Stock market volatility: from empirical data to their interpretation

Marie-Hélène Grouard, Sébastien Lévy, Catherine Lubochinsky
Directorate General Operations
Directorate General Economics and International Relations
Market and Financial Stability Research Division

Wide swings in stock market prices in both Europe and the United States in recent years have revived the financial community's interest in the concept of volatility. Even though investors frequently use the volatility of equity returns as an instrument for measuring risk, estimating volatility still raises problems and caution should be applied when interpreting it. However, an analysis of various available volatility indicators suggests that stock market volatility has shown an upward trend since 1997. This increase is most noticeable for technology, media and telecommunications stocks. Yet, when seen in the very long-term perspective, the current level of stock market volatility does not seem unusual or even extraordinarily high.

Recent volatility patterns stem primarily from the lasting and substantial decline in stock prices from the highs reached in 2000, a large number of shocks affecting the financial economy, heightened uncertainty about geopolitical and macroeconomic developments and investors' growing doubts about the quality of financial assets against the background of weaker corporate capital structures. In addition to these cyclical factors, this article examines how the way markets work may also have an impact on volatility. In particular, it looks at how widely held beliefs, or the « market consensus », can create price misalignments, which then lead to corrections. This usually results in large changes in prices associated with a high level of volatility. Finally, it looks at the role of the market participants' operating environment, where there is a degree of uniformity in market risk management techniques and where institutional asset management is growing. This environment could in fact contribute to even greater uniformity in investors' behaviours and fuel a rising trend in volatility.

Financial asset prices have posted very wide swings in recent years. This pattern of impressive fluctuations has revived interest in market volatility amongst academics, market practitioners and regulatory and supervisory authorities. Investigation of these phenomena is warranted since market shocks can have an impact on financial stability and have repercussions in the real economy. Yet, price fluctuations are inherent in the very existence of markets, each participant incurring the risk of making a loss. The question that has been the focus of economic and financial literature for about 100 years now is whether it is possible to estimate this risk in theoretical and empirical terms. Much of the research in this field tends to assimilate the notion of risk to the volatility of returns.

After reviewing the ways in which the concept of volatility can be used to evaluate risk and the limitations of such an approach, the first section of this article will attempt to highlight the main trends and characteristics in recent patterns of historical volatility of stock market indices. Even though we can identify an increase in volatility over the recent period, which is mainly due to the market correction
under way since 2000, a longer-term view puts these volatility levels into perspective and shows that a wider-ranging investigation is necessary. The second section of the article analyses this increased volatility. It distinguishes between short-term explanatory factors and structural factors, such as the impact of innovations in investment products and fund management techniques.

1| Uncertainty, risk and volatility: from theory to empirical data

Ever since F. Knight's famous book was published in 1921, distinction between risk, which can be measured in terms of mathematical probabilities, and uncertainty, which cannot be measured, has been applied to many fields. In finance, for example, estimated asset price fluctuations are used to evaluate market risk and unforeseeable price swings are assumed to reflect uncertainty. Volatility of returns is the most widely used concept for representing risk. Historical volatility is used to analyse past or present prices and expected volatility (or the implied volatility derived from option prices) is used to predict future price changes. Under this approach, the only real problem for the various agents in the financial economy stems from unexpected volatility.

After a review of the reasons for using volatility as an instrument for evaluating risk, with the understanding that it is merely an approximation and that the perception of risk varies for different types of market participants, empirical observations show a recent increase in volatility on the main stock markets, albeit to different degrees in different industries. We also observe more frequent volatility peaks in the recent past. In a longer-term perspective, this paper highlights the persistence of high volatility levels.

1|1 A review of some concepts

Volatility as a proxy for risk

Under the assumption of a normal distribution of returns (i.e. stock prices follow a random walk process), which means that the distribution of returns is symmetrical, one can estimate the probabilities of potential gains or losses associated with each amount. This means the standard deviation of securities returns, which is called historical volatility and is usually calculated as a moving average, can be used as a risk indicator. The prices used for the calculations are usually the closing prices, but Parkinson (1980) suggests that
take two distributions: one that is normal (A) and one that is not (B). B may be a riskier distribution in terms of Value at Risk, because it is more leptokurtic. Yet, it may have a smaller standard deviation than that of distribution A, because the probabilities of returns in B are more centered around the mean. Yet, all of the risk models based on volatility measured by the standard deviation would show that B is less risky than A.

