. French, W. Schwert, and R. Stambaugh, 1987 *Journal of Financial Economics*, pp. 3–29.

13. This dramatic evidence in support of a high level of risk aversion on the part of stock market investors stands in marked contrast to the evidence coming from the *cross-section* of stock market returns. There is very little evidence that stocks of relatively greater risk carry relatively greater expected returns. At the least, we can say that relatively risky stocks have failed to produce relatively greater returns for their investors for the past 40 years! A possible explanation for disparity in the evidence coming from the time-series and the cross-section is provided in R. Haugen, *The New Finance: The Case Against Efficient Markets* (Englewood Cliffs, NJ: Prentice Hall, 1995).
14. We would expect investors to require higher (lower) returns only over the period for which the volatility shift is expected to persist. Because, as we have discussed above, volatility shifts occur quite often, the expected duration of the shift is likely to be short. A 4-week period to measure the realization of the new expected return seems reasonable, and it has the advantage of being consistent with the periods of the other blocks.
15. Remember that this is only the average percentage change in the price of the index. Adding the dividend yield brings the return to a level roughly commensurate with yields on fixed income securities over the period of the study.
16. As measured by the change in the volatility implied by the market value of the options on the S&P 100 Stock Index and the value of the S&P 500 Index itself.
17. This estimate is made after excluding the crash from the events used to measure the relationship between the magnitude of the volatility shift and the magnitude of the corresponding price response.
18. In a portfolio insurance strategy, you automatically sell stocks from your portfolio into a market decline. On the eve of October 19, as much as $80 billion in equities was invested this way. One large pension plan, which had invested under the strategy, accounted for 7% of the total volume of trading on the nineteenth, as it repeatedly sold $100 million blocks of stock in the cash market.
19. The media search is conducted for the last day of the first block as well as for all the days of the second block. The search was conducted using *Day by Day, Facts on File*, and *Keesing's Contemporary Archives*.
20. In their individual presidential addresses to the American Finance Association, Fisher Black and Richard Roll have focused on the extremely low power of economic fundamentals and empirical models in explaining changes in stock prices. See F. Black, 1986, "Noise," *Journal of Finance*, pp. 529–543; and R. Roll, 1988, "R^2", *Journal of Finance*, pp. 541–566.
21. D. Cutler, J. Poterba, and L. Summers, 1989, *Journal of Portfolio Management*, pp. 4–12.
22. They use the Cowles Index for the early years of their work, and then they switch to the S&P 500.
23. The unexplained change in the variable after relating it to lagged changes in its own value as well as to lagged changes in the other economic/financial variables.
24. The "T" statistic on the volatility variable is –7.33.
25. All the events were carried by the *New York Times* as the lead story and were indicated in the Business Section as having affected stock market participants.
26. Assuming that daily market returns are normally distributed.
27. Similarly, Schwert finds that the volatility of stock returns is not significantly related to the volatility of other economic variables such as the long- and short-term interest rates, the money supply, and inflation rates. See G. W. Schwert, 1989,

"Why Does Stock Market Volatility Change Over Time?" *Journal of Finance*, pp. 1115–1153.

28. Another possible cause would be significant changes in the relative prices of competitive beverages, but Roll allows for this in some of his tests.
29. See R. Roll, 1984, "Orange Juice and Weather," *American Economic Review*, pp. 861–880.
30. That means the expected percentage change in the price tomorrow has nothing to do with the change in the price today or any other day in the past.
31. See K. French and R. Roll, 1986, "Stock Return Variances: The Arrival of Information and the Reaction of Traders," *Journal of Financial Economics*, pp. 5–26.
32. Since the variance over *n* hours is *n* times the hourly variance, it will be true that the ratio of the variance over the 72 hours on Saturday through Monday to the 24 hours on other days can be written as:

$$\frac{66 \times \text{Variance}(C) + 6 \times \text{Variance}(O)}{18 \times \text{Variance}(C) + 6 \times \text{Variance}(O)} = 1.11$$

where Variance (C) and Variance (O) are the variance when the market is closed and open, respectively. By manipulating the equation, we can solve for Variance (O)/ Variance (C).

