Global Market Strategy
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Volatility, Leverage and Returns

- **Market volatility has collapsed:** this is great for growth, but a problem to investors, as it depresses the return from taking risk.
- A **dramatic fall in economic and corporate "surprises" and a move to predictable monetary policies** have pushed macro and corporate volatility to decade lows.
- But a certain degree of **luck** has helped, with high oil prices and low bond yields almost perfectly offsetting each other this past year. This luck is about to run out.
- Next year promises a rebound in macro and market volatility from depressed 2005 levels, but only modestly, with a dramatic rise in volatility delayed to 2007-08.
- **Equity and EM credit volatility** should rise into 2006**. Corporate credit and bond volatility to rise only slightly** from current levels.
- **Risk premia on credit should rise slightly in 2006, with larger rises in 2007**.
- **Leverage** is generally considered the evil force that produces excessive volatility in markets and economies.
- We find that corporate and macro leverage do bring about high market volatility, but find instead a **negative relation between investor leverage and volatility**.
- We find strong evidence that bond managers, credit managers, banks, and hedge funds **raise leverage when volatility is low, and reduce when volatility is high**.
- **Market leverage thus lags rather than leads volatility**. Managers appear to target a **stable Value-at-Risk**, which is the size of their positions times volatility.
- Over the past year, **banks and bond managers have taken larger positions as volatility collapsed. Hedge funds and credit fund managers, in contrast, are taking remarkably little risk**, quite likely as they see lower spreads and fewer trading opportunities.
- Active managers have complained that low volatility prevents them from finding profitable trading opportunities.
- We find, though, that **active managers** of bond and hedge funds earn **lower alpha when volatility rises unexpectedly**. This is because many are structurally long risky assets that get hurt when volatility rises. Alpha returns when volatility stops rising and becomes high only when volatility starts falling again.

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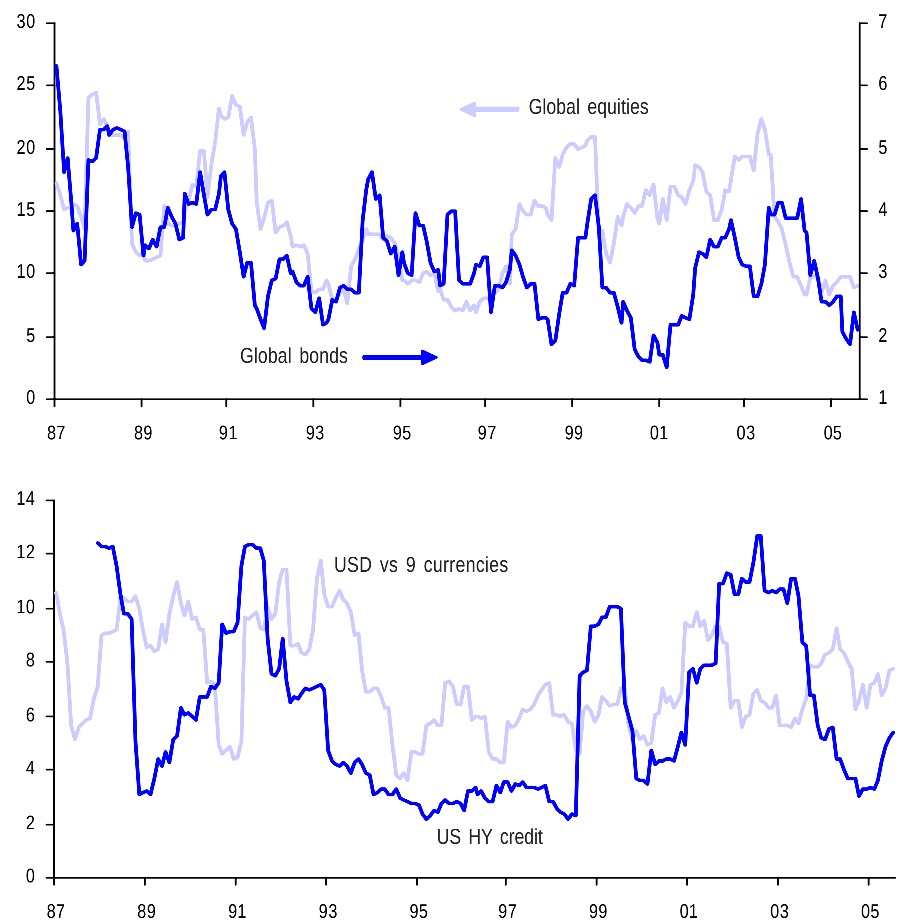
1. The problem of low volatility

Volatility in many markets has **fallen to very low levels** over the past year and a half, depressing risk premia and leading fund managers to complain it has become much harder to earn decent returns from active investing. Central bankers, such as Fed Chairman Alan Greenspan, are instead worried that market participants have become too sanguine about risks, and thus vulnerable when a big shock hits us. Chart 1 shows how return volatility of equities, bonds and credit has fallen to decade lows, despite maintained volatility in currencies.

We all tend to be **ambivalent** about volatility: Too little and investors do not get paid to take risk. Too much, and asset prices collapse and central bankers have to pick up the pieces. To assess future returns from both active and passive risk taking (the alpha and the beta), or the need for policy intervention, we need to forecast volatility. And that is where we run into problems, as there is little guidance in economic theory and practice to help us do this. Plenty of econometric approaches exist, but they only extrapolate the past and do not relate to fundamental economic developments.

Volatility of bonds, equities and credit has collapsed over the past two years

Chart 1: Market volatility
12-month annualised stdev, percent



Source: JPMorgan

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A fundamental approach to projecting volatility is needed

In this paper, we attempt to fill this gap by developing a **fundamental framework** to project future market volatility. We then apply it to current conditions, expecting in 2006 a rebound in market volatility from depressed levels, but with high volatility delayed to 2007-08. We draw implication for asset returns, active returns, and for what policy markets should be looking out for. We come up with some expected results, but also with quite a few surprises (at least to us). Among these are that leverage by investors tends to lag, rather than lead market volatility; that corporate leverage and macroeconomic volatility are more causally related to market volatility; that hedge funds seem very reluctant to raise leverage, in contrast to banks; and that active investors tend to do poorly when volatility rises unexpectedly.

2. A matter of surprises and market vulnerability to them

Historical and implied volatility are closely related

Volatility has two facets: actual price movements, and the uncertainty about future prices. The former — **historical price volatility** — is an important driver of active investment returns (alpha) as produced by hedge funds and other active managers. The second aspect of volatility — **uncertainty** about future prices — is the main driver of risk premia in the market (the higher internal rate of return (IRR) on risky assets that compensates risk-averse investors for this uncertainty).[1] Increased uncertainty leads to higher risk premia, and vice versa. Uncertainty about future prices also shows up in the prices of options, from which we can derive the implied volatility[2] of the future prices of the underlying assets.

These two facets of volatility are **not unrelated.** Generally, a rise in delivered volatility, due to surprises[3] to the market, will also increase uncertainty about future prices. For one, an increase in delivered volatility is usually due to events that change the present value of assets. These events will create more uncertainty about the future as it takes investors time to assess the implications of the shock.

What drives volatility? Economic theory tells us that the price of a financial asset is set as the present value of the cash flows expected from the asset. Asset prices change when either the expectations of future cash flows change, the uncertainty around them or the rate at which cash flows are discounted changes. Prices change by larger amounts or more frequently — i.e., become more volatile — the greater the number of reasons for investors to alter their views on future cash flows, and the greater the fluctuations in discount rates. This **requires news or unexpected events**.[4]

Volatility = News × Leverage

Conceptually, we can think of market volatility as the **product of the supply of surprises (news) and the vulnerability of markets to these surprises** (Table 1). An unexpectedly high reading on monthly CPI (the "surprise") can change bond and equity prices by raising expected inflation. The actual price move and thus volatility are driven by the degree to which this CPI news affects inflation expectations and inflation uncertainty (the vulnerability or sensitivity of prices to the surprise). We distinguish these two forces as we believe they behave in different ways over time.

1. In *A fair-value model for US bonds, credit and equities* (Panigirtzoglou and Loeys, Jan 2005), we show how volatility affects the yields on different asset classes.

2. An alternative to time-series model volatility is to use option implied volatility. As a market expectation, implied volatility is potentially more forward looking, but to us, this only moves the problem. It does not address the issue on how option markets themselves should assess future market volatility, which is the topic of this paper.

3. Note that expected events, such as predicted rises in the price level, earnings, or policy actions that are not a surprise to the market all will change the level of asset prices, but they do not create volatility in returns. That is, as prices rise steadily in line with predicted changes in these variables, asset returns will be stable and thus will not create return volatility.

4. In real-life markets, prices will fluctuate also due to the regular adjustments of portfolios and non-alignment of savings and borrowing. Most of this can be considered "noise," constituting the normal, rock-bottom volatility of markets. We assume here that this rock-bottom volatility itself does not change much over time.

In the following, we present a framework on how to formulate views on the amount of surprises likely to affect major asset classes as well as the sensitivity of these asset classes to these surprises. This sensitivity should be driven by the degree to which the surprises force investors to change their holdings, which in turn will be driven by their leverage, by their risk capital and by the cost of funding. We focus on **macro-volatility**, or the volatility of asset classes, rather than on micro-volatility, which is the volatility and dispersion of individual bonds and shares.