Box 1

**Formal presentation of the main concepts**

**Continuous return:**\[
    r_t = \ln \left( \frac{S_t}{S_{t-1}} \right)
\]

where \( S \): security price or portfolio value

\( \ln \): napierian logarithm

**Mean return:**\[
    \bar{r}_t = \frac{\sum_{t=1}^{n} r_t}{n}
\]

where \( n \): number of observations

If \( r_t \) is normally distributed with a mean \( \mu \) and a standard deviation \( \sigma \), then the expected arithmetic return is:

\[
    E(R_t) = e^{\mu + \frac{\sigma^2}{2}}
\]

**Standard deviation:**\[
    \sigma_r = \sqrt{\frac{n}{n-1} \sum_{t=1}^{n} (r_t - \bar{r})^2}
\]

Volatility is expressed as percent per year obtained by annualising the standard deviation.

**Semi-variance:**\[
    s\sigma_r^2 = \frac{n}{n-1} \sum_{t=1}^{n} (r_t - \bar{r})^2
\]

for any \( r_t \leq \bar{r} \) if we are interested in returns below the mean.

**Value at Risk:** \( \text{VaR}_q(X) = \) the probability \( q \) that the loss will exceed an amount \( X \) over a given period (\( 1-q \) that the loss does not exceed \( X \) over the given period). With a normal distribution, \( \text{VaR}_q = E(r_t) + Z_q \sigma_r \) where \( Z_q \) corresponds to the quantile associated with probability \( q \).

**Skewness** of the distribution (third moment) \( s = \frac{n}{(n-1)(n-2)} \sum_{t=1}^{n} \frac{(r_t - \bar{r})^3}{\sigma_r^3} \)

If the distribution is symmetrical (normal distribution), the skewness coefficient is equal to zero.

**Kurtosis** (thickness of distribution tails, fourth moment) \( k = \frac{n(n+1)}{(n-1)(n-2)(n-3)} \sum_{t=1}^{n} \frac{(r_t - \bar{r})^4}{\sigma_r^4} \)

A normal distribution has a kurtosis coefficient equal to 3. A coefficient greater than 3 indicates thick tails and the distribution is qualified as leptokurtic.
In illiquid markets, prices may not change over a certain period simply because no transactions take place. In this case, low volatility should not be interpreted as indicating low market risk. It should be seen as a sign of high liquidity risk instead. Furthermore, wide price fluctuations may be necessary in an illiquid market in order to match bid and offer transactions. In this case, the high price volatility is due to illiquidity and not to changes in the fundamental value of the assets. In other words, liquidity may be a critical factor for interpreting volatility.

Clearly, volatility analysis alone does not provide complete information about the market risk incurred by financial agents. Volatility is an approximate and biased indicator of risk, both in the case of empirical volatility calculated from past prices (historical volatility) and in the case of implied volatility derived from option prices.

In any case, volatility has to be estimated since it cannot be observed directly. Several models have been constructed to represent the dynamics of the volatility of returns and to attempt to forecast it. These models are very frequently autoregressive conditional heteroskedasticity (ARCH) models, which were introduced by Engle in 1982 and then extended by Bollerslev in 1986 with the Generalised ARCH (GARCH) model. These models introduced explicit modelling of the variance of returns. This variance follows a specific temporal process. Thus, given the historical information, the conditional distribution of returns is normal with a mean equal to zero and variance of $h_t$, which is a function of historical variance. This makes it possible to introduce a correlation between returns and thereby formally represent persistence phenomena (see Avouyi-Dovi et al., 2002). These models, which have limited predictive powers, do not fall within the scope of this article. The volatility measurement used here is therefore that of the historical standard deviation. But it is important to keep in mind the limits of this volatility indicator as an instrument for measuring the risk incurred by financial agents.

The problem is to reconcile the theoretical concepts of risk with risk estimates made by the investors who have adopted the notion of volatility.

Following Granger (2002), a typology of agents would make a distinction between:

- **Mathematicians**, who are interested in option pricing theory, using a continuous-time approach. The need to integrate price volatility forecast into option pricing led to thorough modelling of this forecasting and highlighted several characteristics, such as the decreasing term structure of volatility. Since volatility is the only non-observable component in an option price, reasoning directly in terms of volatility is the same as reasoning in terms of prices. Thus, “implied” volatility derived from traded option prices corresponds to the mean volatility expected by market participants;

- **Econometricians and empirical statisticians**. ARCH, GARCH and other models have revealed the phenomena of heteroskedasticity and volatility persistence (see 2.2 below). These approaches have also highlighted the limitations of the normally distributed returns assumption and thus the limitations of historical volatility for assessing market risk, as well as the mean reversion characteristic of volatility;

- **Economists** using uncertainty theory. They work on portfolio theory, on the benefits of diversification, through the distinction made between specific risk and systematic risk, and on the Capital Asset Pricing Model (CAPM), in which volatility plays a critical role in determining returns;