33. To test whether the exchange holiday effect is real, French and Roll look at the variance of Wednesday–Thursday returns for each year *except* 1968 relative to the 1-day weekday variance for the entire period of their study (July 1963 through December 1982). They find that the average ratio across all the years is 2.00—just as it should be. (The ratios over the individual years ranged from a low of 1.18 to a high of 4.32.) They conclude that the 1968 variance ratio of 1.14 was not caused by chance but rather by the exchange holiday.
34. For exchange holidays, the ratio of the 2-day variance (the exchange holiday and the day following) to the 1-day variance on an open day is equal to:

$$\frac{24 \times \text{Variance}(C) + 6 \times \text{Variance}(O) + 18 \times \text{Variance}(C)}{6 \times \text{Variance}(O) + 18 \times \text{Variance}(C)} = 1.145$$

The ratio for the open to closed variance can be computed as 25.

35. For election holidays, the open volatility is estimated to be 21 times the closed volatility.
36. After seeing the exchange holiday results, French and Roll eventually narrow the explanation for their results to two alternatives. The first is that return variances are higher during trading hours because most private information is incorporated into prices during this period. They say, for example, that most security analysts are at work at this time, visiting corporate headquarters and reading company documents. They conjecture that analysts might be more likely to look for private information during trading hours because they can quickly act on it, and therefore it is more valuable. Presumably, they stop looking during exchange holidays for this reason. The second possible explanation they consider is that the high trading-time volatility is caused by pricing errors that occur during trading.

To discriminate between these competing hypotheses, French and Roll look at the ratio of the weekly variance during exchange holiday weeks relative to the variance over other weeks. They find that the exchange holiday variance is 82% as large as the variance over the other weeks. (Presumably because 1 out of the normal 5 trading days is missing.) They agree that this would support the pricing error hypothesis because private information found during the holiday, or found after the holiday because of the search delay, would be impounded into prices on the following Thursday and Friday, increasing the variance then, raising the weekly variance ratio toward 100%.

They also argue that if the results are caused by pricing errors when the exchange is open there should be evidence of short-term reversal patterns in stock returns as the errors are subsequently corrected. French and Roll look for these reversal patterns, *and they find them, and state that they have found them.*

As a final discriminatory test, these researchers state that pricing errors are likely to be corrected within 3 weeks. This being the case, the variance of long holding-period returns is less likely to be affected by pricing errors than the variance of short holding-period returns. Confirming that this is in fact the case, they find that the "semi-annualized" variance of daily returns is significantly greater than the variance of 6-month returns. And the same result holds for periods shorter than 6 months. Amazingly, in spite of *all* this evidence supporting the pricing errors hypothesis, French and Roll, long-standing supporters of the Efficient Market Hypothesis, conclude, at the end of their paper, that the *exchange holiday variances suggest that private information cause most stock price changes. WOW!*

37. In the Seventh Mystery, we will find a stronger relationship between the returns on small stocks and changes in the magnitude of the closed-end investment company discounts.
38. A. Makhija, and R. Nachtmann, 1989, "Empirical Evidence on Alternative Theories of Stock Return Variances: The Effect of Expanded Trading Time on NYSE-LSE Cross-listed Stocks," unpublished manuscript, University of Pittsburgh.
39. Firms are included in the study if there are no missing rates of return for the 400 trading days surrounding the cross-listing and if the firm does not merge with another during this period.
40. Firm sizes were computed as of the date of the cross-listing admission to the LSE.
41. During the period of their study, the LSE was open from 4:30 A.M. to 10:30 A.M., EST, and the NYSE was open from 9:30 A.M. to 3:30 P.M., EST.
42. For the average, the increase in the daily variance is consistent with an increase in the annualized volatility from 36% to 41%.
43. Wilcoxon Z matched-pair tests provide strong support for the hypothesis that the distribution of the variance after cross-listing is fundamentally different from the distribution before cross-listing. No contraindicative inferences from parametric findings were observed.
44. The average changes in the variances of the 30 stocks in the Dow Jones Industrial Average are netted from the changes in the cross-listed stocks, matched in calendar time.
45. Interestingly, Makhija and Nachtmann find no significant increase in the market beta factors (the sensitivity of individual stock return to market return). The significant increases come from increases in the fraction of the stock's variance that is unexplained by the market—the stock's so-called residual variance. This makes sense because, if the increases in variance are created by additional pricing errors being made by London traders, these errors are being made during time periods when the U.S. market index isn't visibly moving. The U.S. market is closed during these periods—reducing the possibility that London traders are reacting to contemporary moves in the U.S. stock index. Indeed, they may be, instead, reacting to changes in the UK stock index.