We step back from traditional mean-reverting time-series models of volatility and focus instead on its fundamental drivers

Our approach is fundamental as we aim to understand what really drives volatility and how we can link views on volatility to other views we develop on markets. It is quite different from the dominant, time-series approach to forecasting volatility, which is best represented by GARCH models (Box 1). Effectively, they are moving

Table 1:

Volatility	=	Surprises	×	Vulnerability
		Structural: – Stability Culture – Global risk sharing		Structural: – MTM
		Cyclical: – Policy Actions – Business cycle		Cyclical: – Levels – Market direction – Leverage – Inbalances

Box 1

The dominant model of volatility: GARCH

Most forecasting models of volatility are **GARCH** type of econometric models. Effectively, they are moving average models that tell you that volatility will eventually pull back to some form of long-term average. The speed of mean reversion is determined by the persistence of the volatility process. We found that volatility exhibits generally high presistence for macroeconomic variables, implying a half life of 1.5 years for annual inflation and 1 year for quarterly GDP growth. The "half life" is the time it takes any variable to get halfway back to equilibrium, once it has moved away from equilibrium. The half life is similar for equities and bonds, at 1 year and 9 months respectively. The half life is longer for corporate and EM credit at 1.5 and 2 years respectively.

Asymmetry of volatility to return shocks appears to be more pronounced for economic growth, equities and credit

What does a time series approach like a GARCH model tell us about macroeconomic and asset price volatility? The GARCH model was developed to capture the heteroskedasticity (empirical evidence of non-constant variance of shocks) observed in many financial and macroeconomic time-series. The form of heteroskedasticity emebedded in the GARCH model allows the variance of the forecast error to depend on the previous period variance and the size of the previous period's shock. Another feature found in many financial and macro variables is that volatility responds asymmetrically to past negative and positive return shocks, with negative returns resulting in larger future volatilities. This feature gave rise to GARCH models with asymmetric or "leverage" effects.

By fitting asymmetric GARCH models we found that the variance of equity and credit returns and of economic growth is asymmetric to bad news. But we did not find any evidence of an asymmetric effect in the volatility process for bond returns and inflation.

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average models that tell you that volatility will eventually pull back to some form of long-term average. These time-series models are widely used in risk management. We focus on a **fundamental approach** to projecting volatility as our aim is to develop an active view on volatility, consistent with our fundamental valuation of markets.

3. The supply of surprises

With "**surprises**", we refer to the supply of market-relevant news, or unexpected events. Some of these are truly exogenous and random, such as war and pestilence. By definition, we should think of the supply of exogenous events as mean reverting around a (hopefully) constant mean. We distinguish between two types of macro news: unexpected developments in macroeconomic variables such as economic activity, inflation, and corporate earnings data, and economic policy actions by the government. To project changes in the supply of these surprises, we focus on the macroeconomic forces of the "surprise production function", some of which are longer-term trending (structural), while others are more medium-term and mean-reverting (cyclical).

3.1 Long term (structural)

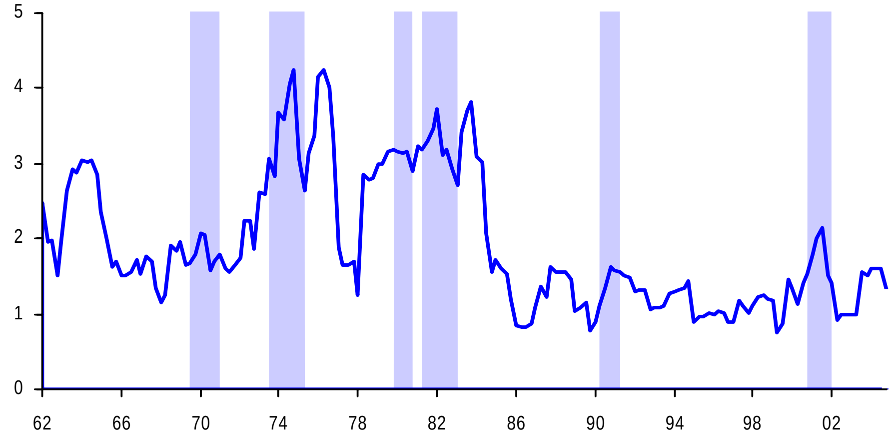
The supply macroeconomic shocks has fallen over the past two decades relative to the 60's and 70's. In our view this is largely due to increased **global risk sharing** and a move by policy makers towards **stability-oriented economic policies**.[5] The steady opening up of markets and economies over the past 50 years has provided economic agents a greater ability to insure against shocks and has stabilized their consumption and production decisions. Globalization of economies in turn is allowing the effect of country-specific shocks to be spread out across the world, thus reducing growth dispersion and volatility of national economies.

Global risk sharing and stability-oriented economic policies have lowered macroeconomic volatility and suprises over the past two decades

The move towards **stability-oriented economic policies** by major policy makers across the world, which we have termed The Stability Culture, has probably been an even larger determinant of reduced macro volatility.[6] At the end of the 1970's, policy

Chart 2: Global real GDP growth volatility

NBER recessions in shaded areas, annual rolling standard deviation of quarterly annualised global real GDP growth in percent, OECD data before 1970



Source: JPMorgan, OECD.

5. See for example Bruce Kasman, *A stable and divergent world,* October 2005.

6. See Bruce Kasman, Reflating a Disinflationary World, Oct 03, and David Mackie, The Stability Culture in the Euro Area, Oct 03.

makers across the world, and in particular central banks, became aware that their activist policies had created a lot of volatility but in the long run added little social value in terms of higher growth and lower inflation. As a result, we saw a steady move to central banks and treasuries pursuing stability as an objective per se on the conviction that creating stability in growth, inflation, and policy itself was the best way to maximize economic welfare. By the end of the 1990s, a dozen OECD countries had explicit inflation targets and over 20 had explicit fiscal rules. The Stability Culture had impressive results on stabilizing growth and inflation rates (Chart 2).

But the Stability Culture should gradually fade

The **Stability Culture**, is unlikely to persist, though, as it is not providing the hoped for increase in economic growth. Policy regimes tend to shift over time in response to any perceived deficiencies in existing policies.[7] We do see a gradual shift towards more growth oriented policies which will eventually create more macro economic volatility, but the shift will be gradual.

3.2 Short- to medium-term (cyclical)

Among the more medium-term drivers of surprises are the **cyclical behavior of policy makers**, and the **surprises in macro variables such as growth, inflation corporate earnings and credit ratings along the business cycle**. Charts 3 to 6 depict different measures of the magnitude of macroeconomic surprises for the US. Given the prevalence of the US business cycle and markets for the world, these US-based measures are a good proxy for economic surprises relevant for world markets.

Chart 3 presents the frequency of surprises in US economic activity data, derived from JPMorgan's **Economic Activity Surprise Index** (EASI). This index tracks how 21 broadly followed US economic activity data (such as payrolls, claims, housing starts, GDP, retail sales, etc.) come out relative to consensus expectations over the past 6 weeks. The chart shows the percent of releases that came out a standard deviation different from consensus over the past 10 years.

Charts 4 to 6 show a broader measure of surprises by looking at the impact the monthly flow of information is having on the consensus forecasts for growth, monetary policy and inflation over the coming year. The charts depict the standard deviation of monthly changes in the median Blue Chip forecasts for US growth, CPI inflation and the short rate (3-month Tbill) over the next four quarters. The greater the volatility of forecasts, the higher the supply of surprises must have been.

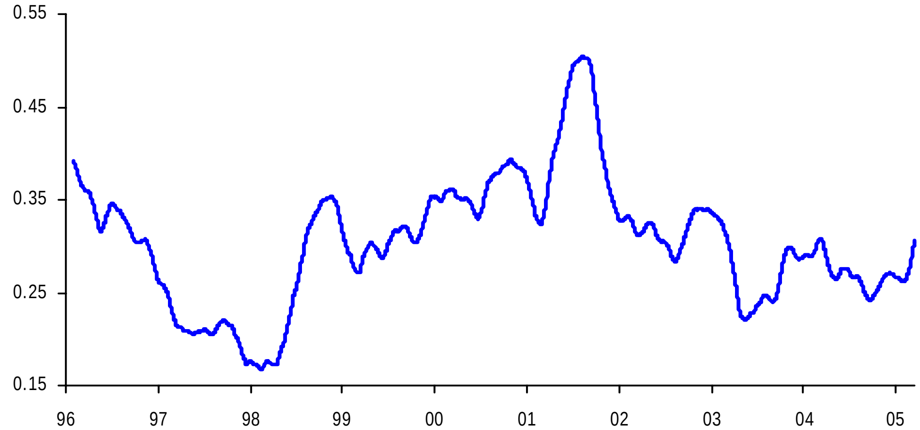
Growth and monetary policy suprises have a strong cyclical influence ...

Broadly, we detect a **cyclical pattern** to these surprise functions. The peaks in surprises on growth and monetary policy come during the boom-and-bust phases of the business cycle. The sample period includes two recessions — 1991 and 2001 — which define the peaks in growth and monetary policy surprises. The late years of the expansion (overheating) and the first year of recovery similarly show elevated levels of surprises. Mid-cycle (mid-1990s and the period since 2003) show a trough in the level of growth and monetary policy surprises. This is indeed the time when the economy should be most stable and more easily predictable. At mid-cycle, the expansion is far enough from the previous recession to be established and sustainable. It is also far enough from the next recession to the perceived risk of falling

7. This is an application of the well-known Lucas Critique in econometrics. Accordingly, policy makers choose optimal policy rules on the basis of past experience, when this new regime was not pursued yet. When the regime changes, economic behavior (the model) then tends to change in reaction to the new regime, and the new regime is thus not optimal anymore. When policy makers recognize their error, they re-optimize and chose a new regime, which after a while will again turn out to be suboptimal. In the UK, a variation to this is also known as the Goodhart Law: whatever the central bank tries to control will eventually become unstable in its relation to the policy maker's ultimate objective.

