

## **Why Stock Return Volatility Really Matters**

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## Why Stock Return Volatility Really Matters

*"...It is fully as important to the stockholders that they be able to obtain a fair price for their shares as it is that dividends, earnings and assets be conserved or increased. It follows that the responsibility of management...includes the obligation to prevent...the establishment of either absurdly high or unduly low prices for their securities."*

*Graham and Dodd, Security Analysis, 1951.*

Investor relations (IR) management is concerned with the flow of information between the firm and its management and the firm's shareholders. As firms are complex organizations of strategies, plans, commitments, personnel policies, competitive threats, managerial succession plans, as well as bundles of patents, products, research and development expertise and assets in place, the IR task is much broader than simply overseeing the disclosure of financial statement or other corporate information to investors or analysts by means of press releases, conference calls or annual general meetings. Rather, IR officers (IROs) bring to bear technical skill and expertise in understanding and interpreting issues that help to determine the intrinsic value of the firm.

Stock return volatility represents the variability of stock price changes during a period of time. Investors, analysts, brokers, dealers and regulators care about stock return volatility not just because it is perceived as a measure of risk, but because they worry about "excessive" volatility in which observed fluctuations in stock prices do not appear to be accompanied by any important news about the firm or market as a whole. The existence of excessive volatility, or "noise," undermines the usefulness of stock prices as a "signal" about the true intrinsic value of a firm, a concept that is core to the paradigm of the informational efficiency of markets. Volatility, of course, is not evidence of irrational

market behavior or inefficient markets, but IROs are often put into a position of rationalizing episodes of heightened volatility (i.e. lowering the noise-to-signal ratio) in their stock to management, analysts or shareholders. To understand what is a reasonable amount of volatility and what is not requires an understanding of how to measure volatility, what the macroeconomic or market-wide forces are driving stock return volatility over time, and what special firm characteristics are usually associated with higher or lower volatility. Bringing the latest wisdom from academic research in Finance on this subject is the objective of this article.

In the next section, I will describe the conventional approach to measuring stock return volatility and outline some of the newer statistical techniques for forecasting volatility. I will follow up with a brief survey of the key stylized facts about patterns in stock return volatility over time and across stocks, some of which is based on newest research evidence in Finance. In the conclusion, I will remind readers what it is about stock return volatility that is so important for IROs and boldly offer some prescriptive advice on how deal with market environments of unusual or unexplainable volatility in their stock.

### **Measurement Issues: Perception versus Reality**

One of the reasons for recent interest in stock return volatility is the historically high level of the Dow Jones Industrial Average and Standard and Poor 500 stock market indexes, notwithstanding the 19 percent “millennial correction” this past calendar year. While many of the largest one-month swings in the level of these indexes have occurred over the past few years (in fact, 24 of the largest 25 one-month changes in the S&P 500

have occurred since November 1996), it is a somewhat illusory result as only one (August 1998) of the largest 25 one-month percentage changes has occurred since 1990. The fact is that there appears to be *no significant trend* toward higher stock market volatility; in fact, stock market volatility may have declined over the last decade.

To see this feature, Figure 1 presents a time series plot since 1926 of annual measures of stock return volatility from monthly returns of the Standard and Poor's 500 stock index and Ibbotson's Small Stock Index (Ibbotson Data Center Version 8.0, 2000, is the source for the data – [www.ibbotson.com](http://www.ibbotson.com)). The conventional estimator of annual volatility computes the sum of squared deviations of returns from the average monthly return during the year; however, in the figure, we display an improved estimator of annual volatility from French, Schwert and Stambaugh (1987) and Schwert (1990) which includes the sum of squared monthly returns plus twice the cross-covariance in monthly returns (to control for autocorrelation in monthly returns).<sup>1</sup> It is clear from the plot that S&P 500 stock return volatility has rarely exceeded 40 percent in a given year and has typically remained just under 20 percent per year since the 1940s. An exceptional burst of volatility is evident in the early 1930s during the period of the Great Depression. In 1933 and 1934, S&P 500 volatility exceeded 80 percent. The patterns are similar for Ibbotson's small stock index though the average level of volatility per year is considerably higher at about 30 percent per year. During 1934, small stock volatility exceeded 120 percent.

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<sup>1</sup> Mathematically, the improved estimator for year  $t$  is written as  $\sigma_t^2 = \sum_n^N (r_n - \mu)^2 + 2 \sum_n^{N-1} (r_n - \mu)(r_{n+1} - \mu)$ , where  $r_n$  is the return in month  $n$  of year  $t$  ( $N$  equals 12 for months per year),  $\mu$  is average return across  $N$  months in year  $t$ , and  $\sum_n^N$  is a symbol for summation of elements from  $n$  equals 1, 2, ...,  $N$ . See K. French, G. W. Schwert and R. Stambaugh, 1987, Expected stock returns and volatility, *Journal of Financial Economics* 19 (3-29) and G. W. Schwert, 1990, Why does stock market volatility change over time? *Journal of Finance* 44 (1115-1151).