- **Fund managers and traders** ("market professionals"), whose objective is basically to maximise returns on their transactions (albeit with a different time horizon). For them, price predictability depends on volatility, or even the volatility of volatility. Their behaviour is sometimes cited as an explanatory factor of volatility (see 2.2 below). As for hedge funds, the diversity of their strategies makes it impossible to reach any conclusions about the impact of their behaviour on volatility. Nevertheless, it is widely agreed that their arbitrage strategies improve market efficiency and that their transactions improve market liquidity;

---

**Different perceptions of risk**

The diversity of financial agents (ranging from theoreticians to practitioners) concerned with the concept of volatility explains the diversity of the approaches used to deal with this concept and the debates surrounding it. All market participants have their own perception of risk (risk aversion function).
individual investors are typically concerned about falling prices, especially when their retirement pension depends on stock market investments. Individual investors are also more concerned about the volatility of specific securities than the volatility of stock market indices. These indices show less volatility when there is less correlation between securities.

This classification should be expanded to include prudential authorities and central banks, which are concerned about the potential impact of increased volatility on systemic risk and financial stability.

1|2 Empirical observations: volatility has shown a rising trend since 1997

A global phenomenon

There has been a sharp increase in stock market volatility in all western countries in the recent past. This followed a period in the first half of the nineteen-nineties, when volatility levels were very low. The movement began in the second half of the nineteen-nineties, as shown in the chart 1, which plots the annual historical volatility of some major stock market indices. After large increases between 1997 and 1999, volatility stabilised at a high level before resuming its upward trend in 2001. Annual historical volatility reached levels in excess of 15 to 20 percentage points above the mean estimated over 15 years. In 2002 and 2003, the annual historical volatility of the CAC index was greater than 38%, whereas monthly volatility occasionally hit 60% (see charts 1 and 2).

Equity returns in Japan are less correlated with those in US and European markets, primarily because Japan’s business cycle is not correlated with those of the United States or Europe.

Comparing volatility patterns in various industrialised countries reveals their similarity. All of the main stock market indices, whose correlation has increased over the last ten years, have shown fairly similar volatility patterns. Japan is the only country in this group where the volatility pattern is different from that in the industrialised countries.

Implied volatility analysis confirms the rising trend in stock market volatility. In the French market, implied volatility derived from CAC 40 option prices reached 60% on occasion in 2002 and 2003. An analysis of the differential between implied volatility and historical volatility seems to confirm an increase in investors’ uncertainty over the last six years. Implied volatility was several percentage points higher than historical volatility (an average of 2.5 percentage points between 1997 and 2003 in the case of the CAC 40). This widening of the differential indicates that investors expect volatility to increase in the future. On the other hand, when historical volatility increases sharply, the differential between implied and historical volatility usually turns negative, thus signalling that volatility is expected to return to more moderate levels. It is noteworthy that the decline in monthly historical volatility between September 2002 and March 2003 was not accompanied by a fall in implied volatility, which remained high, testifying to investors’ persistent uncertainties.
Differences in volatility levels between indices and industries

Even though volatility patterns look similar for all indices, substantial differences between the volatility levels of indices can be seen. The monthly historical volatility of the CAC 40 index stands at 20%, whereas that of the EuroStoxx and SP 500 indices stands at just under 16%. Such differences arise from combined factors linked to the indices composition. The main stock market indices usually include the largest market capitalisations on the national stock exchange, but their composition varies greatly. The number of companies included, the volatility of the individual stocks tracked and the degree of diversification, as shown by the covariances between the stocks tracked, can differ significantly.

Similarly, the volatility of stock prices in different industries can also vary substantially. The data from a broad European index (EuroStoxx) show that some industries like construction, food processing and utility, have registered very little volatility compared to other industries. Their stock prices have been less volatile than the index itself. On the other hand, technology stocks, telecommunications stocks and, to a lesser extent, media stocks posted historical volatility over the same period that was more than 10 percentage points greater than the volatility of the index (see chart 4).
Thus, after estimating volatility thresholds on the basis of the distribution of the monthly historical volatility of the SP 500 index over the last 50 years, a look at the recent period allows two comments:

- a sharp increase in the number of volatility peaks regardless of the thresholds chosen over 95% ¹. Thus, between 1997 and 2003, 6 out of the 7 years showed volatility peaks at high distribution thresholds (up to 98%). This is the first time that such a configuration has appeared in 50 years. Before that, volatility peaks were short-lived and spaced out;

- an increase in the duration of volatility peaks, so much so that some peaks could be called “volatility plateaus”. Historical volatility reached the 97% threshold in 2002 and stayed there for 73 days. The only time it was greater was in 1950.