Chart 3: US Economic Activity Data Surprises (EASI)

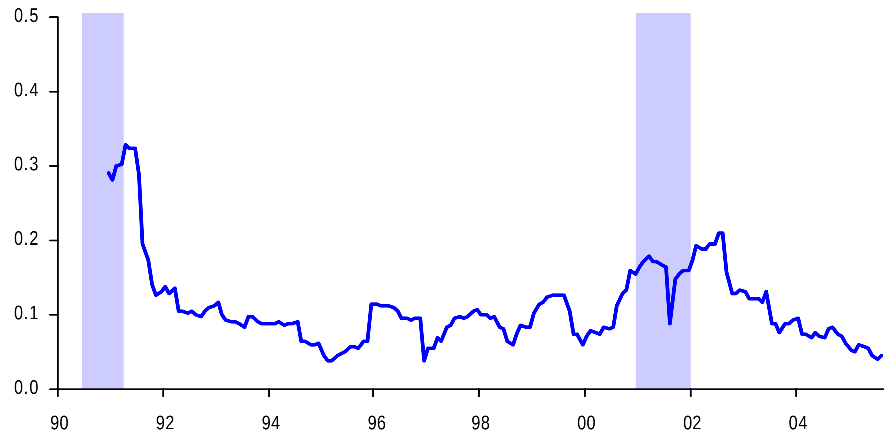
share of economic activity data that are 1 standard deviations from consensus, 6-month moving average



Source: JPMorgan

Chart 4: US growth surprises

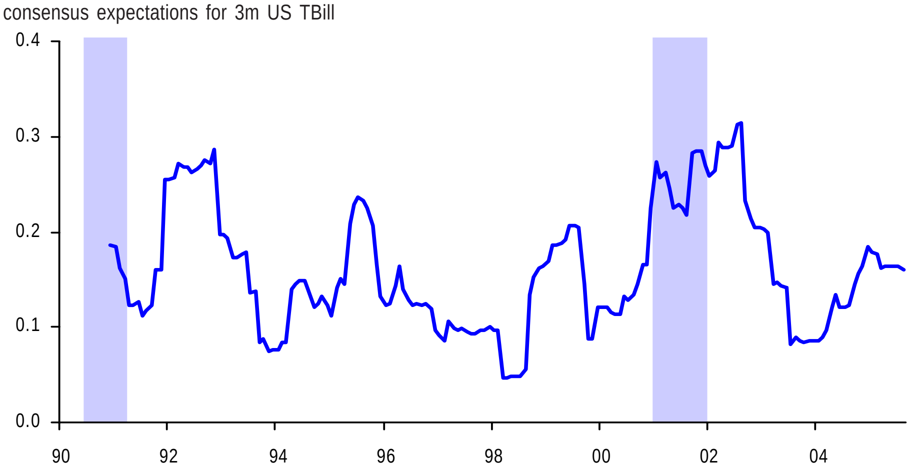
NBER recessions in shaded areas, annual rolling standard deviation of monthly changes in 12m ahead consensus expectations for US growth



Source: JPMorgan, Blue Chip Economic Indicators

Chart 5: US monetary policy surprises

NBER recessions in shaded areas, annual rolling standard deviation of monthly changes in 12m ahead consensus expectations for 3m US TBill



Source: JPMorgan, Blue Chip Economic Indicators

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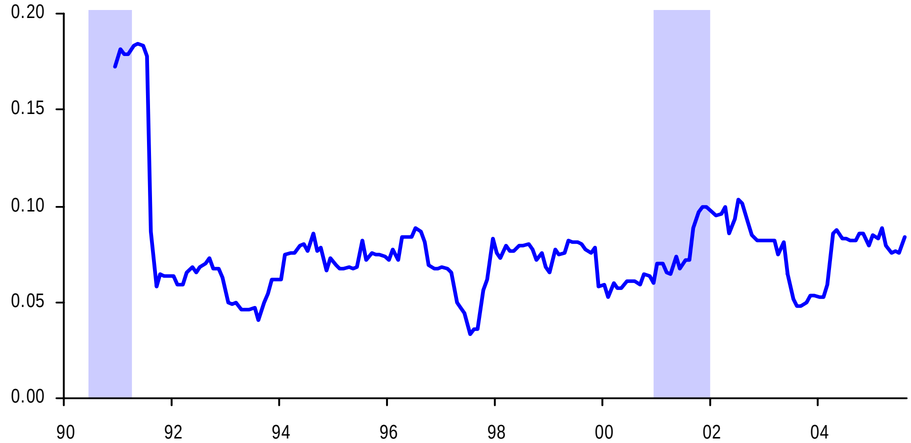
Chart 6: US inflation surprises

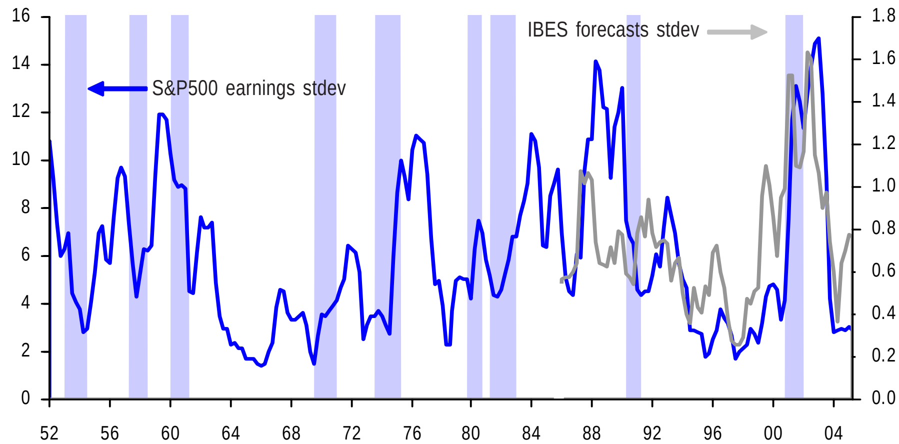
NBER recessions in shaded areas, annual rolling standard deviation of monthly changes in 12m ahead consensus expectations for US inflation



Source: JPMorgan, Blue Chip Economic Indicators

Chart 7: S&P 500 earnings and IBES earnings forecasts volatility

NBER recessions in shaded areas, 8-quarter rolling annualised standard deviation of quarterly S&P500 earnings per share growth, 12-month rolling standard deviation of monthly changes of 24-month ahead IBES forecasts for S&P500 earnings, in percent



Source: JPMorgan, Standard & Poor's, Thomson Financial.

again into recession will be low.[8] Mid-cycle, however, is also a time when monetary policy will be normalized and will already be on its way to become tight. So, the mid-cycle is more likely to be followed by an increase rather than a decrease in surprises from policy makers.

.. but inflation has been a non-event in past years

Inflation surprises and volatility have been in a range since 1992 after a decade-long falling trend. More credible monetary policies across the world in the 1990s helped to anchor long-term inflation expectations resulting in less persistence and more ranging behavior for inflation.

The amount of surprises coming from the **corporate** sector will affect markets ultimately through **changing expectations on earnings** and **uncertainty about earnings.**

8. It has to be recognized there is a two-way relation between macro-economic volatility and the business cycle. The boom-and-bust part of the cycle bring more macro-economic surprises indeed, but it is also the case that causes of macro-economic volatility — corporate overextension, policy mistakes, macro imbalances — are themselves the causes of overheating, a correction, and rebuilding.

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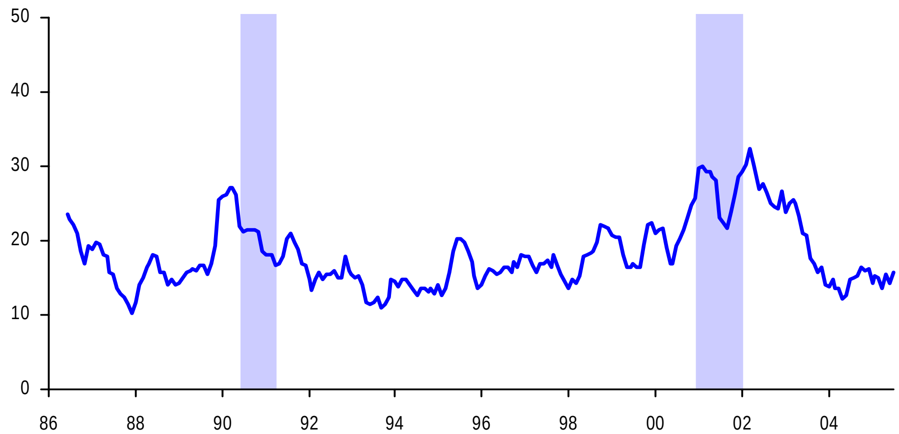
Chart 8: Corporate credit rating actions

US High Grade corporate number of rating changes per month, 6-month moving average



Source: Moody's.

Corporate surprises are also cyclical peaking into recessions and troughing at mid cycle

We proxy corporate surprises by the volatility of both delivered and forecasted by IBES earnings (Chart 7) and the number of credit ratings changes (Chart 8). Both show the same cyclical patterns as the US growth surprise function: peaking during recessions and troughing at mid-cycle.

A first gauge on **how economic surprises and market volatility are related** to each other is offered by their correlation matrix. Table 2 shows that monetary policy surprises tend to correlate with growth surprises but there is no correlation with inflation surprises. Growth and inflation surprises are correlated strongly with a coefficient of 0.73. Corporate earnings volatility exhibits positive correlation with growth and monetary policy surprises.

Corporate earnings and macro surprises are strongly related to equity and credit volatility

How do these surprises affect asset volatility? **Equity and corporate credit spread volatility are strongly correlated with macro surprises and corporate earnings volatility.** Currency volatility is mostly correlated with monetary policy surprises. But bonds and EM credit spread volatility appear to be more modestly correlated with macroeconomic surprises. **Among financial markets, equity and credit volatility are most highly integrated with economic surprises, while bond and FX volatility are less affected by macro volatility.** A more complete picture on how macro surprises affects market volatility requires us to assess the changing sensitivity of these markets to macro surprises.