Figure 2 repeats the sample computations using (1) above but for monthly estimates of stock return volatility from daily returns for the S&P 500 and IBM stock. The data runs from January 1981 through 1999 and is from the Center for Research in Security Prices at the University of Chicago. The application of the estimator for monthly measures of volatility computed from daily returns is identical to that for annual measures from monthly returns, except the number of days and daily squared returns (and cross-covariances) changes per month. The figure shows that monthly S&P 500 volatility has remained steady at 5 percent (which is about 18 percent annualized) except for the October 1987 market crash in which volatility soared to 24 percent. The monthly volatility of IBM is modestly higher than that of the S&P 500 for most of the sample, reflecting the power of diversification, but during the 1990s there is a shift toward higher volatility and greater amplitude in the monthly volatility (“volatility of volatility”) in IBM stock. Is this an artifact of IBM or individual stocks, in general? We will return to this issue.

Table 1 presents summary statistics including means, standard deviations, skewness and kurtosis coefficients and autocorrelations of the estimates of annual and monthly stock return volatility for the S&P 500, Ibbotson small stock indexes and IBM. It is clear that the average volatility and ‘volatility of volatility’ go together, especially comparing the small stock index and S&P 500 for annual estimates and IBM and the S&P 500 for monthly estimates. Moreover, there is both significant positive skewness, which is expected for a non-negative statistic like volatility, and kurtosis, which reveals “fatter tails” in returns than what we would expect for a Normal (“bell-curve”) distribution. The other remarkable feature of the summary statistics is the time-

dependence of year-to-year and month-to-month volatility estimates revealed in the autocorrelations (up to three lags). The first-lag autocorrelation of 0.459 for the S&P 500 annual estimators is large, positive and significant; those for the second and third lags are lower but still positive and significant. This phenomenon is known as “volatility clustering.” For years,<sup>2</sup> we have known that *volatility, unlike returns, is predictable*: a large price change this month is likely to be followed by a large price change next month. This dependence is a key element of a class of forecast models, known as Autoregressive Conditional Heteroscedastic (ARCH) developed by Engle (1982) and Bollerslev (1986), that have come to be very popular.<sup>3</sup> These models have been shown to work well in forecast experiments for stock index and individual stock return volatility, and have become commonplace in many statistical packages for Finance practitioners and researchers. But, being time series models, they are explicitly designed to do so and are often criticized because they shed little light on the economic forces underlying stock return volatility. What drives this forecastability in volatility is the real question – we return to this below, also.

Because many investors hold large, well-diversified portfolios of stocks, market-watchers, such as regulators and the media, are usually focused on aggregate stock market volatility. Asset pricing theory, typically learned with the Capital Asset Pricing

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<sup>2</sup> R. Officer, 1973, The variability of the market factor of New York Stock Exchange, *Journal of Business* 46 (434-453), E. Fama, 1976, *Foundations of Finance*, Basic Books (Chapter 1 and 2), R. Merton, 1980, On estimating the expected return on the market: An exploratory investigation, *Journal of Financial Economics* 8 (323-361).

<sup>3</sup> Mathematically, these models in their generalized form propose, say, for forecasts of monthly return volatilities that  $\sigma_t^2 = \alpha_0 + \beta \sigma_{t-1}^2 + \alpha_1 (r_{t-1} - \mu)^2$ , where  $\alpha_0, \alpha_1, \beta$  are parameters with specific values for stock or stock index returns. See R. Engle, 1982, Autoregressive conditional heteroscedasticity with estimates of the variance of U.K. inflation, *Econometrica* 50 (987-1008) and T. Bollerslev, 1986, Generalized autoregressive conditional heteroscedasticity, *Journal of Econometrics* 31 (307-327). A. Pagan, 1996, The econometrics of financial markets, *Journal of Empirical Finance* 3 (15-102) provides a nice survey of these and other forecast models of volatility.

Model (CAPM), has taught us that only the market risk component (also known as “covariance” or “beta” risk) of a stock is the component of individual firm volatility that matters for pricing and returns. The theory guides us to decompose total individual stock return volatility into its components due to its relationship with the market, often captured by returns on the S&P 500 index, and the residual, or “firm specific” risk that is unrelated to the market.<sup>4</sup> In fact, there has been remarkably little research on the components of stock return volatility over time. However, a new study by Campbell, Lettau, Malkiel and Xu (2001) has shown that, while overall volatility of markets and stocks have been stable over the last thirty years, there has been a noticeable *increase in the firm-specific risk* component of individual stock returns.<sup>5</sup> In fact, they show that this component has more than doubled in importance between 1962 and 1997 for most individual stocks in U.S. markets. Figure 3 shows just such trend for IBM stock between 1981 and 1999. In this figure, I compute the total monthly stock return variance for IBM stock from daily returns and the associated market and firm-specific risk components (using a regression model using the daily returns over that trailing month). The figure shows the overall volatility of IBM, as in Figure 2, but just about 1990, the proportion of firm-specific risk increases from about 48 percent (1981 – 1989) to 73 percent (1990 – 1999).

