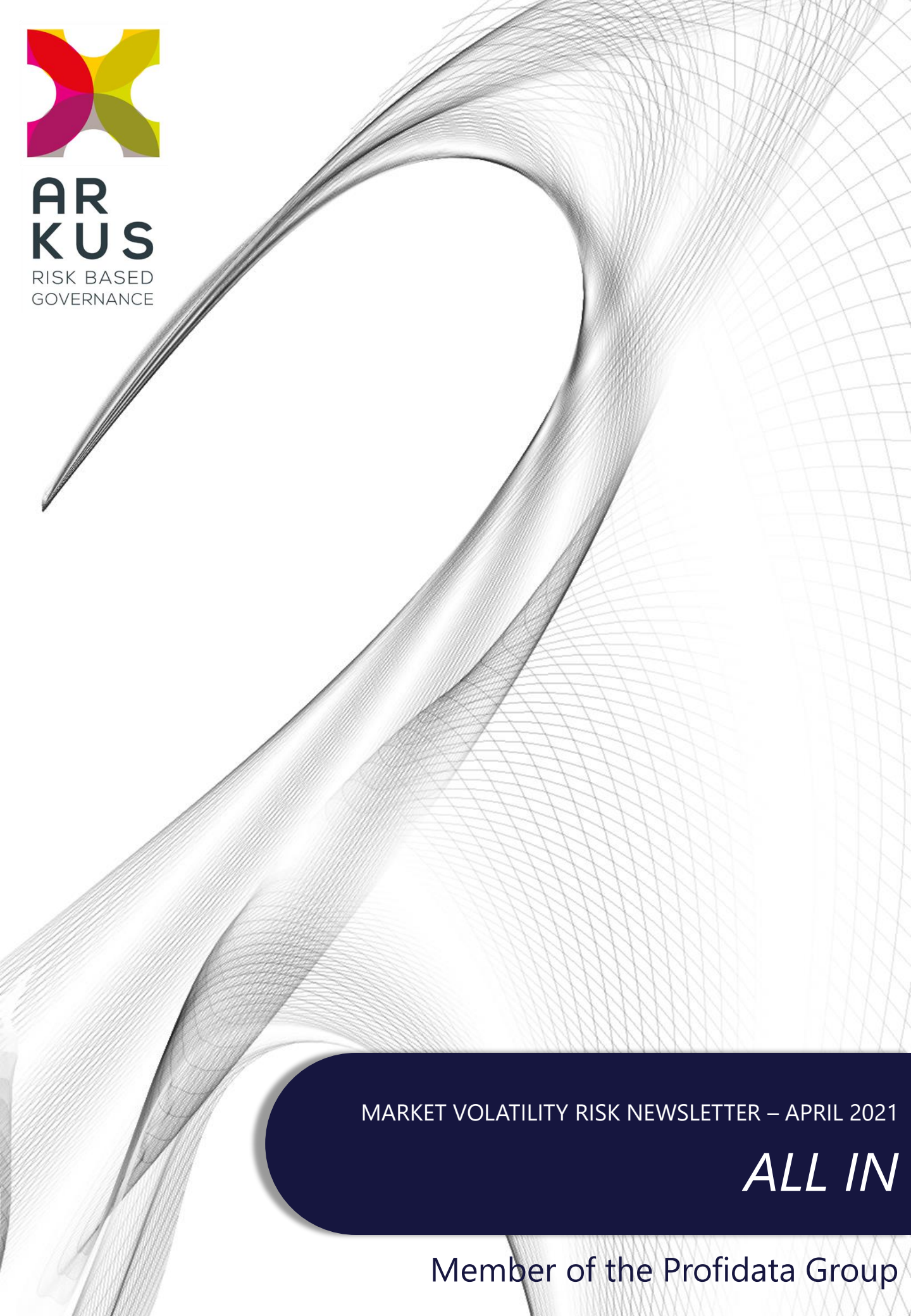

ARKUS
RISK BASED GOVERNANCE

MARKET VOLATILITY RISK NEWSLETTER – APRIL 2021

ALL IN

Member of the Profidata Group

Executive Summary

- **Region volatility movements were mixed.** Region volatility spanned a range that goes from 10.8%(Europe) to 19.8% (Japan Nikkei), with North America changing from low up to medium volatility regime.
- **Realized volatility** (of the Euro Stoxx 50 index over 30 days) decreased from **14.1% to 13.2%.**
- **Equity price sector results were all upward trending,** with Consumer Staples gaining the most (+6.3%). Sector **volatilities** spanned a range that goes from 9.6% (Consumer Staples) to 29.3% (IT), with IT changing from low up to medium volatility regime.
- **Sovereign bond price movements were mixed,** with US losing the most with -2.1%. **Volatility** moves were all upward and spanned a range that goes from 2.1% (Japan) to 6.4% (Italy).
- **EUR price results were mixed,** with the EUR losing the most against US Dollar (-2.7%)**. FX volatility results were mixed;** ended ranging between 4.4% (€/£) and 5.8% (€/$), with €/Yen changing from medium down to low.
- **Options' implied volatility decreased in both observed markets**, with the VIX decreasing from 28.0 to 19.4 and the VSTOXX from 26.9 to 18, with both observed markets changing regime from medium down to low.
- **Commodities price changes were all downward;** with Iron Ore losing the most (-6.7%). **Volatility changes were mixed** and spanned a range between 14.8% (Gold) to 51.6% (Oil Brent).
- **Real Estate (equity) prices increased during March**, with Japan increasing the most (+5%). **Volatility moves were downward**, ranging between 13.4% (Japan) to 16.4% (US)**.**
- **The average PE Funds** gained +3.7%, while the **average Hedge Fund** lost -0.2%. **Volatility** for the average hedge fund increased from 3.1% to 4%, while the average PE fund decreased from 14.1% to 14%.