¹ A “95% threshold” means that 95% of the observations in the sample are lower than the level selected. In the case of the SP 500, the 95%, 97%, 98% and 99% thresholds correspond to volatility levels over 20 days of 24.3%, 27.7%, 31.0% and 34.7% respectively.
during this period. Even though volatility peaks are more frequent and last longer, they are not as high. The intraday volatility observed in the recent past has never exceeded the levels seen during the stock market crash of 1987, when variations of 14% in a single day were seen. Since 1997, with the exception of 10% variations within a day seen during the Asian crisis, the largest variations between daily highs and lows range from 4% to 8%. In the current period, the salient fact is not the level of volatility during peaks, but the length of time over which volatility remains high.

**Chart 8**

Intraday variation in the FTSE index moving average and 6-month historical volatility

(vin %)

[Chart showing intraday variation and 6-month historical volatility]

**Is current stock market volatility exceptional from a long term perspective?**

If we look at a longer period of time, which is only possible for the United States, where available data stretch back to the beginning of the twentieth century, it seems difficult to conclude that historical volatility has reached an unusual level. Volatility levels in the recent past differ depending on the indicators used to measure them:

- a slightly different volatility indicator, the six-month average of absolute daily variations, reveals that the recent past appears exceptional compared to earlier episodes. The volatility level measured in this way in 2002 and 2003 was the highest observed in the United States in the last 75 years. It stood at more than 25%, which is slightly higher than the levels seen in 1987 and 1929. This seems to confirm that the current period is exceptional, not because of the extreme variations in stock prices, but because the variations are large and long lasting.

**Chart 9**

Annualised historical volatility of the SP 500 index

[Chart showing annualised historical volatility]

**Chart 10**

Annualised moving average of daily absolute variations of the SP 500 index

[Chart showing annualised moving averages]

NB: Data are not annualised.

Sources: Banque de France, Bloomberg
These two indicators offer different views of the same phenomenon. Using the standard deviation to calculate volatility tracks the average deviation of returns from the mean return for the period. If the daily variation in stock prices were 1% during the period, volatility would be equal to zero. Calculating volatility from the mean absolute returns is more in line with the intuitive "impression of volatility" produced through observation of market trends. Under this approach, if the daily variation in prices stands at 1% over the whole period, volatility would be equal to 1%.

2| Interpreting the recent volatility pattern

Do the rising trend of volatility and the more frequent volatility peaks stem from cyclical phenomena linked to the characteristics of the current period, with a sharp decline in stock prices, doubts about the criteria used for asset pricing and high levels of corporate debt? Or are they the result of structural factors, linked to the way capital markets operate, investors’ asset management techniques or even to financial instruments themselves?

Even though there seems to be an undeniable link between current volatility and current circumstances, we should still investigate whether the development of certain management techniques has had an impact on capital markets.

2|1 Analysis of the macro-financial environment has become more difficult

More frequent shocks and growing uncertainty

In an analytical framework where the price of financial assets is determined by discounting expected future dividends, prices change when new information arrives. Important news leads to major variations in prices and, ultimately, to an increase in volatility. The recent increase in volatility stems from a conjunction of phenomena that are specific to the recent past. These include:

- more frequent major shocks. The Asian crisis in 1997, the Russian crisis and its impact on emerging economies in 1998 (Brazil), the crisis of the LTCM hedge fund in the same year, the events of 11 September 2001, and the Argentine crisis in 2001 were all exceptional shocks that radically changed investors’ perception of risk and the outlook for growth;

- a general increase in uncertainty about macroeconomic outlook. This phenomenon has been particularly marked since the business cycle upturn in 2000, owing to the distinctive characteristics of the latest recovery, which started as a rapid V-shaped recovery, then slowed to a U-shaped recovery, and even a W-shaped recovery. Under these circumstances, the geopolitical uncertainty that has prevailed in the wake of the 11 September attacks and the United States’ action in Afghanistan and Iraq has had an even greater impact on stock market price swings;

- greater volatility of corporate earnings. In keeping with the traditional approach to asset pricing, stock price volatility and volatility of corporate earnings appear to be empirically linked \(^2\) (Shiller, 2000). The price volatility of stocks in the SP 500 index at the end of the nineteen-nineties matched the volatility of earnings per share, as the chart below shows.

Using both measurements over substantially longer periods of five years confirms the previous observation and highlights another longer-term trend. After declining between the nineteen thirties and the mid nineteen-sixties, volatility started to rise again and the trend has continued since then, except for one short interruption at the beginning of the nineteen-nineties.