We now have a clear point-of-departure for our discussion about why stock return volatility matters. Here are a few “truths.” First, we know that stock return volatility is predictable from year-to-year and month-to-month and models of stock return volatility

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<sup>4</sup> Mathematically, the returns on stock  $i$  in month  $t$ ,  $r_{it}$ , linearly depend on the returns on the market in that month,  $r_{mt}$ .  $r_{it} = \alpha_i + \beta_i r_{mt} + \varepsilon_{it}$ . The standard deviation of the returns on that stock can then be written as,  $\sigma_i^2 = \beta_i^2 \sigma_m^2 + \sigma_\varepsilon^2$ , where  $\beta_i^2 \sigma_m^2$  is the market risk component and  $\sigma_\varepsilon^2$  is the firm-specific risk component. See Chapter 9 of Z. Bodie, A. Kane and A. Marcus, 1999, *Investments*, (Fourth edition, Irwin McGraw-Hill Publishers) for background on the decomposition with the single-index model of stock returns.

<sup>5</sup> See J. Campbell, M. Lettau, B. Malkiel and Y. Xu, 2001, *Have individual stocks become more volatile? An exploratory investigation of idiosyncratic risk*, *Journal of Finance*, forthcoming.

now capture this fact. Second, while it may be the market's perception that volatility has increased in recent decades, the reality is that it has not and, in fact, may have declined. Finally, there is new evidence that firm-specific risk has grown dramatically as a proportion of total stock return volatility of individual stocks.

### **Why Does Stock Market Volatility Change Over Time?**

While academic research has hardly developed any kind of consensus model of volatility, how it changes over time and the fundamental economic forces guiding it, there is a scatter of puzzle pieces. We call these puzzle pieces “stylized facts” and they arise from a variety of research studies new and old.

#### *Stylized Fact #1: Macroeconomics Factors Cannot Explain Stock Return Volatility*

Shiller (1981) argued in a seminal study that the level of stock market volatility is too high relative to the variability of dividends, a key element of valuation using a discounted cash-flow model. He showed that S&P 500 index was several times more volatile than the “bounds of rationality” measured by the average fluctuations of inflation-adjusted earnings- or dividends-per share from 1900 through the 1970s. These tests came to be known as “variance-bounds” tests and challenged efficient markets orthodoxy. These tests were, of course, subject to numerous methodological and other substantive criticisms from Flavin (1983), Kleidon (1983) and others.<sup>6</sup>

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<sup>6</sup> See R. Shiller, 1981, Do stock market prices move too much to be justified by subsequent changes in dividends? *American Economic Review* 71 (421-436), M. Flavin, 1983, Excess volatility in financial markets: A reassessment of the empirical evidence, *Journal of Political Economy* 91, (929-956) and A. Kleidon, 1986, Bias in small-sample tests of stock price rationality, *Journal of Business* 59 (237-261). R. Haugen, 1999, *Beast on Wall Street: How Stock Volatility Devours our Wealth* (Prentice Hall, New Jersey) offers an entertaining survey of this debate.



In addition to an active debate about research strategy, however, this line of questioning spawned new studies of how stock market volatility changes over time. Schwert (1990) hypothesized that, though stock return volatility did not stem from innovations in dividends or discount rates, it may be proportional to the volatility of expected future cash flows revealed in macroeconomic factors like inflation, industrial production, money growth, unemployment and other measures of economic activity (like the 1930s in Figure 1). He employed a Vector Autoregression (VAR) model with monthly stock and bond market volatility series from 1885 to 1987 and found surprisingly only weak evidence (less than 2 percent of total variation, his Table XII) of any forecast power from macroeconomic factors, though financial market variables (e.g. interest rates, term and default yield spreads) were more successful. While he is hesitant to cede all the unexplained behavior in stock market volatility to social psychology as evidence of fads or bubbles, he acknowledged in a paper for the ten-year anniversary of the 1987 market crash that little progress has been made even in the decade since.<sup>7</sup>

*Stylized Fact #2: Trading Drives Stock Market Volatility*

Researchers have long established an empirical relationship between trading volume and stock return volatility. The premise underlying theoretical and empirical models is that price movements are caused by the arrival of new information and by the process that incorporates new information into market prices.<sup>8</sup> Some of the news is public

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<sup>7</sup> G. W. Schwert, 1998, Stock market volatility: Ten years after the crash, working paper, Brookings-Wharton Conference on the Tenth Anniversary of the Crash.

<sup>8</sup> See the seminal studies by P. Clark, 1973, A subordinated stochastic process model with finite variance for speculative prices, *Econometrica* 41 (135-155) and G. Taughen and M. Pitts, 1983, The price variability-volume relationship on speculative markets, *Econometrica* 51 (485-505). T. Andersen, 1984, Return volatility and trading volume: An information flow interpretation of stochastic volatility develops a new model, but also provides a nice survey of the literature.