The Arkus Risk Team

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Summary volatility matrix and outlook

Despite central banks claiming for an only temporary phenomenon inflation expectations and yields continue to rise. This and further mutants of the coronavirus along with mixed success across countries in their vaccination campaigns did not impress equity markets much which continued to rally.

Joe Biden accelerates the vaccination race in the US and signs a $1.9tn COVID relief bill for US citizens and the US economy. This joins the "whatever it takes" measures by governments and central banks in the Western world and has supported the equity rally.

The last month has shown volatilities creeping further upwards with Fixed Income leading the pace now all in their high regimes (despite Germany). Something seems to be simmering in the background as uncertainty rises on how long money supply and state debt will continue to NOT be an issue.

ASSET CLASS	AREA	LATEST VOLATILITY	LATEST Z-SCORE	REGIME
EQUITIES	North America	17.7%	-0.3	medium
	Asia ex-Japan	19.6%	0.1	medium
	Europe	10.8%	-0.8	low
	Japan (Nikkei)	19.8%	-0.1	medium
	Energy	24.3%	-0.7	low
	Consumer Staples	9.6%	-0.5	low
	Financials	14.6%	-0.7	low
	IT	29.3%	0.1	medium
VOLATILITY OF VOLATILITY	Volatility of VIX	123%	-0.1	medium
	Volatility of VSTOXX	111%	-0.4	medium
GOVERNMENT BONDS	Germany	4.6%	0.3	medium
	US	5.1%	1.3	high
	Japan	2.1%	1.3	high
	Italy	6.4%	0.7	high
FX VS $	€/$	5.8%	-0.4	medium
	€/Yen	5.2%	-0.9	low
	€/CHF	5.1%	1.1	high
	€/£	4.4%	-1.2	low
COMMODITIES	Oil (Brent)	51.6%	0.0	medium
	Gold	14.8%	-0.7	low
	Copper	27.5%	0.7	high
	Iron Ore	25.8%	0.6	high
PROPERTY	US	16.4%	-0.7	low
	Europe	16.2%	-0.5	low
	Japan	13.4%	-0.6	low
ALTERNATIVES	HFRX Global HF	4.0%	0.3	medium
	Avg PE Fund	14.0%	-0.6	low
KURTOSIS	ZCF 1% left (vs -2.33 for normal curve)	-1.91	1.6	low
CORRELATION	Average market correlation with euro equities	24%	-1.0	low

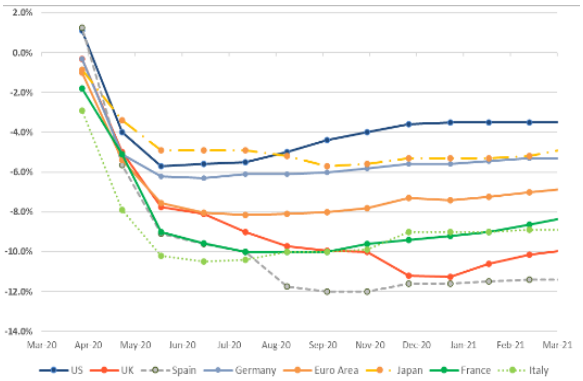
Note: *Throughout the text we refer to volatilities as being "low", "medium" or "High". We define this by defining three equal "sized" regimes over the last 12 months. i.e. "High" volatility implies that volatility is in the upper third of its statistical range over the last 12 months. The table shows the "z-score" of the volatility of each market, i.e. how many standard deviations above (or below) the mean over the last 12 months each market's volatility is.*