\(^2\) However, Shiller shows that dividend volatility is not the only explanation for price volatility.
Earnings volatility and, simultaneously, the volatility of projected earnings, were more intimately linked to stock price volatility after 2000, when analysts faced growing difficulties in assessing earnings projections. Reflecting frequent and substantial revisions of earnings expectations, the analysts' own forecasts became more volatile (see chart 12). The analysts' revision of earnings forecasts started in 2000 and increased substantially in 2001. This change is noteworthy, since the revised forecasts focused on recurring income, i.e. profits from firms' core business, and excludes non-recurring items, such as write-offs of goodwill.

*New economy* stock prices dropped and prospects were highly revised as investors and analysts' earnings projections were trimmed to more reasonable levels as start up companies' profits were postponed.

![Chart 12](image)

The financial information required to value assets is not reliable enough

Ever since the stock market bubble burst in 2000, a chain of events caused market participants to question their quality assessments of financial assets. This increase in the risk associated with holding such assets contributed to an increase in the volatility of securities. The deterioration of asset quality stems from three phenomena:

- **doubts about the accuracy of corporate financial statements** in the wake of various scandals, such as the Enron and Worldcom affairs, which revealed accounting fraud in the United States and the collusion of the auditors responsible for vetting the statements. This had an especially big impact on investors, since corporate financial statements are the key to asset valuation. Financial scandals involving leading companies led to fears of widespread fraud, which substantially increased the perceived risk incurred by owning securities issued by the private sector and ultimately increased volatility;

- **doubts about the robustness of information provided by rating agencies**, as these agencies downgraded many companies' ratings very suddenly in the recent past. This makes the signals given by ratings particularly weak. What good is the protection offered by owning *investment grade* securities if, in the next six months, they can be downgraded to *speculative grade* or even *default*?

- **doubts about the advice of financial analysts** with regard to the prices or potential changes in equities, following scandals in which it was revealed that financial institutions gave their customers recommendations that were contrary to their real assessments of issuing firms. This type of scandal, which shook investors' confidence in stock values, had an even greater impact on their risk perceptions because the improper recommendations were given by leading international investment banks.

These three major elements, which increased the risk associated with owning securities issued by the private sector, therefore led to increased volatility. In times of high risk, any minor news may bring about a radical change in the investors' valuations. A very weak firm can suddenly be transformed from a company on the brink of bankruptcy into a viable one and *vice-versa*, which can lead to big swings in stock prices. On the other hand, a company with sound fundamentals would be subject to smaller shifts in investors' perceptions and, therefore, its share price would be less volatile.

**Economic and statistical properties of volatility**

Falling stock prices and rising volatility

The increase in volatility seen since 2000 has taken place against the backdrop of falling stock prices. This confirms that, while some volatility is a feature of rising stock prices, market corrections usually lead to much greater volatility. This asymmetrical volatility response can be seen in the chart 13, which
Stock market volatility: from empirical data to their interpretation

Banque de France  FSR  June 2003


compares the average monthly variation of the CAC 40 index with its historical monthly volatility. For the same variation in prices over one month, volatility tends to be higher if the variation is negative. For example, a price increase of 8 to 10% leads to average volatility of 18%, whereas drop in prices of the same magnitude leads to average volatility of more than 30%.

Chart 13
Volatility and the CAC 40 index (1987-2003):
volatility skew

Average volatility level and mean variations of the index
(in %)

This volatility skew may seem surprising. If we consider, in keeping with conventional asset pricing theory, that news moves asset prices, there is no apparent reason for “bad” news that depresses stock prices to produce more overall volatility than “good” news. In practice, there are two phenomena that seem to explain this skewed response:

- leverage — as measured by the ratio of total debt to equity —, which moves in the opposite direction to stock prices. Good news raises prices and reduces leverage, thus alleviating the associated risk and thereby reducing volatility. Merton’s research showed that the more highly leveraged a firm is, the more volatile its shares are. Empirically speaking, it seems that the increase in leverage when stock markets decline leads to weakening of corporate capital structures. This means that in the event of a downturn in the business cycle or bad news, a highly-leveraged firm automatically becomes riskier and its share price more volatile.

Changes in the ratio of non-financial firms’ debt to GDP can be used to track the indebtedness of the productive sector at the macroeconomic level. In recent decades, this ratio has usually moved in parallel to volatility. When corporate debt rises, volatility increases, as has been the case since 1997. On the other hand, the marked decline in corporate debt between the end of the nineteen-eighties and the mid-nineteen-nineties corresponds to a decrease in volatility in the United States.