(e.g. unemployment statistics, earnings announcements), but most of the news is private (including interpretations of the public information) and this latter type of event motivates trade in response to the arrival of new information. Empirical work with intraday, transactions-based data has shown systematic patterns in the relationship between stock return volatility and trading volume, the number of transactions, the bid-ask spread, or market liquidity, in general. As a result, a whole new branch of Finance, “market microstructure,” has been spawned by these theories and the evidence. The challenge of this field, however, is that the specification of the process is still ad hoc. That is, one can only show an association between stock return volatility and trading activity and not that one *drives* the other. We can guess that the same underlying factors generate both volatility and volume, but what those factors are and how many are at work is still largely unresolved.

*Stylized Fact #3: Stock Return Volatility is Asymmetric*

Stock return volatility rises more following stock price declines (“bad news”) than following stock price increases (“good news”). There are a host of popular explanations for this well-known “asymmetry” in stock return volatility. The “leverage effect” posits that a firm’s stock price decline raises the firm’s financial leverage, resulting in an increase in the volatility of equity.<sup>9</sup> Others have suggested that this negative relationship between returns and return volatility stems from natural time-variation in the risk premium on stock returns. That is, an unexpected increase in volatility today leads to

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<sup>9</sup> See F. Black, 1976, Studies of stock price volatility changes, Proceedings of the American Statistical Association Annual Meetings, Business and Economics Section, Washington DC (177-181) and A. Christie, 1982, The stochastic behavior of stock return variances: Value, leverage and interest rate effects, Journal of Financial Economics 10 (407-432).

upward revisions by market participants of future expected volatility and, therefore, upward revisions of the risk premium, which compensates them for greater risk. But, a higher risk premium leads to a greater discounting of future expected cash flows (holding those cash flows constant) and, therefore, lower stock prices or negative returns today.<sup>10</sup>

While these explanations are popular, the empirical evidence to support them has been limited in scope and two relatively new studies have suggested that these perspectives may be biased by the fact that they focus on aggregate market returns and not those of individual stocks.<sup>11</sup> Duffee (1995) explicitly studies stock returns and volatility of individual firms and finds that the negative relationship between changes in stock return variances and stock returns stems from the fact that the relationship between volatility today and returns today is actually strongly positive, but that between volatility tomorrow and returns today is negative. He finds this regularity for large and small capitalization firms and similar for firms with little and high financial leverage. In addition to de-bunking the leverage and risk premium hypotheses for the asymmetric effect in volatility, he offers another related to the option properties of growth opportunities, rather than assets in place, for a firm. In other words, growth opportunities are “real options” on future cash flows from assets in place and firms with greater volatility would have more valuable growth opportunities and higher equity value. A newer study by Shin and Stulz (2000) also performs a firm-level analysis but they decompose risk into its market and firm-specific components. They show that changes in market risk are positively correlated with changes in firm value, but changes in firm-

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<sup>10</sup> See R. Pindyk, 1984, Risk, inflation and the stock market, *American Economic Review* 74 (334-351) and French, Schwert and Stambaugh, 1987, *ibid*.

specific risk are negatively correlated with changes firm value, and this new regularity applies mostly to small firms and equally for low- and highly-leveraged firms. They suggest that this finding is not consistent with Duffee's "growth option" theory and appeal to capital structure and risk management theories that relate to the ease of access to capital markets (especially for large firms) and of economies of scale in setting up risk management programs.

*Stylized Fact #4: Contagion Versus Volatility "Spillovers" Across International Markets*

An important and often overlooked fact about the Market Crash of October 19, 1987 was the fact that it was simultaneous and similar in major stock markets around the world.<sup>12</sup> This event led to a number of studies of commonalities in stock market volatility patterns globally and, more specifically, on their joint dynamics. That is, various studies had uncovered that increases in volatility in some markets, such as the U.S., led increases in volatility in other markets, such as in Japan, Europe and Latin America, by one day or even up to one month.<sup>13</sup> These dynamic patterns came to be known as "volatility spillovers." While some researchers were able to document regularities in these patterns, such as larger volatility spillovers following large, negative returns compared to large, positive returns,<sup>14</sup> most were unable to find any fundamental or macroeconomic news

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<sup>11</sup> See G. Duffee, 1995, Stock returns and volatility: A firm-level analysis, *Journal of Financial Economics* 37 (399-420) and H. Shin and R. Stulz, 2000, Firm value, risk and growth opportunities, 2001, Dice Center Working Paper, Ohio State University (WP 2000-8).

<sup>12</sup> One of the earliest studies to point out this fact is R. Roll, 1988, The international crash of October 1987, *Financial Analyst Journal* 44 (September, 19-45).