Key News

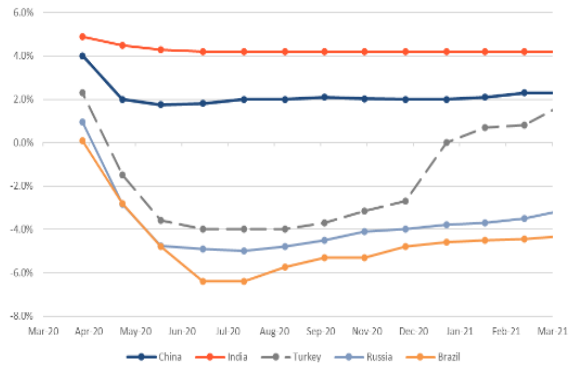
Major Volatility-Driving Events

- Alibaba charged with a record fine of $2.8bn by Chinese regulators for abusing its market position. The fine amounts to 4% of the annual turnover of the company and reflects the enhanced scrutiny Chinese regulators have started to apply to internet companies recently as their importance for the economy has grown rapidly.
- The UK is lifting restrictions after 100 days of lockdown as 60% of its population have had the first jab of the vaccine. Shops, pubs and restaurants are now open again.
- Credit Suisse set for a hit on results as the bank is suffering losses from its business relationships with insolvent Greensill Capital and hedge fund Archegos.
- EMA interrupted vaccinations with AstraZeneca as concerns about complications arose in several member states of the EU. The rising critique and doubts on this vaccine have harmed citizen´s trust in it and further delayed the vaccination race.
- Tesla now accepts Bitcoin for payments. This comes after the company massively invested in the cryptocurrency. After other market players announced the acceptance of Bitcoin prices were pushed near ATHs, despite growing concerns from an environmental perspective.
- Russia suspended travelling to Turkey after Turkish president Erdogan backed Ukraine and the NATO against Russia. As Russians are a very important group of tourists Turkish Lira plunged near ATLs.
- The director of Germany´s regulator Bafin, Felix Hufeld, resigned after continued criticism of his role in the Wirecard scandal. He will be replaced by the Mark Branson who comes from Swiss regulator Finma.

GDP ESTIMATES FOR 2021, DEVELOPED COUNTRIES



GDP ESTIMATES FOR 2021, DEVELOPING COUNTRIES



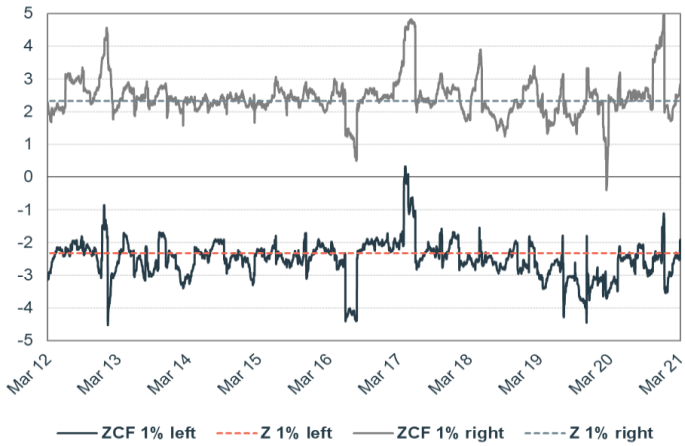
Kurtosis

Correlation in the equity markets

Kurtosis (against normal +/- 2.33)

The distribution of risks in European equity market displays denormalization with the ZCF 1% left at -1.91 and the right ZCF 1% at +2.84 (both as of 31st of March).

Cornish-Fischer expansion of Eurostoxx50 (60 days)



Methodology

To capture a measure of both Skewness and Kurtosis we look at the Cornish-Fischer expansion, which gives a good measure of the tails of the equity market. (We use a 60-calendar day rolling basis). The underlying market we plot is the Euro Stoxx 50, but other equity markets normally show very similar results.

We plot on the chart the expected Z-scores for 1% left tail (i.e. a 99% VaR) and a 1% right tail assuming a normal distribution: +/-2.33.

We also show the Cornish-Fischer expansion result for the same market. This indicates how far from a normal distribution each tail was.

On a long-term basis, on average, the tails are slightly fatter than the normal distribution would suggest, which should not come as a surprise. What is perhaps more surprising is how much variation in fat-tailedness there has been: a daily 99% VaR has varied between -1 and -4.5 standard deviations over time.

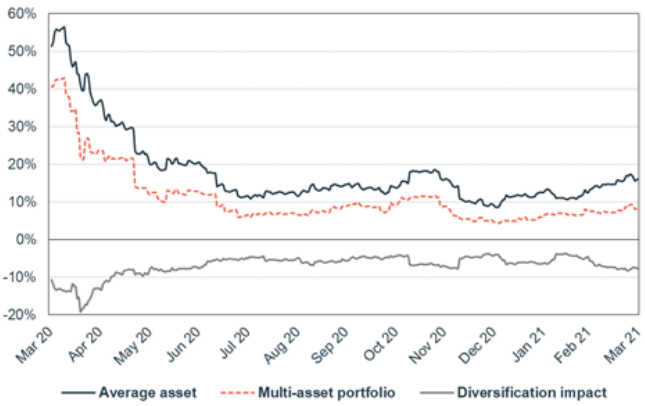
Inter-market correlations
with EU equities

Inter-market correlations (with EU equities)

↘ **23.7%** AVERAGE CORRELATION

Correlation with euro equities decreased during last month, leading our average correlation indicator to change from 31%. to 23.7% (medium down to low).

Multi-asset portfolio volatility



↗ **16.02%** AVERAGE VOLATILITIES

↗ **8.20%** PORTFOLIO VOLATILITY

We also look at a hypothetical multi-asset portfolio consisting of equities, bonds, gold, oil, and hedge funds.