There were two reasons for the increase in corporate debt in the second half of the nineteen-nineties. First, firms were under financial pressure to produce higher returns on equity (ROE targets of 15% became standard) and they could increase earnings per share by increasing leverage; secondly, industrial strategies led firms to make major investments in order to gain positions in innovative sectors such as technology, media and telecommunications;

Chart 14
Stock market volatility and debt ratios of non-financial firms in the United States
(Percent – Annual data)

Sources: Banque de France, Bloomberg

- the feedback effect or the intertemporal variation in the risk premium, which does not depend on the impact of price variations, like the financial leverage effect does, but on expected volatility.

For example, expectations of an increase in volatility, in an uncertain international context, depress domestic stock prices, investors asking for a higher return in exchange for incurring a higher risk. Thus, when market risks increase, volatility rises. This hypothesis is based on the fact that present and expected volatility both increase during periods when there is lots of news.
This effect can explain the volatility skew for the market as a whole, as represented by an index, and for individual stocks, since the covariance between a stock returns and the market returns is positive. Wu (2001) shows that the feedback effect is more powerful when the covariance between individual stock returns and market return is higher, which is the case for bad news (higher than in the case of good news).

These two effects put forward to explain the volatility skew involve two different types of causality. The leverage hypothesis is based on the idea that variation in prices causes change in volatility, whereas the intertemporal variation in the risk premium hypothesis assumes that the change in prices results from a change in expected volatility. These two factors can simultaneously affect prices, as stressed by Wu (2001). The feedback effect, which depresses stock prices when expected volatility increases, causes leverage to increase. This then in turn increases risk and volatility. However, according to Campbell and Hentschel (1992), market trends can reverse, which means that the feedback effect is the weaker of the two effects.

**Volatility persistence and mean reversion**

The persistence of high volatility levels is one of the statistical characteristics of volatility. Volatility occurs in clusters, as a quick look at the charts in section 1|2 shows. In other words, major swings in asset prices do not suddenly stop after major news breaks. Instead, they tend to persist. This volatility persistence means that market participants' volatility expectations are influenced by their perception of high volatility (Poterba and Summers, 1986).

The other noteworthy statistical property of volatility is its tendency to revert to the mean. Mean reversion means that, even though shocks lead to large variations in prices and an increase in volatility, their effects eventually wear off.

These properties raise several problems when analysing the current situation, since the time required for volatility to revert to the mean is unknown. Analysis of the various phases of volatility clusterings does not reveal any truly comparable mean reversion periods. Moreover, the mean depends on the inherently arbitrary choice of observation period.

This then raises the question of the “normal” volatility level. This is a particularly difficult question to answer, since markets, along with the macroeconomic environment, are constantly changing, which makes historical comparisons a delicate matter.

### 2|2 Does the way capital markets operate fuel price volatility?

**Conventions, herd behaviour and divergence between stock prices and fundamentals**

The valuation of financial assets, by discounting expected future cash flows, is particularly difficult in the case of shares, where the future cash flows are based on earnings forecasts for the next year, the expected rate of earnings growth and the discount rate. Under the assumption of an efficient market (informational efficiency), even though all the information needed to estimate these parameters is available, the real problem lies in interpreting the information. A degree of subjectivity explains why different agents may have different interpretations of the information and the opinions of others have to be taken into account in the information. Therefore, the analytical framework is both conventional and “consensual” (Aglietta in *Cercle des Économistes – 2002*) and within it, capital asset prices may deviate from their fundamental value.

This gives rise to an explanatory model of market prices, based on a “market consensus” which is fuelled by all market participants, including analysts, strategists and investors. The participants are deemed to behave rationally in this model. Their investment decisions are based on the most comprehensive assessment that they can make of the value of available assets at a given time. This determines the equilibrium prices, which integrate all available information and thus reflect the “conventional” fundamental value of the underlying assets.

The market conventions concern the general analysis of the macroeconomic environment, the judgment about the prospects for various industries and any micro and macroeconomic and financial indicators deemed to be relevant and their interpretation. Behavioural finance has revealed a number of cognitive and behavioural “biases”, particularly when it comes to processing information. These “biases” were obvious during the “new economy” bubble, more specifically in the case of Internet and telecommunications stocks. Since they could not use conventional indicators to justify the prices of these stocks, market participants relied on new *ad hoc* valuation measures based on such shaky criteria as the number of subscribers, instead of actual or expected earnings. Furthermore, some analysts...
focused too narrowly on certain financial ratios, such as EBITDA\textsuperscript{5}, and some companies abused \textit{pro forma} presentations of their financial statements, which led to the same type of biased reasoning. A great deal of research has shown that the format used to present financial data gives rise to biases in the perception of risks and has an impact on investment decisions\textsuperscript{6}.