<sup>13</sup> Important contributions include M. King and S. Wadhvani, 1990, Transmissions of volatility between stock markets, *Review of Financial Studies* 3 (3-33) and Y. Hamao, R. Masulis and V. Ng, 1990, Correlations in price changes and volatility across international stock markets, *Review of Financial Studies* 3 (281-308).

<sup>14</sup> See K.H. Bae and G.A. Karolyi, 1994, Good news, bad news and international spillovers of stock return volatility between Japan and the U.S., *Pacific Basin Finance Journal* 2 (405-438), F. Longin and B. Solnik,

that could explain volatility spillovers. In addition to fundamental factors, some have examined whether these spillovers exist because of institutional factors, such as the number of stocks that are cross-listed across major international markets, the scope of closed-end country funds, international portfolio flows and even margin regulations across markets. This dearth of evidence, coupled with the resurgence of dramatic volatility spillovers surrounding the events of the Asian financial crisis in 1997 and Russian crisis in 1998, prompted a number of researchers to cite irrationality or “contagion” effects as the only remaining explanation.<sup>15</sup>

*Stylized Fact #5: Derivatives Do Not Exacerbate Volatility*

There has been much research on the question of whether trading in options and futures cause increases in stock return volatility. The so-called “triple witching days” when contracts on options, futures and options on futures simultaneously expire are often claimed to be associated with unusual bursts of volatility. While the financial media still cite traders concerns about this hypothetical relationship, academic research has delivered a remarkably consistent message: derivatives do not exacerbate volatility. Edwards (1988) was one of the early studies to show that stock market volatility has not increased since the advent of trading in stock index options and futures in the early 1980s (see Figure 1). His and another study by Stoll and Whaley (1987) also showed that volatility of individual stocks that comprise indexes on which futures and options contracts are written did not experience any unusual increase around triple-witching expiration days

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1995, Is the correlation in international equity returns constant? *Journal of International Money and Finance* 14 (3-23), and G. A. Karolyi and R. Stulz, 1996, Why do markets move together? An investigation of U.S.-Japan stock return comovements, *Journal of Finance* 51 (951-986).

compared to non-expiration days and compared to stocks not included in the indexes. Stoll and Whaley's (1991) follow-up study on the impact of changes in the settlement procedures in June 1987 showed that the "market appears to have adjusted reasonably well to expirations of index futures and options." Karolyi (1996) showed a similar "much ado about almost nothing" for Japanese market volatility when the Ministry of Finance in Tokyo and the Singapore International Monetary Exchange (SIMEX) changed their expiration procedures.<sup>16</sup>

### **Why Stock Return Volatility Matters**

Perspectives on academic research can be likened to the metaphor about the glass of water. The optimist who sees the half-full glass remarks on the progress researchers have made and the pessimist focuses on the half-empty glass and the remarkable number of unanswered questions. Our understanding about stock return volatility is no different. It is not clear whether the part that we know is greater or smaller than the part that we do not know. Personally, I prefer the perspective of the optimist, but I like the challenge of the pessimist. I would like to summarize the main points of the article and share some final thoughts on why and how what we know about stock return volatility matters, especially for IROs.

There is a common understanding about how to measure stock return volatility. There are also a number of regularities that we agree on. We know that stock return

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<sup>15</sup> For a comprehensive survey of this literature, see K.H. Bae, G. A. Karolyi and R. Stulz, 2001, A new approach to measuring international financial contagion, NBER working paper 7913, Cambridge, MA.

<sup>16</sup> See F. Edwards, 1988, Does futures trading increase stock return volatility, *Financial Analyst Journal* 44 (February, 63-69), H. Stoll and R. Whaley, 1987, Program trading and expiration day effects, *Financial Analyst Journal* 43 (April, 16-28), H. Stoll and R. Whaley, 1991, Expiration day effects: What has changed?, *Financial Analyst Journal* 47 (58-72), and G. A. Karolyi, 1996, Stock market volatility around expiration days in Japan, *Journal of Derivatives* 4 (Winter, 23-44).

volatility varies over time, but that it is not increasing in recent years, as many market participants may have perceived. Stock return volatility is predictable and asymmetric in its response to past negative price shocks compared to past positive price shocks, but what and even how many fundamental factors drive volatility over time is not clear. We know that these forces are likely global in nature, that volatility moves in sympathy with trading activity in the primary market, but not with events in the derivatives markets. Finally, we have newer evidence that decomposing individual stock return volatility is important, as researchers have noted that firm-specific risk as a fraction of total return volatility is growing over time. Moreover, increases in firm-specific risk appear to affect adversely stock valuation.

The opening quote from Graham and Dodd (1934) implicates management for “absurdly high or unduly low” prices in their stock. The concern about unusual levels of volatility in the stock price of a firm stems from the fact that stock price under those circumstances no longer plays its role as a “signal” about the true intrinsic value of a firm. The first, and most important, contribution of this article lies in helping to define a benchmark for IROs on what is a reasonable level of stock return volatility and what is not. A critical component of this message is that there are common forces at work in volatility across stocks, that some of these forces are more important in certain market conditions than others. Most importantly, the component unique to the firm, “firm-specific risk,” is what IROs and management should keep their eyes on.