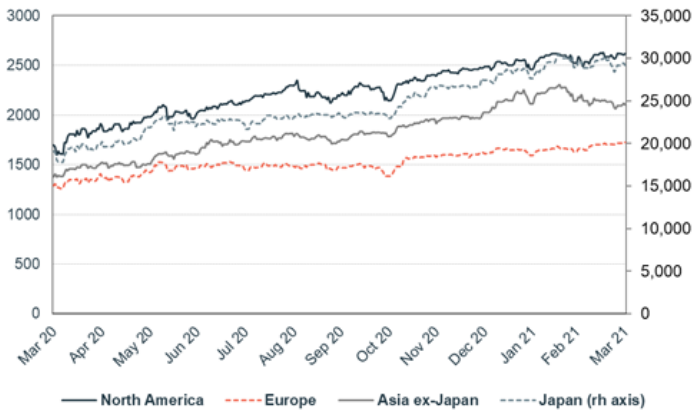
The average asset volatility increased, moving from 12.39% to 16.02%, while the benefit of multi-asset diversification increased, moving from 4.7% to 7.8%.

In combination, multi-asset portfolio volatility increased from 7.6% to 8.2%.

Note: *The chart shows 30-day correlation over time between different markets and the pan-Euro equity market. Higher levels of correlation will in general lead to less ability to diversify risks, and higher portfolio volatility for given position holding volatility.*

Equities
Stock price

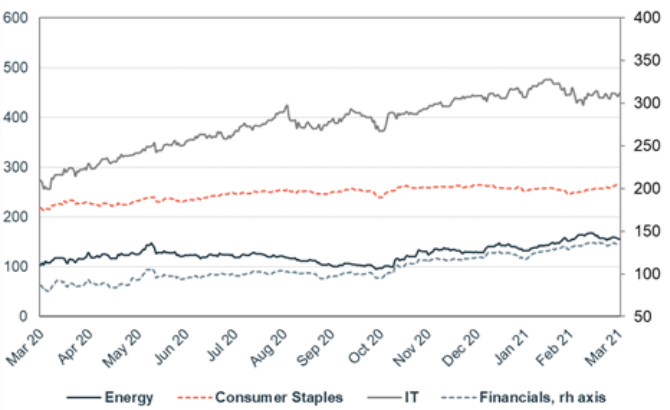
STOCK PRICE PERFORMANCE: REGIONS (LOG SCALES)



Equity region price movements were mixed. North America gained +3.7%, Asia ex-Japan lost -1.9%, Europe gained +5.7%, Japan (Nikkei) gained +0.7%.

+5.7%
Europe

STOCK PRICE PERFORMANCE: SECTORS (LOG SCALES)



Equity sector results were all upward trending. Energy gained +2.1%, Consumer Staples gained +6.3%, Financials gained +4.3%, IT gained +0.7%.

+4.3%
FINANCIALS

+0.7% IT

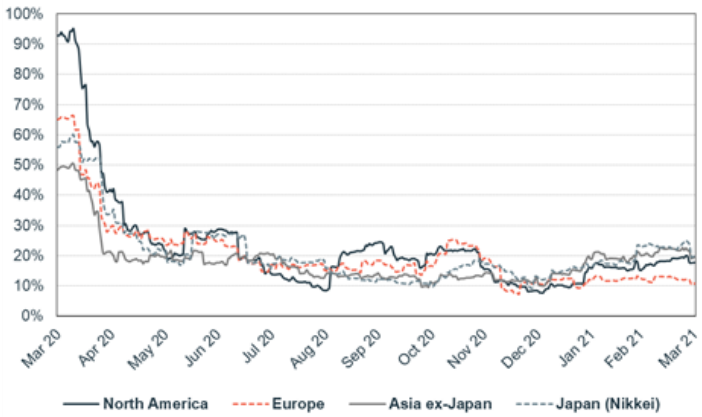
+2.1%
ENERGY

+6.3%
CONSUMER STAPLES

Equities
Volatility

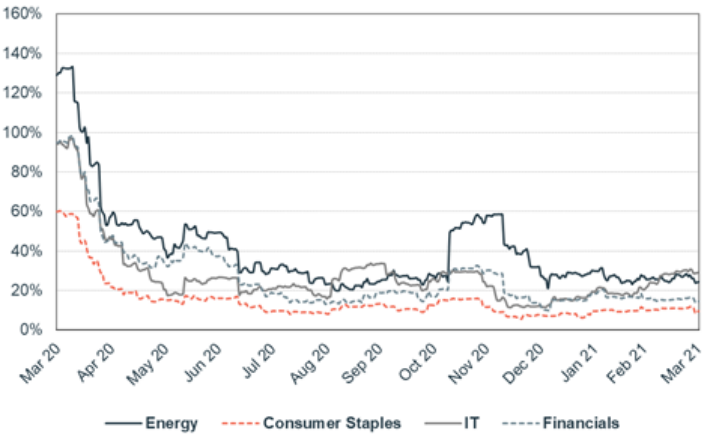
10.8%
EUROPE

EQUITY VOLATILITY: REGIONS



Volatility results were mixed. North America rose from 15.1% to 17.7% (low up to medium), Asia ex-Japan fell from 20.2% to 19.6% (medium), Europe fell from 12.6% to 10.8% (low), Japan (Nikkei) fell from 22.7% to 19.8% (medium).