Table 2: Volatility correlations

Pairwise correlations, volatility is measured by 12-month ann. stdevs, sample period starts in 1990 for macroeconomic surprises, 1987 for S&P500, GBI bond, USD and HY, 1990 for HG and 1992 for EMBIG

	Growth	Inflation	Monetary policy	Corporate earnings	Bonds	Equities	HG	HY	EMBIG	USD
Growth	1.00									
Inflation	0.73	1.00								
Monetary policy	0.33	0.14	1.00							
Corporate earnings	0.39	0.08	0.52	1.00						
Bonds	-0.02	-0.03	0.14	0.41	1.00					
Equities	0.39	0.13	0.18	0.44	0.33	1.00				
HG	0.49	0.25	0.34	0.69	0.34	0.85	1.00			
HY	0.73	0.48	0.51	0.57	0.34	0.70	0.86	1.00		
EMBIG	-0.16	0.18	0.01	-0.34	-0.18	-0.11	-0.01	-0.05	1.00	
USD	0.29	-0.07	0.36	0.35	0.15	0.07	0.09	0.24	-0.33	1.00

Source: JPMorgan.

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4. Market sensitivity to surprises: levels, direction, ...

The impact of surprises on markets is, in turn, a function of the **market's sensitivity, or vulnerability to these surprises**. What drives this sensitivity? This vulnerability will be defined by the degree to which surprises force investors to change positions. This is defined by how much risk capital they have, by how leveraged they are, and by whether they are forced to mark portfolios to markets.

A **longer-term structural** force that has been increasing the market's sensitivity to shocks is the steady move to impose marking to market on institutional investors. In a nutshell, investors who are not required to regularly mark their assets and liabilities to market, and who instead use accrual accounting, are more able to withstand market shocks. In recent years, a series of new accounting rules have been introduced to force corporations and institutional investors such as pension funds and insurance companies to mark their assets to market.

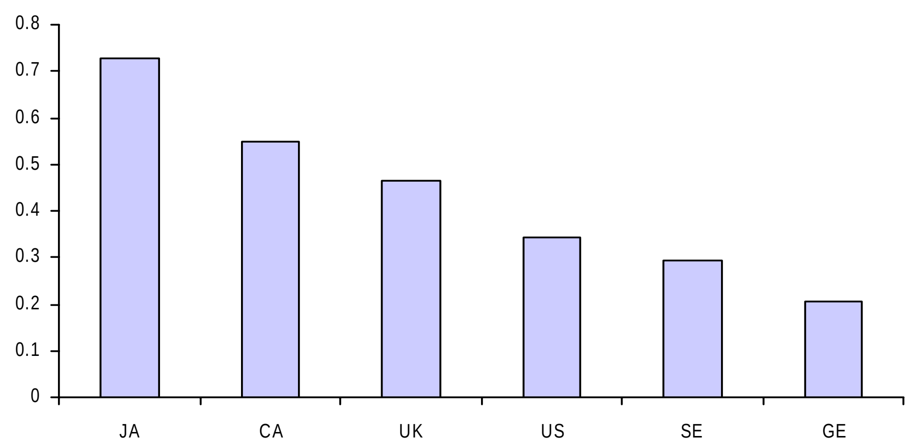
We see the move to MTM as a slow moving one that should not have much impact over the next few years. Hence, we instead focus on four more **medium-term, cyclical forces** affecting the market's sensitivity to shocks — **yield levels, market direction, leverage**, and **economic imbalances** recognizing these forces are interrelated.

4.1 Levels and natural barriers

Volatility falls when assets approach their zero or negative carry barrier

Investors are generally reluctant to hold risky assets without sufficient excess yield over cash, or carry over funding costs. We observe that when the relative supply of assets drives yields or spreads close to the **natural barrier of zero or negative carry**, volatility falls. This is because the probability distribution of the market's expectation shrinks to the left as yields approach this natural barrier. For example, when yield curves become relatively flat, as the central bank pushes the policy rate to neutral, bond volatility tends to be low.[9] When government bonds trade close to libor flat, due to high supply of government debt, swap spread volatility becomes very low. Across major markets, the correlations between swap spread levels and volatility has been positive over the past 20 years (Chart 9). Similarly, credit markets with low spreads have much lower spread volatility.

Chart 9: Correlation between swap spreads level and volatility
1987-2005



Source: JPMorgan

9. Admittedly, the causality goes somewhat both ways as low volatility by itself will lower risk premia and thus push yields closer to the cost of funding. Overall, this effect is small compared to the macro supply forces that drive swap spreads, yields levels, and curves flatter. See Terry Belton, *Volatility as an asset class*, Oct 2005 for more on the relation between curve and volatility and how this can be used to position on volatility.

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4.2 Market direction, asymmetry of volatility

As discussed in Box 1, time series approaches such as GARCH frequently find that market volatility is "directional", i.e., volatility is higher in a down- than an upmarket. Returns are thus said to have an asymmetric impact on volatility. In GARCH models, we find indeed that this **asymmetry applied to equities, credit, and economic growth, but not to bonds or inflation.**

Volatility is higher in bear than in bull markets

The asymmetry of growth volatility to growth shocks reflects that economic recessions tend to be associated with higher growth volatility. This is shown in Chart 2 on page 5. Consumers and firms tend to respond in a more pronounced fashion to negative growth shocks, creating higher output volatility during recessions. The high correlations between growth volatility and equity and credit volatility in turn could help to explain the asymmetry in the volatility process for equity and credit. Table 3 shows there is overall a negative correlation between asset price volatility and cyclical economic indicators.

A second force that makes market volatility directional is the **prevalence of stop losses** relative to "stop profits". Directionality of volatility is thus caused by the breach of VaR limits and the dissipation of risk capital during bear markets which makes forced selling more likely in bear markets.

A third factor is **return correlation**, which is known to rise in down-markets, thus amplifying the impact of individual stock volatility. A negative shock tends to hit many individual names simultaneously causing an increase in correlation. In this case, it is possible to have an increase in index volatility without any increase in the volatility of the individual constituent stocks or credit.

5. Leverage

Positions and leverage are generally considered important drivers of how much markets react to news. Central banks and regulators similarly try to prevent excessive leverage as it is thought to lead to market instability, losses to smaller investors, and systemic risks. A news event that goes against the dominant position of active investors will require them to exit, raising volatility as it creates a logjam as everybody tries to "get out the door" at the same time.[10] We thus need to look at the overall size of market positions.

More broadly, we need to look at the degree of financial **leverage** applied by market participants. Investors apply leverage when they use debt or derivatives to take a larger position in financial assets than the size of their capital. An investor with $1 in capital can borrow $4 to buy an asset worth $5. Or they can use their $1 in capital as

Table 3: Correlation between asset price volatility and cyclical indicators

	BBBVOL12M	HYVOL12M	EMBIVOL12M	SP500VOL12M	GBIVOL12M	FXVOL12M
CAPU	-0.69	-0.52	0.45	-0.15	-0.33	-0.09
UST 10Y-3M	0.21	0.31	-0.42	0.00	0.42	0.15
Industrial production oya	-0.66	-0.57	0.25	-0.13	-0.09	-0.38
Index Leading Indicators	0.21	0.04	-0.33	0.04	0.26	-0.26
ISM mfg	-0.30	-0.27	-0.24	-0.08	0.36	-0.12

Source: JPMorgan.

10. Clearly, if the news item supports market positions, then it has little impact. Overall, though, if the event is congruent with positions, then it was probably not unexpected, and does not count as a surprise.

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margin to buy derivatives on $5 worth of underlying assets. Leverage is not merely an issue of amplifying risk positions, but fulfils the social function of redistributing risk towards those most willing to take the risk. That is, a risky asset worth $5 could either be owned by 5 different investors each at $1, or it could be owned by one investor holdings the $5 on a leveraged basis, with the other four lending him/her $1.

Economic and corporate leverage tend to amplify market volatility ...

How does leverage affect volatility? If leverage merely redistributes risk towards those most able and willing to carry risk, then this should improve the market's ability to handle adverse circumstances and thus reduce market volatility as risky assets are in experienced hands. But there is a price to this risk redistribution. By concentrating risk in fewer hands — as able as they may be — there is less diversification of risk and investment losses across market participants. If the market turns down 25% in a non-leveraged market, the five investors lose 25% each of their capital. In the leveraged market, the leveraged investors would be bankrupt, requiring a forced sale of the assets in hostile market conditions, which would push the price down further, exacerbating market volatility.

... but investors' leverage tends to lag and have a negative association with market volatility

The true impact of leverage on market volatility thus becomes an empirical issue. In the tests below we analyze leverage by different type of investors, by corporations, and by economies. We find that, contrary to our initial hypothesis, **investor leverage does not appear to lead volatility, but instead to lag it**. **Investor's leverage and volatility are negatively related** as high volatility leads to reduced leverage and low volatility forces investors to leverage up. This result is confirmed by econometric tests that show a statistically significant one-way causality from asset volatility to leverage. But we do find that **increased corporate and economic leverage leads to higher volatility in equity and credit markets**.

5.1 Financial market leverage

We measure investor leverage in two ways: the size of active positions reported in JPMorgan investor surveys, which capture largely real-side investors, and the leverage of hedge funds and banks, which we derive from the volatility of their returns relative to market volatility.

Our Client Surveys show an overall negative correlation between investors exposure and market volatility

ASSET MANAGERS: JPMorgan has published surveys of client positions in the US and European bond and credit for a number of years. These clients are mainly "real", long-only asset managers who manage funds against a well defined benchmark.