What can IROs do about the potentially adverse stock price impact of an increase in the firm-specific risk component of stock volatility? One prescription is associated with the richness of the information environment for the stock. Robert Merton’s

Presidential Address to the American Finance Association in 1987 spelled out a new framework that extended the traditional world of asset pricing of the CAPM to one in which investors would consider only securities about which they were aware, an assumption about incomplete markets.<sup>17</sup> With this assumption, Merton showed that expected returns depended on factors other than just market risk and, specifically, included compensation for the “shadow cost” of incomplete information which related to the relative market value of the firm, its firm-specific risk and the size of the firm’s investor base relative to the total number of investors. Since investors consider only part of the opportunity set of stocks available, firm-specific risk adversely affects stock prices, and, even more importantly, this penalty is magnified for relatively smaller firms and those that have a narrower shareholder base.<sup>18</sup> The message? IROs may not necessarily be able pro-actively to achieve lower market risk, let alone firm-specific risk, but they can take an active role in limiting its adverse consequences for share prices by ensuring the richness of the information environment for their stock and by maximizing the investor participation.

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<sup>17</sup> See R. Merton, 1987, Presidential address: A simple model of capital market equilibrium with incomplete information, *Journal of Finance* 42 (483-510)

<sup>18</sup> A number of studies have offered empirical validation for this paradigm. See evidence from companies listing on NYSE from Nasdaq in G. Kadlec and J. McConnell, 1994, The effect of market segmentation and illiquidity on asset prices: Evidence from exchange listings, *Journal of Finance* 49 (611-636) and, for international markets, S. Foerster and G. A. Karolyi, 1999, The effects of market segmentation and investor recognition on asset prices: Evidence from foreign stocks listing in the United States, *Journal of Finance* 54 (981-1013).