EQUITY VOLATILITY: SECTORS



Volatility results were mixed. Energy fell from 27.1% to 24.3% (low), Consumer Staples fell from 11.1% to 9.6% (low), Financials fell from 16.5% to 14.6% (low), IT rose from 20.4% to 29.3% (low up to medium).

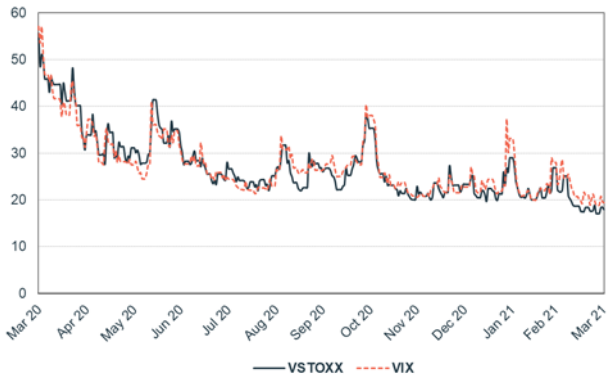
Equity Implied Volatility

Market-Implied Near Term Outlook

Implied Volatility

Implied volatility in both, US and Europe, decreased and both markets changed volatility regime. VIX fell from 28.0 to 19.4 (medium down to low), VSTOXX fell from 26.9 to 18.0 (medium down to low).

IMPLIED VOLATILITY



19.4% VIX

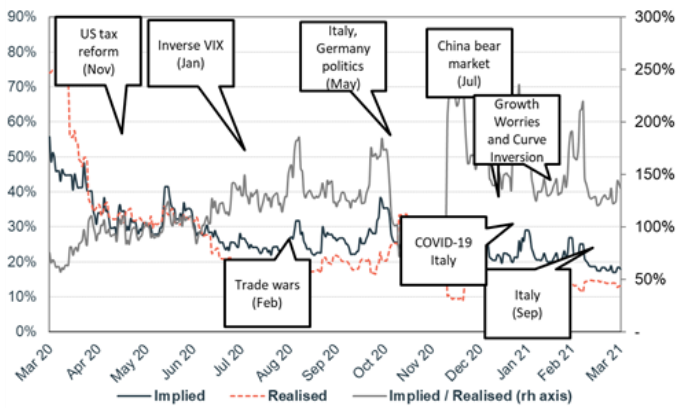
18.0% VSTOXX

Implied vs Realised Volatility

(European equity) implied volatility decreased from 26.9% to 18%. The realised volatility (of the Euro Stoxx 50 index over 30 days) also decreased from 14.1% to 13.2% bringing the ratio of implied/realised volatility to move down from 190% to 137%.

This ratio is suggesting that the market is currently anticipating future volatility to be higher than current, but lower than in previous month.

IMPLIED VS. REALISED VOLATILITY



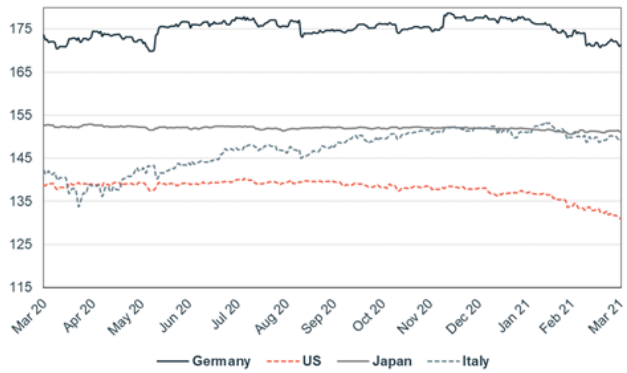
137% IMPLIED/REALISED VOLATILITY

Note: *Note: the implied/realised volatility ratio gives an indication as to whether the market sees an event in the next 30 days (the implied volatility period) which will increase realised volatility (implied/realised >100%, e.g. within 30 days prior to the Greek elections during the Greek crisis) or a period of relative calm after high realised volatility (implied/realised <100%, e.g. immediately after Draghi's calming "whatever it takes" comments).*