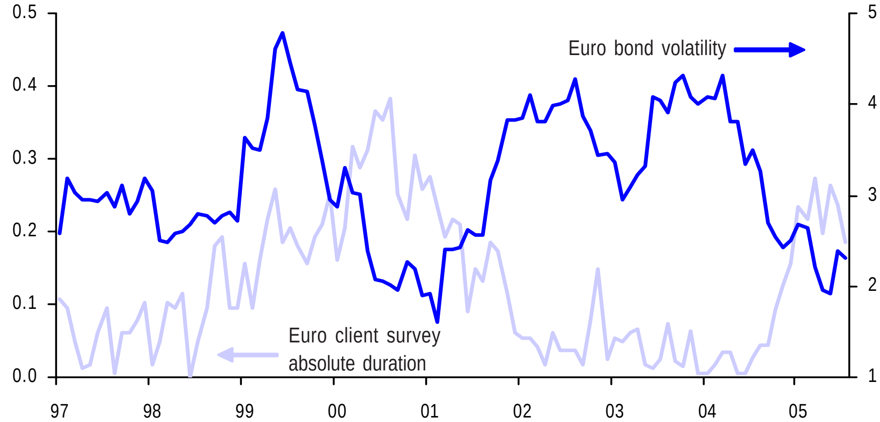
Surprisingly, we find a **negative** contemporaneous correlation between market volatility and the magnitude of investors' active deviations from benchmark. Charts 10 and 11 show the result for our European Client Duration Survey and US Credit Client Survey, which ask investors whether they are long or short against their neutral. The chart indicates that periods of high market volatility tend to lead to a reduction in the size of investor deviations from benchmark, while periods of low market volatility tends to push investors into larger active positions. This suggests that **bond investors are keeping relatively stable value-at-risk** on their active positions: higher volatility requires cutting the size of positions, while lower volatility requires taking on larger positions, in the name of reaching a fixed alpha target. We find the same result in our US Treasury (duration) Survey. Next, we look at hedge funds.

Investors try to maintain their VaR levels by increasing leverage when market volatility falls and vice versa

HEDGE FUNDS represent an important part of investors' universe as they account for a third or more of total trading volumes on some financial assets. They control more assets than the capital they receive as they are able to take up more leverage because they are subject to fewer regulatory restrictions. They can leverage up by either borrowing or using derivatives. Estimating hedge fund leverage is a difficult

Chart 10: Bond duration exposure and volatility

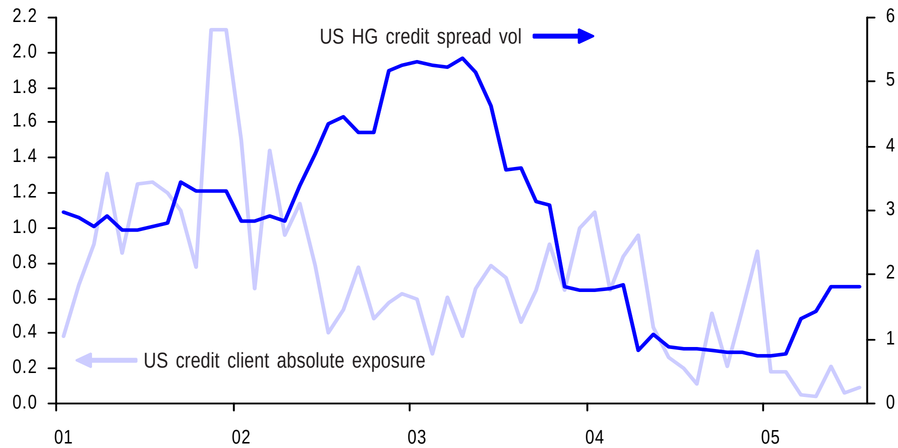
absolute duration position in Euro bonds of international investors from JPM European Client Survey, Euro bond vol is the annualised 12-month stdev of monthly bond index returns



Source: JPMorgan

Chart 11: Credit duration exposure and volatility

absolute duration position in US high-grade of US investors from JPM US Credit Client Survey, HG vol is the annualised 12-month stdev of monthly HG credit spread returns



Source: JPMorgan

Our proxy for hedge funds leverage also confirms a negative association between leverage and market volatility

task as they have significant flexibility as to the exact assets they can invest in. We address this problem by establishing "benchmark" asset classes for different types of hedge funds, through a style analysis, and then relating hedge funds return volatility to the asset class volatility. The higher the ratio of these two, the higher the leverage of the funds must have been. Chart 12 shows this proxy of hedge fund leverage averaged across types of funds and the volatility of the underlying asset classes.[11, 12]

11. A recent BIS study (Patrick McGuire, Eli Remolona and Kostas Tsatsaronis, *BIS Quarterly Review* Mar 2005) attempts to quantify hedge fund leverage in a different manner. It does so by summing the absolute values of the betas of hedge fund returns to different asset price returns. The drawback of this approach is that the betas are assumed to be constant within the rolling period (i.e. 24 months). But hedge funds are likely to switch exposure from long to short across asset classes several times during the course of year. For example, if a very high leveraged EM hedge fund buys and sells the EMBIG index every second month the beta (sensitivity) to the EMBIG index will be zero and this approach would wrongly imply zero leverage. That is, the mismeasurement of betas due to their time variation will translate into a mismeasurement of hedge fund leverage.

12. Our measure of HF leverage (Chart 12) is a weighted average of the estimated leverage for five HFR hedge fund styles: Equity long/short (37%), Equity short (1%), Macro (22%), Fixed Income arbitrage (8%), Convertible arbitrage (7%) and Emerging Markets (2%), Equity neutral (2%) and Event driven/Distressed debt (20%). For each style we divide the hedge fund index return volatility by asset return volatility which we proxy by S&P 500 returns for Equity long/short, Equity short and Equity neutral, Global bond index USD hedged returns for Macro and Fixed Income arbitrage, high yield returns for Convertible arbitrage and Event driven/Disstressed debt and EMBIG returns for Emerging Markets. The same pattern as in Chart 12 also arises if we adjust the hedge fund leverage proxy upwards by the steady rise in the number of hedge funds over the past decade (see *Have hedge funds eroded market opportunities?* Loeys and Fransolet, Oct 04). The negative relation between HF leverage and asset volatility shown in Chart 12 is not the result of the construction of HF leverage as the ratio of HF volatility over benchmark asset volatility for each hedge fund style. Instead, the pattern of HF leverage in Chart 12 is mostly driven by the numerator, i.e. HF volatility.

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Hedge funds have increased their leverage only modestly in recent years despite the collapse of market volatility...

The chart shows the **negative relation** between market volatility and hedge fund leverage. The low volatility during the 1996/1997 period encouraged an increase in hedge fund leverage through 1998. The LTCM crisis and the resulted increase in volatility triggered a position unwinding and deleveraging. Volatility came down again in 1999 leading to a renewed build up of leverage through the peak of equity market tech bubbly in early 2000. The collapse of the 1990s bubble, the economic slowdown and the September 11 attack, all caused an increase in asset volatility and a protracted decrease in leverage. Since mid 2003 volatility started declining at a rapid pace laying the ground for a rise in leverage.

...likely because they are seeing fewer opportunities in markets

The rise in leverage over the past years has been very modest. The reason could be a perception that fewer opportunities exist in markets, as we discussed last year in *Have hedge funds eroded market opportunities?* Loeys and Fransolet, Oct 04. Or it could reflect a business strategy that focuses more on capital gathering and their 2% management fees, by minimizing downside risks. Or the "demands of institutional investors are stifling hedge fund creativity", see FT article by Phil Davis.

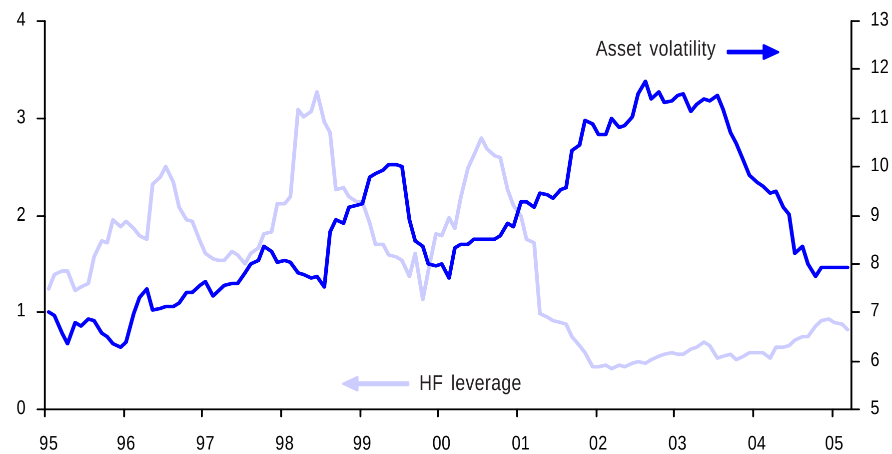
COMMERCIAL BANKS. The proprietary desks of banks, much like hedge funds, are active investors that can control more assets than their capital by using derivative instruments or borrowing. As in the case of hedge funds, we proxy their leverage by the ratio of the volatility of their trading profits over the volatility of their assets (Chart 13).[13] Quarterly data on the trading profits of US commercial banks are available from the Office of the Comptroller of the Currency (OCC).

It is the proprietary desks of the banks that have taken up more leverage in recent years to levels seen before the 1998 LTCM crisis

Here again, we find a negative relation between bank leverage and asset volatility. But unlike hedge funds, US commercial banks, and most likely also the investment banks, have recently greatly increased leverage and position taking in response to the drop in market volatility. The recent increase in bank leverage has been more pro-

Chart 12: Estimates of hedge fund leverage and market volatility

asset volatility is proxied by the first component of Principal Component Analysis of the 12-month volatility of the S&P 500, US GBI, US HY and EMBIG.



Source: CSFB/Tremont and JPMorgan

13. As in the case of hedge funds, we proxy bank leverage by using the ratio of the volatility of their trading profits (scaled by the average size of profits adjusted for the rise in bank assets over time) divided by asset volatility. Quarterly data on the trading profits of US commercial banks are available from the Office of the Comptroller of the Currency (OCC). The trading profits are split into fixed income, equities, currencies and commodities. We derive a leverage estimate for each of these asset classes by dividing the volatility of the trading profits by the volatility of the S&P500 for equities, the US bond index for fixed income, the USD vs an equally weighted basket of 9 currencies for FX and the GSCI index for commodities. We then weigh these four leverage indices according to the average share of profits to total trading profits (41% for fixed income, 46% for currencies, 12% for equities, 5% commodities) to arrive to the bank leverage estimate shown in Chart 13. Given the normalization of the volatility of the trading profits by the average size of profits, only changes in the bank leverage proxy are important rather the absolute levels themselves. As with hedge fund leverage, our proxy for bank leverage in Chart 13 is mostly driven by the volatility of bank trading revenues rather than asset volatility, and thus the negative relation between leverage and asset volatility is not the result of the construction of the leverage measure.