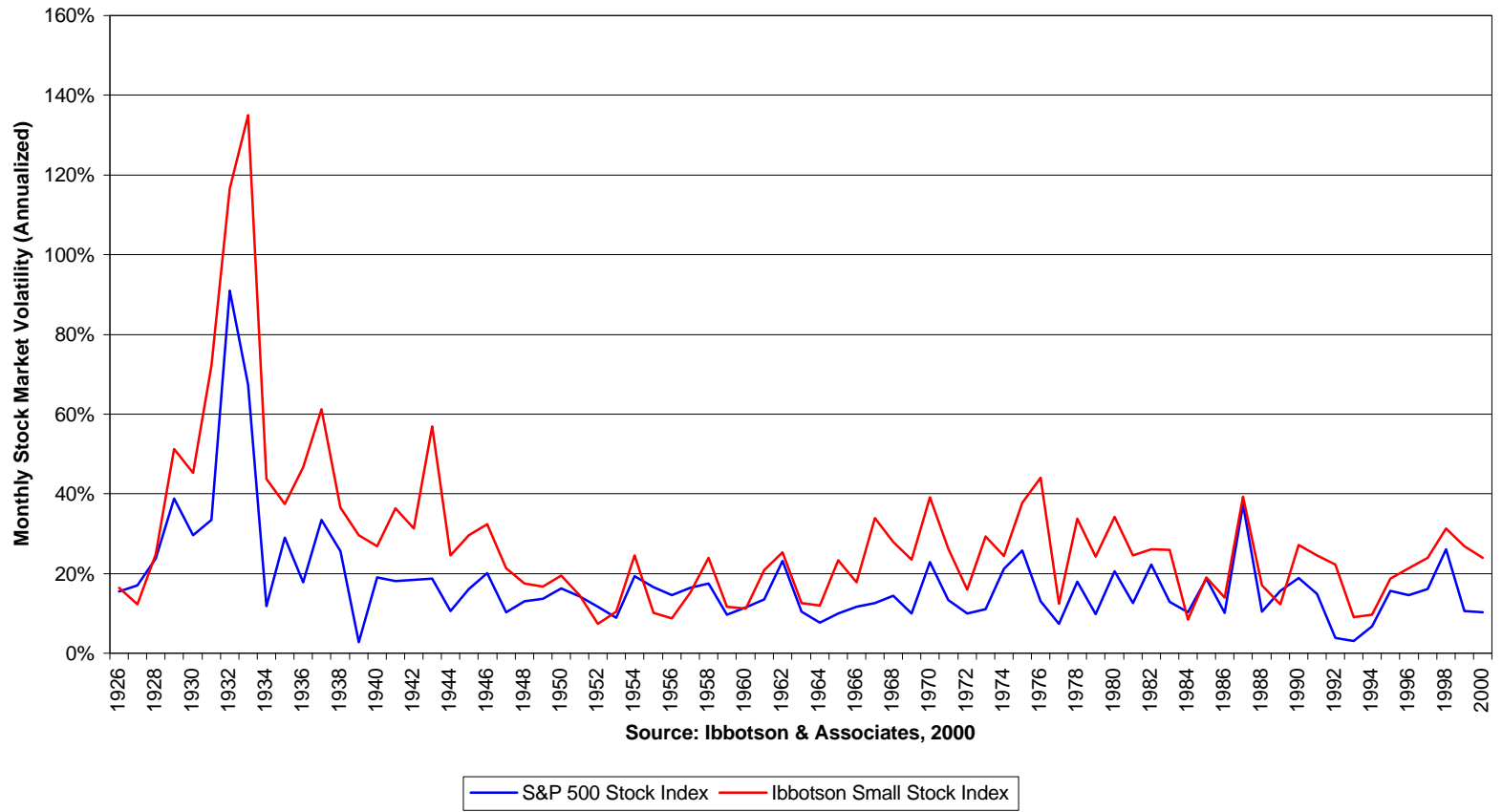
**Table 1**

Summary Statistics of Annual and Monthly Estimates of Stock Return Volatility

	S&P 500 Stocks Annual 1926-2000	Ibbotson Small Stocks Annual 1926-2000	S&P 500 Stocks Monthly 1981-1999	IBM Monthly 1981-1999
Average	17.72%	28.31%	4.12%	6.95%
Standard Deviation	12.71%	20.72%	2.14%	3.20%
Minimum	2.84%	7.37%	0.96%	1.14%
Median	14.85%	24.49%	3.82%	6.21%
Maximum	90.90%	134.97%	27.41%	23.98%
Skewness	3.532	3.090	5.508	1.684
Kurtosis	16.770	12.621	55.557	4.823
Autocorrelations:				
First lag	0.459	0.658	0.377	0.395
Second lag	0.216	0.419	0.337	0.248
Third lag	0.277	0.336	0.291	0.274