Fixed Income

10-Year Government Bond Futures

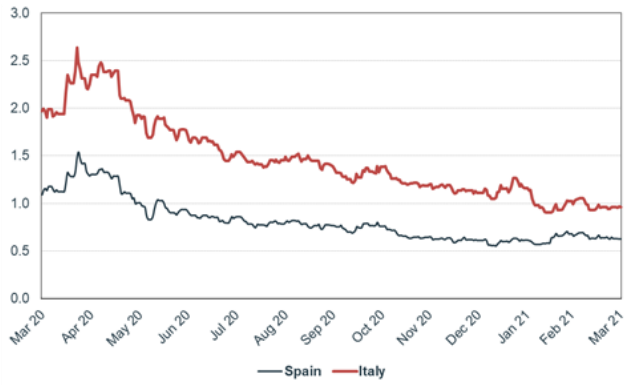
PRICES OF 10Y BOND FUTURES



Prices

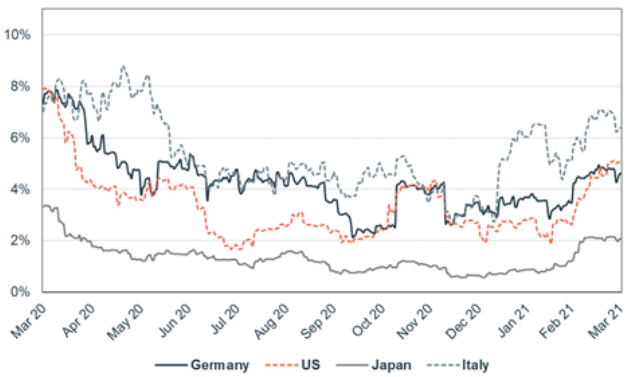
Government bond prices movements were mixed. Germany lost -1.2%, US lost -2.1%, Japan gained +0.4%, Italy lost -0.3%.

10 YEAR BOND SPREADS OVER GERMANY, %



Italian spreads over Germany decreased from 1.04% to 0.96%, while the Spanish spreads against Germany decreased from 0.68% to 0.63%.

VOLATILITY OF 10Y BOND FUTURES



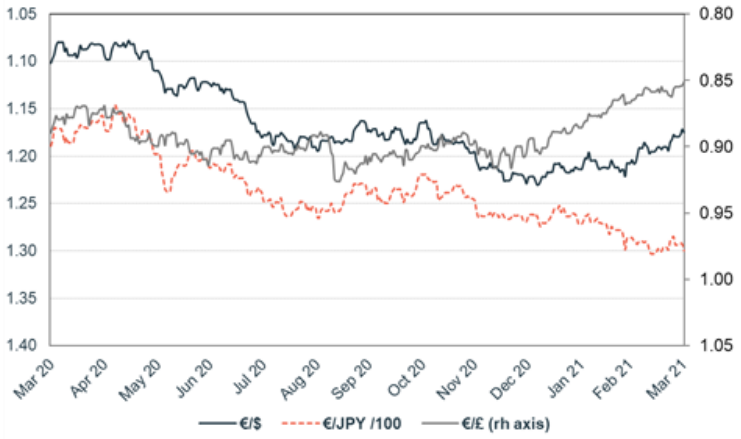
Volatility moves increased in all observed markets. Germany rose from 3.5% to 4.6% (low up to medium), US rose from 2.6% to 5.1% (low up to high), Japan rose from 1.2% to 2.1% (medium up to high), Italy rose from 5.1% to 6.4% (medium up to high).

Foreign Exchange

Prices

Euro results were mixed. We have that Euro lost 2.7% against the US Dollar, Euro gained 1.0% against the Japanese Yen, Euro gained 0.9% against the Swiss Franc, Euro lost 1.8% against the British Pound.

FX RATES VS. €



Volatility

FX volatility moves were also mixed. €/$ fell from 6.8% to 5.8% (medium), €/Yen fell from 6.8% to 5.2% (medium down to low), €/CHF rose from 4.5% to 5.1% (high), €/£ fell from 4.7% to 4.4% (low).

VOLATILITY OF FX RATES VS. €

↘ 5.8% € vs. $

↘ 4.4% € vs. £

↘ 5.2% € vs. ¥

Note: *The charts show currencies vs. the €. Axes on the first chart are inverted to show conventional currency quotations, but with higher on the chart representing a stronger currency vs. the euro.*

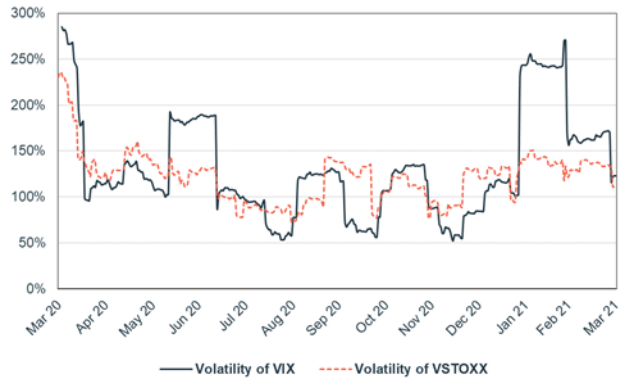
(Equity) Options

Option volatility is mainly driven by the volatility of volatility and moves in prices of the underlying instruments affecting options' deltas.

Implied volatility

Volatility of implied volatility decreased in both US and Europe. Volatility of VSTOXX fell from 121.6% to 111.0% (medium)Volatility of VIX fell from 156.4% to 123.0% (medium).