As long as nobody challenges the market consensus, the pricing framework is likely to create self-fulfilling price dynamics. Market participants are bound to overweight short-term trends and extrapolate them, rather than engage in fundamental long-term analysis. Any change in market prices in the "expected" direction will quickly be seen as confirming the soundness of the originally held beliefs and will make these beliefs stronger. On the other hand, as soon as a new explanatory model challenges this consensus, market prices will adjust to the new fundamental values, which are just as conventional as the earlier values. The longer the former model held sway and the more widely accepted it was, the larger the price adjustments will be\textsuperscript{7}.

The shift from one market convention to another is often the result of greater uncertainty about economic factors, such as economic growth, and financial factors, such as liquidity. In the meantime herd behaviour takes hold and is rationalised by information and reputation considerations like the relative performances of fund managers. Such behaviour is associated with periods of greater volatility, since it leads to an increase in the number of transactions and, more importantly, to "same way" pressures which can create liquidity problems.

It took some time to refute the "new economy" market consensus. Rather than revising their long-term growth projections overnight, market participants seem to have become gradually aware of the excesses of the previous period and adjusted their positions as they went along, as reflected in the overall high level of volatility and the steep decline in stock prices. The major revisions affected technology, telecommunications and media stocks, since the previous valuation criteria were particularly shaky and arbitrary. It also led to substantial revisions of earnings growth forecasts with long-lasting high volatility levels.

**Market participants' operating environment and market dynamics**

Market participants operate within a restrictive framework that potentially influences asset pricing dynamics. The main aspects of this issue stem from market risk management and from institutional asset management.

**Market risk management**

Value at Risk (VaR) and Daily Earnings at Risk (DEaR) are widely used risk management concepts. All financial institutions use them, as do fund managers operating under liquidity constraints. These systems are used to estimate the risk of loss incurred on a portfolio (a set of positions) at a given time horizon, depending on past volatility and the correlations between the assets contained in the portfolio. Logically enough, they show that the less correlation there is between assets in a portfolio (i.e. the more diversified the portfolio), the smaller the risk of net losses is. While we do not question the usefulness of these risk measurement methods, the way in which they are being used is a cause for concern.

- The measures proposed by these systems are usually associated with loss limits. When these limits are reached, "contingency" measures are triggered: portfolios are reallocated by selling off the most volatile assets or the most highly correlated assets in favour of less risky and more diversified assets, margin calls and/or demands for extra collateral are imposed on market participants by the credit institutions providing their funding. When an initial shock, such as drop in stock prices combined with a sudden increase in volatility, means that such measures are implemented by large numbers of market participants simultaneously, they can amplify market movements, add to the volatility of the assets that were the most volatile to begin with and cause a spillover of destabilising price

\textsuperscript{5} EBITDA: Earnings Before Interest, Taxes, Depreciation and Amortisation. This financial ratio is similar to the gross operating surplus (excédent brut d'exploitation (EBE)) used in France.

\textsuperscript{6} Siebenmorgen, Weber and Weber (2000)

\textsuperscript{7} The prevailing market consensus during the market bubble seen at the end of the previous decade was, roughly speaking, that growth was expected to be strong and the equity risk premium was expected to be low. The degree to which investors adhered to this consensus can be seen in surveys. For example, Shiller's surveys of individual investors show that 95% of those surveyed in 1999 and in 2000 thought that "The stock market is the best investment for long-term investors, who are able to buy securities and hold them throughout market ups and downs." Moreover, 91% and 80% of those surveyed in 1999 and 2000 respectively agreed with the statement "If a market crash like that of 1987 should happen, the market is bound to climb back up to its previous levels in a few years."
Box 2

CMF report on increased stock market volatility (December 2002)

In an attempt to identify the factors behind the stock market volatility observed since 2001, the French Capital Market Council (Conseil des marchés financiers) published an interim report in December 2002 that sets out a number of hypothesis and topics for discussion and investigation in conjunction with market professionals. The search for possible sources of volatility can take different directions.

– Issuers: weaker corporate capital structures. In addition to the direct effects of excessive debt (leverage), the report looks into the potentially amplifying effect of some of the borrowing procedures that were widely used in recent years. It focuses more particularly on hybrid instruments, such as convertible bonds, and the use of contingency clauses, such as rating triggers. The report also looks into the possible role played by share buybacks and the procedures for granting and managing stock options.

– Investors: institutional asset management procedures. The report mentions various institutional fund management techniques, including benchmarking and “alternative” management. The report lays more specific emphasis on the role played by management strategies that rely on leverage and the practice of short selling.