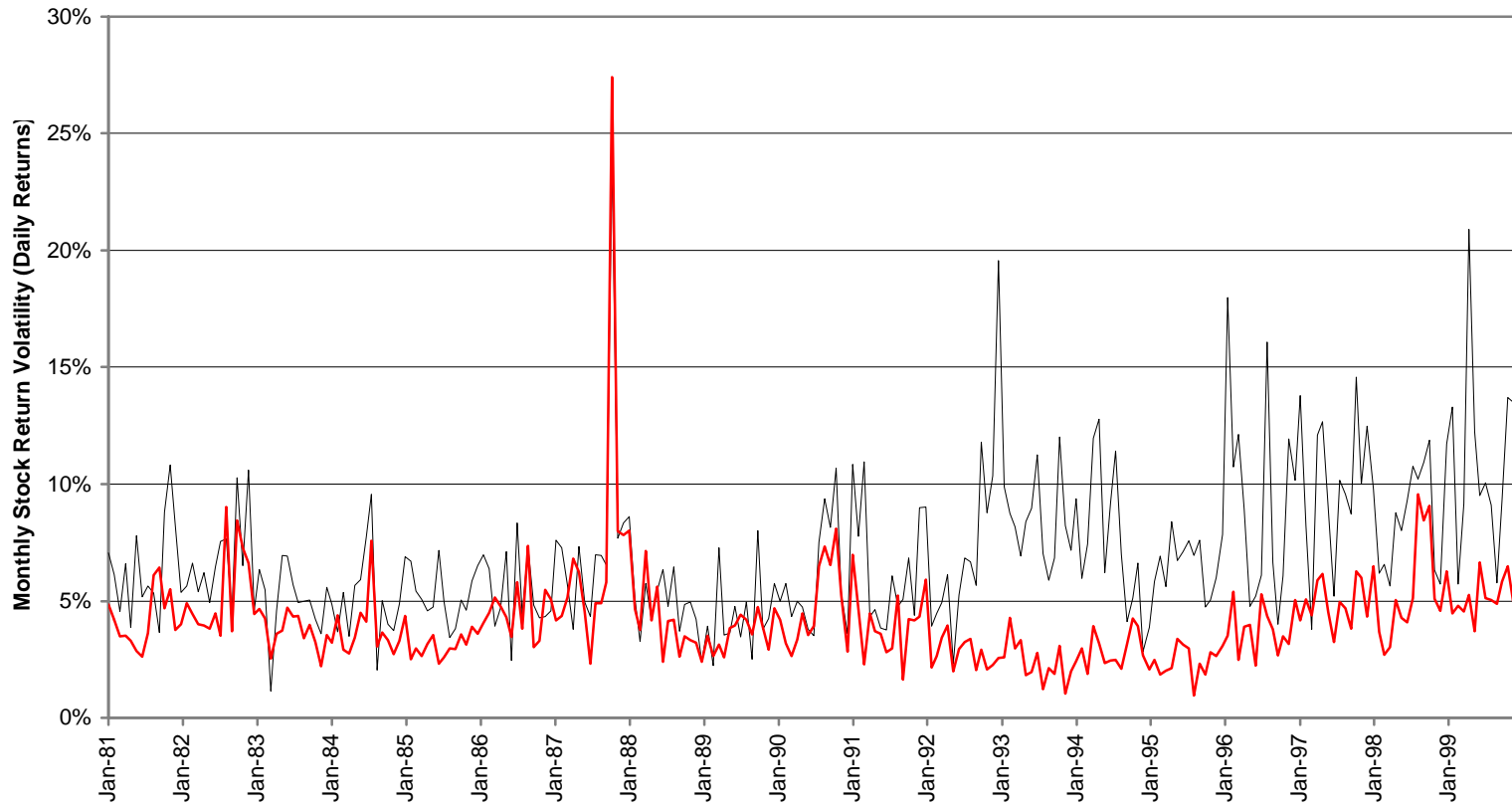
**Figure 1**

**Annual Stock Market Volatility, 1926-2000**



**Figure 2**

**Monthly Stock Market Volatility, 1981-1999**

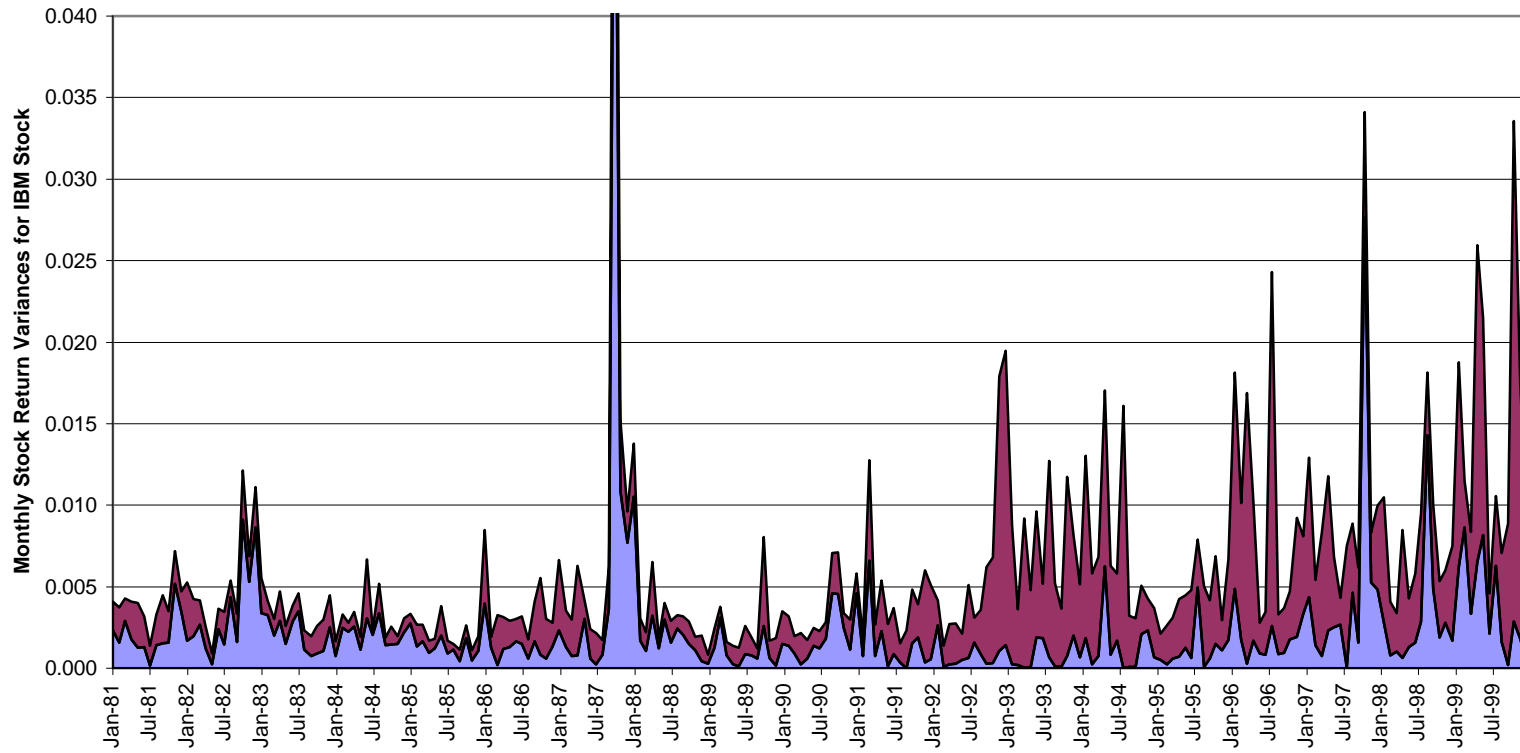


Source: Center for Research in Security Prices, 2000

— IBM — S&P 500 Stock Index

**Figure 3**

**Decomposing Stock Return Volatility - Daily Returns for IBM Stock, 1981-1999**



Source: Center for Research in Security Prices

Market Risk Component Firm Specific Risk Component