VOLATILITY OF VOLATILITY



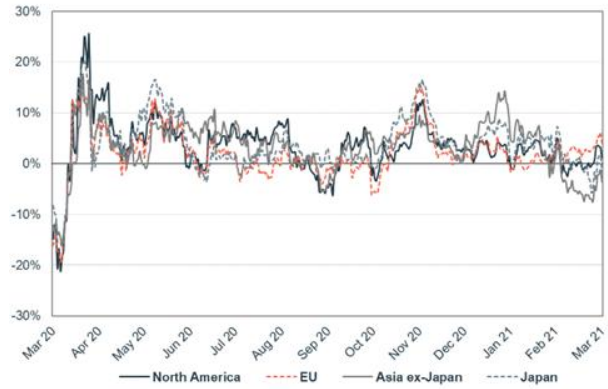
123.0% US

111.0% EUROPE

Major (Regional Equity) price moves

With the exception of Asia ex-Japan, all regions price movements were upward. We have that North America gained +3.7%, Asia ex-Japan lost -1.9%, Europe gained +5.7%, Japan (Nikkei) gained +0.7%.

CHANGE IN PRICES OF EQUITY INDICES, 30 DAYS



Note on Treatment: *Options show more complex behaviour than the other instruments we look at in this report, so we make some simplifying assumptions. As Calls and Puts are in effect polar opposites and in and out of the money options behave very differently, it is hard to generalise all options' behaviour. However, we look at the two key drivers: volatility of implied volatility and major price movements of the underlying security.*

Implied volatility (via an option's Vega) drives option prices, so a big indicator of option price volatility is the "volatility of implied volatility".

But usually the biggest driver of individual option prices is the movement of the underlying (via the option Delta): a move in either direction will cause the option to go more in or out of the money (and a corresponding change in the option's Delta and price volatility). As a proxy for this, we look at the 30-day price swing of equity market indices; options on bonds or FX could of course behave differently. The 30-day period is relatively close to the time to maturity of many options. Calls and Puts will respond in opposite fashions: calls becoming more volatile (relative to the size of the underlying notional) as prices rise.

Note on Convertibles: *Convertibles are in effect a combination of a bond and a call option, with the bond portion usually making little contribution to the instrument volatility unless the option is significantly out of the money. As such, convertible portfolios' volatilities will tend to behave similarly to call option portfolios, and this commentary can be applied to convertibles as well as options.*

Commodities

- 3.9% OIL

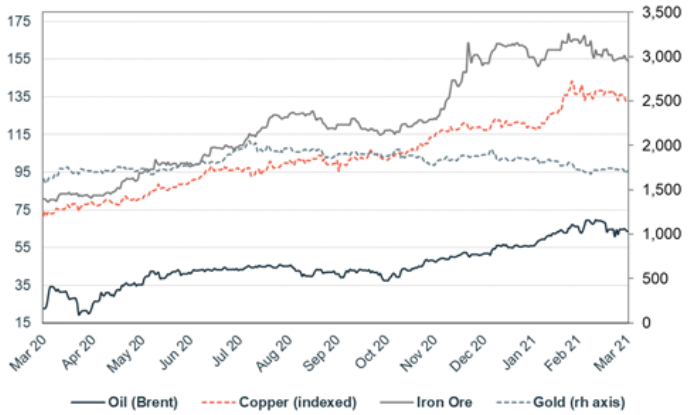
- 0.9% GOLD

- 2.4% COPPER

Prices

All commodity prices decreased during March. We have that Oil (Brent) lost -3.9%, Gold lost -0.9%, Copper lost -2.4%, Iron Ore lost -6.7%.

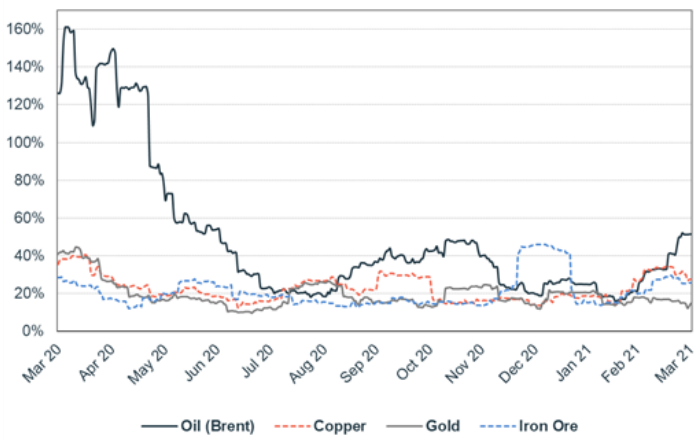
COMMODITIES PRICES, $



Volatility

Volatility movements of Commodities were mixed during March. On this regard, we have that Oil (Brent) rose from 21.3% to 51.6% (low up to medium), Gold fell from 17.9% to 14.8% (medium down to low), Copper rose from 26.6% to 27.5% (high), Iron Ore rose from 19.6% to 25.8% (medium up to high).