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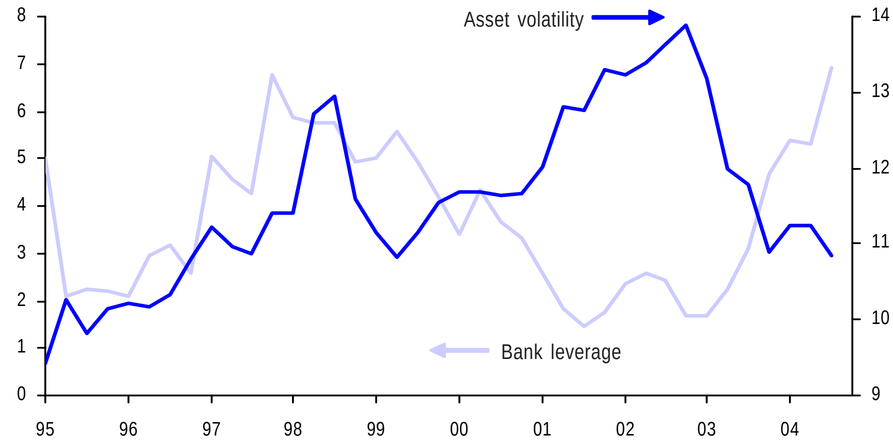
Chart 13: Estimates of bank leverage and market volatility

asset volatility is proxied by the first component of Principal Component Analysis of the 12-month volatility of the S&P 500, US GBI, USD vs 9 currencies and GSCI.



Source: OCC and JPMorgan

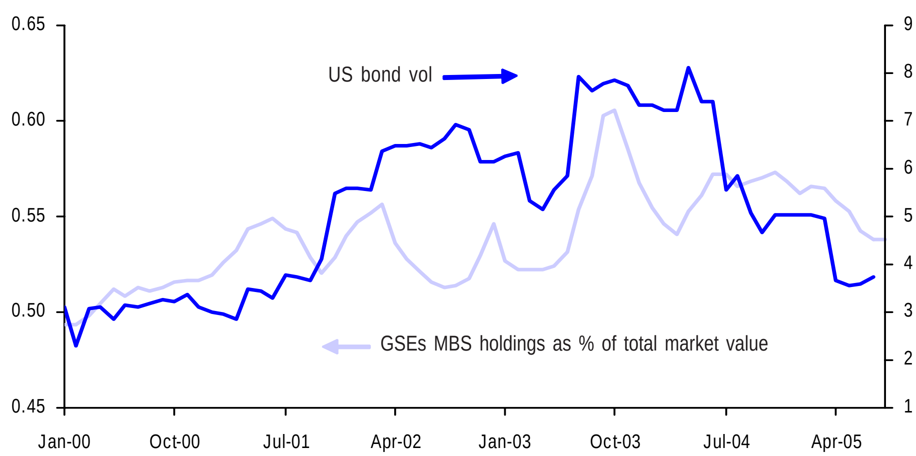
nounced in fixed income. Maybe the fact that banks do not charge a 2% management fee as hedge funds do is forcing them to be more "hungry".

Dynamic hedging of duration exposure by MBS holders has been a factor behind bond volatility in recent years

US MORTGAGE MARKET: One form of investor leverage consists of the convexity of mortgage portfolios. Mortgage-backed securities (MBS) have been growing steadily from 4% of Lehman's US aggregate in 1976 to a current 36%. A large part of these securities are held by investors who dynamically hedge their duration exposure, e.g. GSEs. Dynamic hedging of MBS duration can exacerbate movements in yields: when yields fall the MBS duration falls and these investors are forced to extend duration by buying exacerbating the initial move and vice versa (see Belton et al, *US Fixed Income Markets 2005 Outlook*). We have found a positive relation between the share of MBS held by GSEs (i.e. Fannie Mae and Freddie Mac) and the volatility of US bonds (Chart 14).

Chart 14: GSEs mortgage holdings and US bond volatility

MBS holdings of Fannie Mae and Freddie Mac as % of MBS market value, US bond vol in %



Source: JPMorgan

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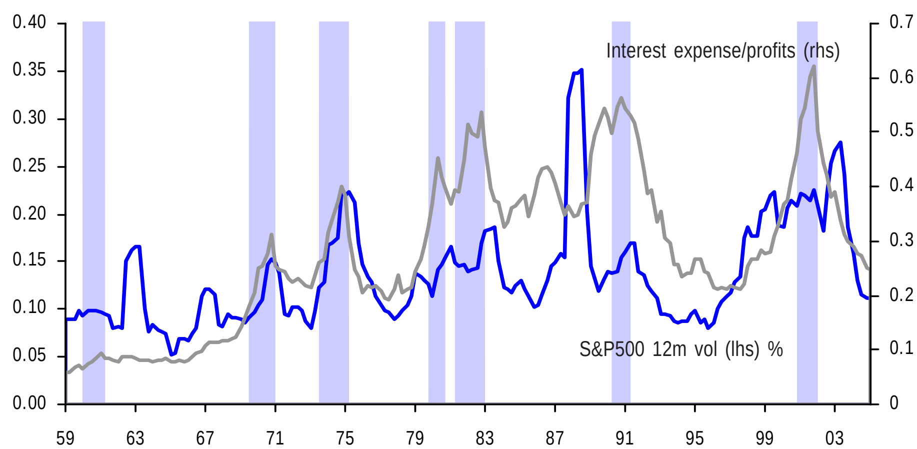
In sum, all the tests we do on leverage by investors indicate a clear **negative contemporaneous relation between market volatility and leverage**. This is at first sight consistent with the so-called **leverage cycle** according to which low leverage induces higher leverage by investors which makes them vulnerable to the next shock at which point the resulting high leverage induces deleveraging which makes the sell-off and the high volatility last for longer. When we test for causality between leverage and volatility we can only confirm that **volatility causes (leads) leverage, but leverage does not cause volatility**. The causality tests are significant at 5% level for our proxies for hedge fund and euro bond investors leverage and at 15%-30% level for bank and credit investors leverage. The data are not detailed enough to exclude the possibility that deleveraging (the process of reducing leverage) contributes to the rise in market volatility, but the causality tests and the fact that volatility remains high even when leverage has come down already for some time would indicate against this hypothesis. This leaves us with the result that investors seem to sense when a rise in volatility is forthcoming and reduce leverage as volatility starts rising. Investors thus all seem to have a clear Value-at-Risk target which forces them to offset higher (lower) volatility with lower (higher) leverage. We **cannot find evidence here for the hypothesis frequently put forward that VaR management is itself a cause of excessive market volatility**.

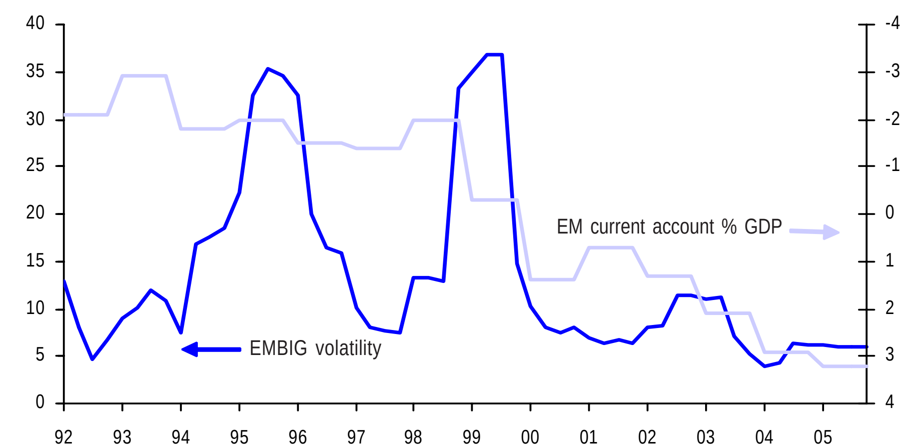
Chart 15: Corporate financial leverage

NBER recessions in shaded areas



Source: US Federal Reserve Flow of Funds and JPMorgan

Chart 16: Emerging market leverage



Source: IMF World Economic Outlook and JPMorgan

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5.2 Corporate leverage

Corporate leverage tends to amplify the volatility of corporate equity. That is, for given asset value and earnings volatility, companies with higher leverage tend to have more volatile equity.

Corporate leverage tends to amplify equity and credit volatility

Chart 15 shows that US **corporate financial leverage** (measured by the interest expense to profits ratio) **is positively related to equity volatility.** Corporate leverage increases into a recession and is accompanied by increased equity volatility. After the recession the corporate sector usually embarks onto an adjustment by reducing its debt and leverage leading, ceteris paribus, to lower equity volatility.

5.3 Economic leverage

Tentative evidence of a positive association between EM economic leverage and EM external debt volatility

Countries also take up leverage to smooth their spending pattern or take advantage of investment opportunities. That is, some countries consume more than they produce, i.e. they run deficits financed by imported capital in anticipation of future income gains from investment opportunities at home. Emerging economies steadily increased their leverage to the global economic cycle during the 1980s and 1990s, by increasing their external debt and their current account deficits. This increased the sensitivity of their growth and asset prices to global shocks up until the late 1990s. The EM crises in 1997 and 1998 and the reversal of EM capital inflows triggered a sharp increase in volatility of EM currencies and external debt. After these crises, emerging economies embarked on an adjustment process by reducing their debt and leverage. The reduction in leverage was reflected in their current account balance that moved to a surplus after almost 20 years of deficits. Chart 16 shows that the deleveraging process by EM was accompanied by reduced asset price volatility as shown by the volatility of their external debt.