46. French and Roll offer the Preposterous Private Information Hypothesis as a possible explanation, for why the variance is anywhere from 13 to 100 times larger when the exchange is open than when it is closed. They argue that traders are more apt to look for private information when open because they can act on it more quickly. I must say, after working with, interviewing, lecturing, and talking to money managers for more than 21 years, that I have never seen anyone behaving in this manner.
47. I'm using months and years because a year unambiguously spans 12 times more time than an average month. Stock returns actually exhibit reversal patterns in the short term (1 to 2 months), inertial patterns in the intermediate term (6 to 12 months), and reversal patterns over the long term (3 to 5 years). Makhija and Nachtmann conduct their tests of variance ratios over the short term, where reversal patterns tend to be present.
48. There was 1 hour of overlap in the 6 hours of trading in New York and London.
49. S. Kaplan and J. Stein, 1990, "How Risky Is the Debt in Highly Leveraged Transactions?" *Journal of Financial Economics*, pp. 215–245.
50. *Ibid.*, pp. 217 and 218.
51. This is approximately equal to the beta on Treasury bonds over their sample period.
52. Fixed costs are those that should not be expected to change in the short term with changes in the level of the firm's production. Thus, executives, salaries would be considered to be a fixed cost and raw materials used in production would be considered a variable cost. If the recaps have the effect of reducing variable costs instead of fixed costs, then the risk of the firms should actually be expected to go *up*.
53. The pre-recap asset betas are adjusted downward by KS, based on the assumption that all of the increase in the market value of the firm, net of the corresponding increase in the market index, from 40 days before the recap announcement until the capitalization is complete, is attributable to a reduction in fixed costs, which would reduce the beta associated with the assets of the firms proportionately.
54. Systematic risk is that part of a securities volatility that is contributed to a well-diversified portfolio of which it is a member. The security's beta factor is a measure of that contribution.
55. The implicit betas displayed in Table 1.11 are for the marketable bonds issued by each firm. In calculating these betas, bank debt is assumed to have half the systematic risk of the marketable bonds.
56. As with the cases of reducing and extending the length of the trading day, the evidence is always more convincing if it can be shown that the effects work consistently in both directions. Kaplan and Stein show that increasing debt has the effect of *reducing* firm risk. Does increasing equity have the effect of *increasing* firm risk? Healy and Palepu find that company risk (again measured by beta) tends to increase after a primary issue of common stock. See P. Healy and K. Palepu, 1990, "Earnings and Risk Changes Surrounding Primary Stock Offers," *Journal of Accounting Research*, pp. 25–48.
57. See B. Malkiel, 1977, "The Valuation of Closed-End Investment Company Shares," *Journal of Finance*, pp. 847–859.
58. C. Lee, A. Shleifer, and R. Thaler, 1991, "Investor Sentiment and the Closed-End Fund Puzzle," *Journal of Finance*, pp. 75–109.
59. Oddly, Lee, Shleifer, and Thaler never fully explain why the discount, which they claim to be a manifestation of a risk premium, would serve as a barometer of investor optimism or pessimism. In this sense, they get the story only half right.

60. Some may argue that Lee, Shleifer, and Thaler get this result because closed-end investment companies tend to invest in small stocks. They argue that, if anything, the contrary is true. To show this, they perform the analysis of Figure 1.11 using the discount on a single closed-end fund, Tricontinental Corporation, as their index of investor sentiment. The results of this test are basically the same in spite of the fact that Tricontinental invests only in large stocks.
61. Swaminathan finds that increases in closed-end discounts forecast low real growth rates in gross domestic product, consumption, and after-tax corporate earnings. He indicates that this may mean that the discounts stem from something rational as opposed to investor sentiment. However, Bittlingmayer finds a negative relationship between volatility and economic growth. It may well be that increases in volatility increase the size of the discounts in the shorter term and slow down economic growth in the longer term. See B. Swaminathan, 1996, "Time-Varying Expected Small Firm Returns and Closed-End Fund Discounts," *Review of Financial Studies*, Fall, pp. 845–888. See also G. Bittlingmayer, "Output, Stock Volatility, and Political Uncertainty in a Natural Experiment: Germany, 1880–1940," working paper, Graduate School of Management, University of California, Davis, April 1997.