– Intermediaries: The increasing trade in credit risk and interactions between credit markets and equity markets, on the one hand, and the growth of option markets, on the other hand, mean that the report puts forward a third topic for discussion on the market dynamics associated with credit risk management and option position management.

The report is an interim report offered as a first step in discussions that need to be taken further. It shows just how complex any analysis of the causes of volatility will be. It even acknowledges that “it would be premature to come up with all-encompassing, clear-cut and definitive conclusions” at this stage.
are experienced market professionals who use advanced asset allocation techniques and take a medium-to-long-term approach for their investment strategies.

Yet, it could be feared that some of the features of the industry structure actually add to market imbalances and thereby increase price volatility.

- Most institutional management is based on benchmarking. This means that managers are judged on their relative performance with regard to a market benchmark, which is usually a stock index, rather than on their performance in absolute terms.

- Managers' performances are usually measured and compared to that of their peers over fairly short periods of a quarter to a year, even though the investment strategies they use ought to be assessed over the medium term.

- Furthermore, their income is directly linked to the amount of assets under management and not to their actual performance.

These factors combine to increase fund managers' sensitivity to short-term market movements and promote uniform investment behaviour, with limited deviations from benchmark indices or even replication of these indices. These factors can even lead to herd-like behaviour amongst fund managers. Dennis and Strickland (2002) have demonstrated that, during periods of turmoil on American stock markets, the stocks showing the greatest downwards variations during market declines and the greatest upwards variations during market rises were the most actively traded ones and those for which mutual funds and pension funds were the largest shareholders: this simply derives from the fact that it has an impact on market liquidity.

This pattern may be reinforced by the fact that UCITS and mutual funds operate under severe liquidity constraints. They must be able to honour final investors' demands to cash out at any time on the basis of the market value of their portfolio. This creates an added incentive for such funds to shadow their benchmark as closely as possible, particularly in times of market turbulence.

**Financial techniques and instruments: ambiguous links to volatility**

The question of whether some financial techniques or instruments may be an endogenous source of volatility in financial asset prices has come up before. The answers are neither clear-cut nor definitive.

**Proliferation of contingency procedures and clauses**

There are recurring suspicions that financial innovation and the growing complexity of the techniques and instruments used by market participants actually contribute to stock market volatility. It is particularly the case for option type products. One common feature of many of the financial instruments developed in recent years is that they implicitly or explicitly incorporate options. This is the case of convertible bonds, investment products offering capital or performance guarantees and bonds with contingency clauses.

With the growth of options markets, volatility or, to be more precise, expected volatility has become a commodity that market professionals now trade and manage like any other commodity. This makes it possible to transfer volatility risk between market participants. Volatility can also be sought out and explicit positions can be taken that are disconnected from the other risks on the underlying asset.

Yet, it is difficult to see how options could be a source of additional volatility. What is being transferred with the volatility risk is a summarised and direct form of the risk of a variation in the price of a financial asset or a stock market index. The changes in implied volatility reveal to the market as a whole the changes in expected volatility, meaning the perception of the risk associated with an underlying asset.

**Market techniques: short selling**

Short selling enables a participant who does not actually own securities to borrow them, and then sell them on the spot market. The objective is to buy the securities back later, hopefully at a lower price, and pay back the initial loan. The opposite of short selling is buying securities on credit. Short selling is often suspected of amplifying price movements on the spot market and increasing market volatility by
It would probably be an oversimplification to attribute most of the observed increase in asset price volatility to the techniques and instruments used by market participants. Even though these instruments may accentuate volatility, by amplifying market trends, it is primarily because they enable market participants to express their expectations more efficiently, more rapidly and at a lower cost. With real-time trading, the constant pressure of new information and the growing interdependency of markets, under certain circumstances, the complexity and diversity of market instruments promote excessive risk-taking and erratic behaviour by giving participants the illusion that they will be able to sell off any position easily. But the primary causes of volatility lie in the market participants’ behaviour and in the interactions between their behaviour and the techniques available to them. Therefore, the development of increasingly complex and technically efficient markets in a macro-financial environment that does not always have the same degree of efficiency and responsiveness (owing to excessively uniform behaviour, the market consensus, rules-based investment strategies and the constraints imposed by regulations, operating rules or accounting rules) could contribute to a rise in average stock market volatility at levels, in certain periods, higher than that observed today.
Bibliography


Buchael (J.-L.) (2002): “Maintien à un haut niveau de la volatilité des estimations de bénéfice des indices”, JCF Outlook, JCF Group, 17 May