Table 4: A set of equations for market volatility

DETERMINANTS

Surprises
Asymmetry
Leverage

BOND (US GBI) VOLATILITY

US bond volatility = -2.4 + 1.7 × abs(10yr-2yr slope) + 0.1 × MBS held by GSEs (Rsq=82% 2000-2005)

EQUITY (S&P 500) VOLATILITY

S&P 500 volatility = 6.1 + 0.16 × interest expense / profits + 0.5 × S&P 500 earnings vol (Rsq=36% 1959-2005)

CREDIT VOLATILITY

US HG volatility = -1.4 + 2.9 × volatility of growth surprises+ 0.15 × S&P 500 vol + 0.10 × S&P 500 earnings vol (Rsq=81% 1991-2005)

US HY volatility = -2.9 + 26.1 × volatility of growth surprises+ 13.2 × volatility of monetary policy surprises + 0.25 × S&P 500 vol (Rsq=78% 1991-2005)

EMBIG volatility = 7.4 + 1.30 × 2yr yield – 1.49 × EM current account (Rsq=21% 1992-2005)

USD VOLATILITY

USD (vs 9 currencies) = 5.5 + 9.9 × volatility of monetary policy surprises (Rsq=12% 1991-2005)

Source: JPMorgan

6. A macro model for volatility

We now present a first attempt to quantify the relation between volatility and its determinants: surprises, asymmetry and leverage discussed above. Table 4 summarizes the equations for bond, equity, credit, EM external debt and FX volatility.

Bond volatility and the slope of the yield curve are closely related

US bond volatility is associated with the absolute value of the slope of the curve. A flat curve leads to low volatility because of the resistance by investors to negative carry, thus limiting downside volatility on yields. A 100bp rise in the absolute value of the slope of the yield curve implies a rise of 1.7% for bond volatility. The second variable in the equation for bond volatility is the share of holdings of MBS securities by GSEs. GSEs dynamically hedge the duration of their MBS portfolios amplifying movements in yields and pushing bond volatility up. The larger the share of GSEs the more volatile the bond markets are likely to be. A 10% increase in the MBS share of GSEs translates into a 1% rise in bond volatility.

Equity and credit volatility appears to be driven by growth and corporate suprises as well as corporate leverage

Equity volatility is related to corporate leverage and the volatility of fundamentals, i.e. earnings volatility. As discussed above, for given asset volatility, the higher the financial leverage of a company the higher the volatility of equities. The asymmetry is captured by the cyclicality of both corporate leverage and earnings volatility. An increase in the interest expense to profits ratio by 10% raises equity volatility by 1.6%. An increase in earnings volatility (annualized standard deviation of quarterly S&P500 EPS growth over 8 quarters) by 1% raises equity volatility by 0.5%.

Corporate credit (both high-yield and high-grade) volatility is associated with growth surprises, and corporate leverage and earnings volatility through the presence of equity volatility in the model. High-yield volatility is additionally affected by monetary policy surprises confirming the higher sensitivity of high-yield to interest rate movements. The asymmetry is captured by equity and economic surprises volatility both of which have a strong cyclical component. For **EM credit**, macroeconomic leverage, proxied by the EM current account balance, appears to be important. A higher current account deficit implies a higher sensitivity of EM economies to global economic and capital flow cycles and thus higher volatility for EM asset prices including EM external debt. The second variable found to be significantly associated with EM credit volatility is the 2-year US yield as EM external debt is denominated in dollars. **FX (USD)** volatility is associated with US monetary policy surprises.

7. Where is volatility heading into next year?

How can we use our analysis of volatility, including the models in Table 4 to formulate an opinion on volatility over the coming year?

The rise in macroeconomic volatility into 2006 likely to be small as global economy overheating still at very early stages

The **global economy** as well as the US one performed over the past year very closely to consensus expectations, depressing the supply of macro surprises to virtual rock-bottom levels. In our opinion, there was a **large amount of luck** involved in this as to major unexpected events — the spike in energy costs on one side and corporate profits and with it the bond yield conundrum on the other side — almost fully offset each other in their impact on economic activity, keeping the global economy growing at expected trend rate. The likelihood of a repeat performance with growth coming in exactly as projected seems low, as a number of shocks — inflation, energy costs, US federal spending, corporate profit margins, leverage, and Asian currency policies — all loom on the horizon. At the same time, the rise in macro volatility will probably be small, as overheating risks seem modest at this point, most central banks have not

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even started tightening yet, corporate health remains excellent, leveraging is still in its infancy, and EM economies are running surpluses as well as sound macro policies. Global terrorism is very costly, but has not affected the global economy since Sep 11.

Equity and EM credit volatility to rise into 2006, but bond and corporate credit volatility to rise only slightly from current levels

Earnings volatility and disappointments have been very subdued with corporate earnings coming out nicely, but modestly above expectations over the past two years in the major economies. As discussed in *Dark Water* Abjijit Chakrabortti Oct 05, we consider consensus expectations of double-digit earnings growth next year way too high given that profit margins are near 40-year highs. Earnings disappointments, revisions, and thus volatility are likely to rise into 2006.

US **bond volatility** should stay relatively low, at close to current 4.3% level, despite risks of the Fed moving into tight territory. This is because the global savings glut, emanating from EM economies and global corporates will ease only very gently[14]. Together with long-term inflation expectations remaining broadly anchored by the credibility of central banks and pension fund buying of the long end, we see the US curve staying quite flat, thus keeping US bond volatility low also. Bonds in the rest of the world should stay steeper than the US but their volatility will remain largely a function of US volatility.

US equity volatility, currently at 8%, should move up towards 9% into 2006, based on our expectation of a rise in both earnings volatility and corporate financial leverage. Corporates will likely continue to leverage up, though from very low levels, as debt funding is cheap relative to equity funding.

Corporate credit volatility to stay largerly idiosyncratic

Credit spread volatility is likely to move up from a current 1.9% in US HG and 5.4% in US HY to around 2.5% and 6.5% respectively as the result of the expected pick up in equity, growth and monetary policy volatility. **EMBIG spread volatility**, currently at 5.4%, should rise by around 2% into 2006 mostly as a result of continued Fed tightening. **FX volatility** is currently 7.8%, close to its historical average. The model above implies a small move up of only 0.2% into 2006, driven by monetary policy surprises which are likely to rise only slightly into next year.

8. Impact on asset returns and alpha

8.1 Impact on risk premia

Volatility can affect asset prices significantly through its impact on the risk premium component of asset yields. In our **fair value models** for US bonds, credit and equities *(Panigirtzoglou and Loeys,* Jan 2005), volatility and risk premia can account for a significant component of asset yields or internal rates of return. The effect of volatility has been found to be more important for equities, where the Equity Discount Rate is a function of macroeconomic volatility, and high yielding corporate and EM credit, where credit spread volatility appears to be a significant determinant of credit spreads.

The contribution of volatility into credit spread valuations to rise by around 3bp in HG, 10bp in HY and 36bp in EMBIG

Our fair value models project that higher volatility per se will only raise modestly **credit** risk premia, up by 3bp for US HG and 10bp for US HY. But credit spreads could rise by more as we expect a small rise in downgrade and default rates into 2006. EMBIG spread risk premia should move up more significantly by around 36bp into 2006 as spread uncertainty rises due to Fed tightening.

14. See also *Corporates are driving the global saving glut*, Loeys, Mackie, Meggyesi and Panigirtzoglou, June 2005.

The S&P500 Equity Discount Rate is more likely to fall into 2006 as it is currently around 50bp above its fair value

For **equities**, the fair value for the Equity Discount Rate for the S&P500 should move modestly up to around 5% from a current fair value of 4.85%. But the expected change in the fair value should not have a negative impact on equity returns going forward. This is because the EDR is currently around 50bp above its fair value and the gap between the two is expected to narrow even with the fair value moving modestly up. What appears to be more important for equity returns going forward is falling earnings expectations, which are expected to have a negative effect on equity valuations from mid 2006.

8.2 Impact on active returns (alpha)

Higher levels of market volatility appear to be associated with larger misvaluations and opportunities for active investors ...

The standard premise of how market volatility affects the return from active investing (alpha) is that given a fixed success rate, or information ratio on directional trades, the higher market volatility, the higher the absolute level of alpha (see, Jan Loeys and Matt King, *Maintaining Returns*, June 1999). This implies that periods of higher market volatility should produce higher excess returns. We find indeed that high volatility leads to greater misvaluation against fair value that should allow active investors to position profitably. Chart 17 shows this for our own fair value model ("*Fair-Value model for US Bonds, Credit and Equities*" Panigirtzoglou and Loeys, Jan 2005). In addition, momentum, an important "inefficiency" of markets that investors aim to exploit, is generally stronger when volatility is high.

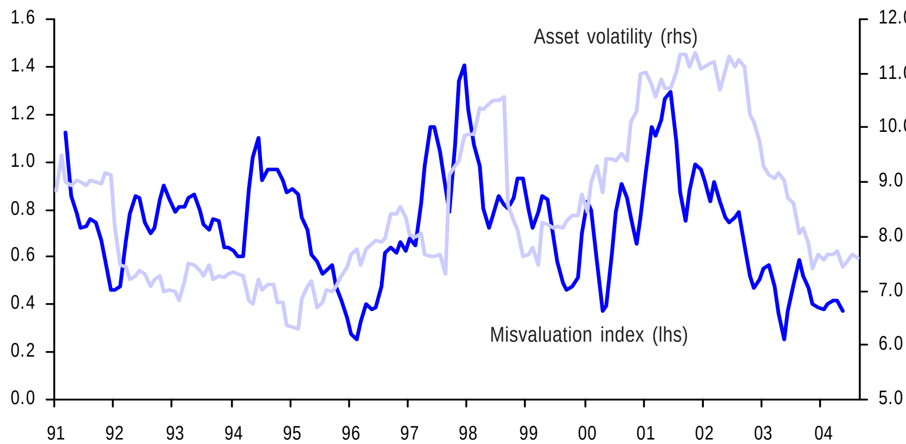
... but overall volatility hurts alpha

An empirical investigation of the relation between market volatility and returns from active investing found, to our initial surprise, a **negative relationship between volatility and alpha**. In the following, we review this evidence and suggest a number of explanations. We look at the excess return delivered by global bond managers against their declared benchmarks, at our own experience in our *GMOS* model portfolio, and at the excess returns earned by hedge funds.

For **"real" fixed income and EM managers** who cannot leverage and who manage against a bond index, Chart 18 shows that over the past 10 years, excess returns against benchmarks were higher in quarters that saw below average volatility, or that saw declining volatility. This suggests they were generally pursuing long-carry (or risk premia) strategies that presumed that market volatility would stay low or at least

Chart 17: Asset misvaluations and volatility

Asset volatility is proxied by the first component of Principal Component Analysis of the volaility of the S&P 500, US GBI, US HY and EMBIG. The asset misvaluation index is proxied by a weighted average of the misvaluation in SEs of the S&P 500, US GBI, US HY and EMBIG



Source: JPMorgan

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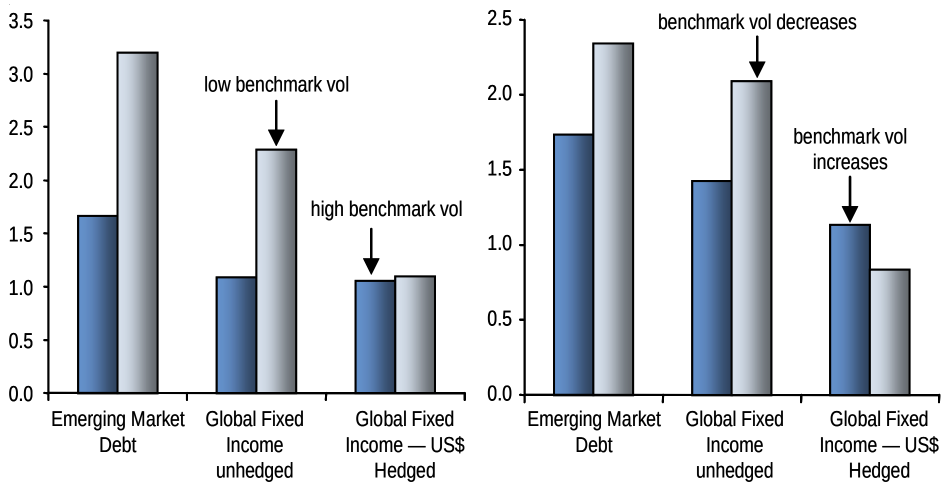
would not rise. We get somewhat different results for managers that use a USD hedged benchmark and who thus make much less use of currency positions. This indicates that unexpected FX vol is most destructive to alpha and that many managers rely on FX carry trades for alpha.

A similar message is sent by JPMorgan's twice-monthly ***Global Markets Outlook and Strategy* (*GMOS*)** model portfolio. In both FX and fixed income trades, we had a higher return to risk (information ratio) when market volatility was low, but unlike for global bond managers, we had better luck when volatility was rising from the period before (Chart 19). The model portfolio focuses only on macro exposures across asset classes, markets and maturities (duration, spreads, curve, FX, and credit) and does not make use of options, unlike most hedge funds.

Chart 18: Bond manager excess returns and volatility

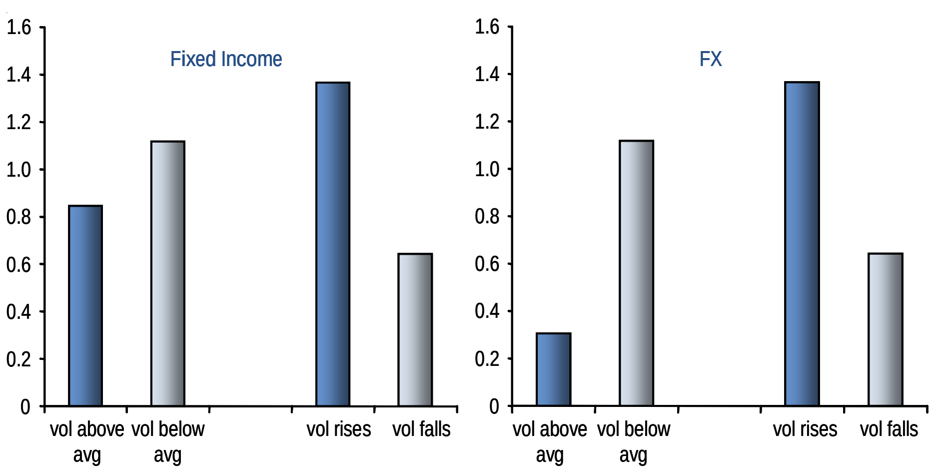
%, 1995 - 2005, annual returns in $ in excess of relevant JPMorgan indices



Source: Frank Russell and JPMorgan

Chart 19: *GMOS* returns and volatility

%, 1995 - 2005, annual returns in excess of JPM Global Bond Index



Source: JPMorgan

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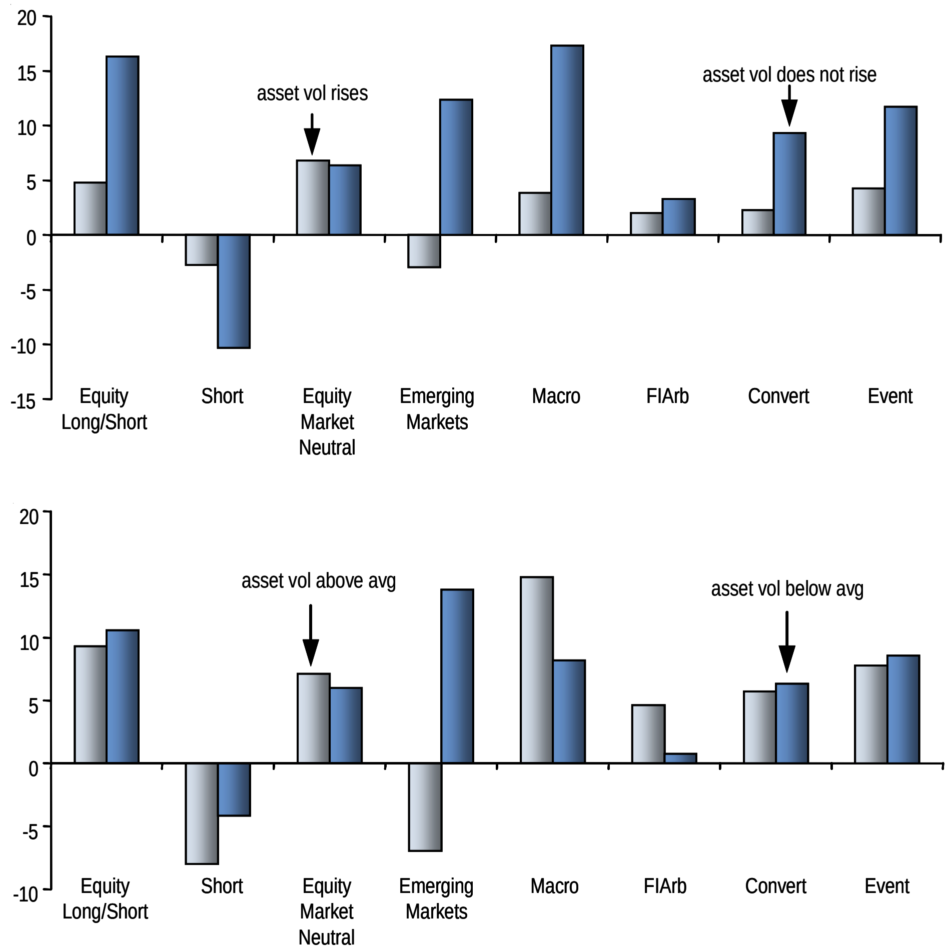
Chart 20: Hedge fund returns and volatility

%, annual returns over cash, 1994-2005



Source: CSFB/Tremont and JPMorgan

Finally, Chart 20 applies the same exercise for eight types of **hedge funds** in the HFR data base. As in Chart 12, where we analyzed hedge fund leverage, we relate each type of hedge funds to the volatility of the asset class that a style analysis indicates it invests in (see footnote 13). We find that for most funds, there is no clear relation between returns and the **level** of volatility. The exceptions are macro funds (positive relation) and EM funds (negative relation). However, we do find a clear **negative relation between returns and the *change* in asset volatility**. Most types of hedge funds perform significantly better when volatility declines than when it rises from the previous month.

What explains this general negative relation between volatility and alpha? We see three reasons, that have in common that **most active managers seek to outperform by being long riskier, higher-yielding assets** on the implicit belief that the imbedded risk premia are on average too high. When volatility suddenly rises from a low level, though, the average active manager loses out as the risk premia at which they bought will have fallen short of the risk delivered.

Volatility and alpha have a negative contemporaneous relation, first because many **managers are structurally overweight the riskier assets** in their benchmark. In our US and our European Credit Survey, for example, we find that over the past five years, our credit clients duration has been on average 0.70, with zero corresponding to a neutral exposure. Second, **VaR management,** as indicated by the above section on leverage, makes investors reduce positions when volatility is high, thus also keeping presumptive alpha low. And third, many active i**nvestors sell options in the belief that on average implied volatility will exceed delivered volatility**.

All this indicates that active returns will be poor when volatility rises quickly and in excess of what is priced into risk premia and implied volatility. Into 2006, we anticipate a gentle rise in market volatility, with a more dramatic rise delayed into 2007-08. Active returns should thus be broadly maintained next year, with most of the risks to investors focused on 2007.

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