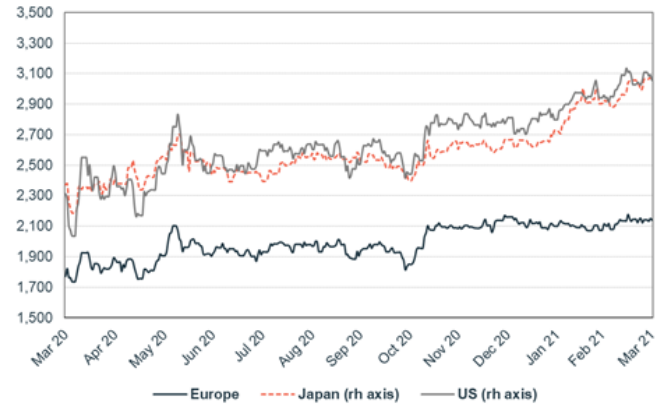
COMMODITIES VOLATILITY



Note: *all prices refer to near futures rather than spot with the exception of iron ore which is a spot price.*

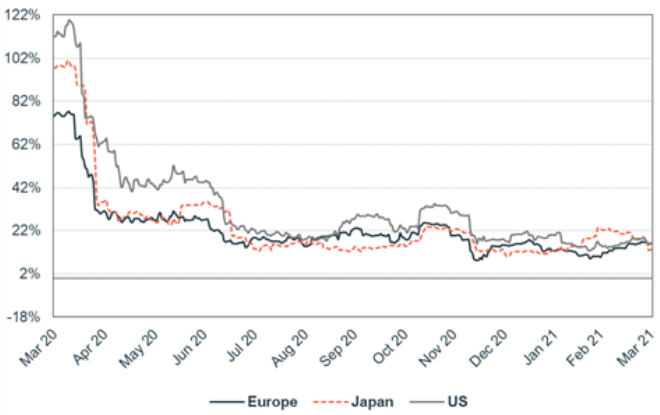
Real Estate and Alternatives
(Real Estate Share Prices)

REAL ESTATE (REIT) PRICES



Real estate regional prices results were all upward trending. We have that US gained +3.9%, Europe gained +3.2%, Japan gained +5.0%.

REAL ESTATE (REIT) VOLATILITY



Volatility moves were mixed. We have that US rose from 15.4% to 16.4% (low), Europe rose from 10.0% to 16.2% (low), Japan fell from 22.5% to 13.4% (medium down to low)

+3.2% EUROPE

+3.9% US

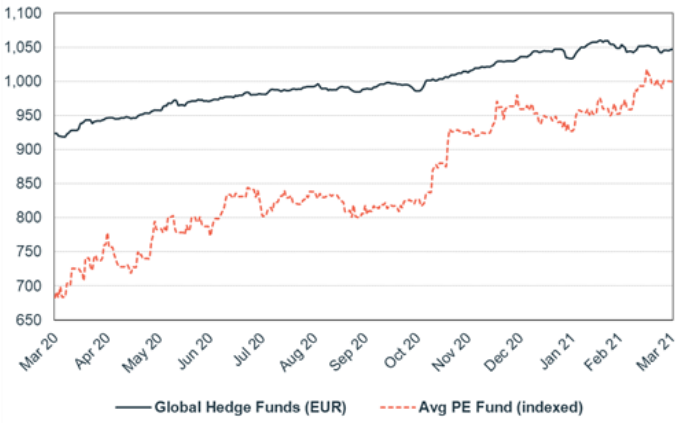
+5.0% JAPAN

Note: *Note that for property we look at indices of the share prices of REITs, and not the underlying property directly, for which little real-time data is available. This is usually consistent with funds which tend to invest in property indirectly, e.g. via REITs or property companies.*

As REITs are usually focused on commercial property, residential property may also follow a slightly different pattern to that discussed in this article.

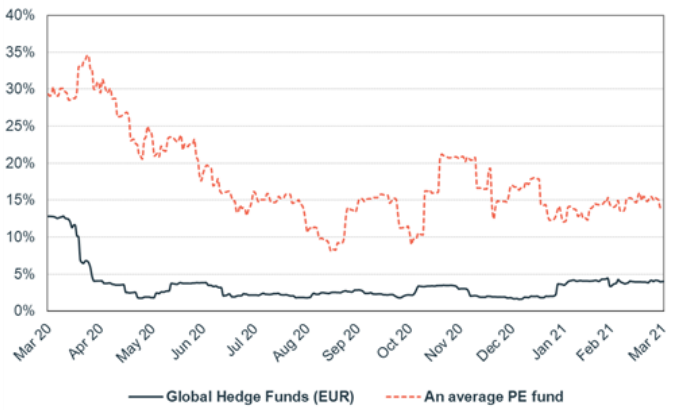
Alternatives

ALTERNATIVES PRICES



The average hedge fund lost -0.2%, an average PE fund gained +3.7%.

AI VOLATILITY



↗ 4.0% HFRX Volatility

↘ 14.0% AVERAGE PE FUND

Volatility results for Alternative Investments were mixed. We have that the average hedge fund rose from 3.1% to 4.0% (medium), An average PE fund fell from 14.1% to 14.0% (low).

Definitions

To avoid repetitions, the term volatility refers to annualised, 30-day average realised volatility in local currency unless otherwise specified. As such, it may be lower than, and lag, shorter-term market volatility in times of high market volatility.

Charts show data up to 31st March 2021, and news and events are included up to that date. The commentary was written on or before April 13th, 2021.

Disclaimer

The commentary does not constitute, and is not intended to constitute, investment advice.

Any views expressed in this report are based on historical market data and as such cannot be interpreted as being forward-looking, or to constitute forecasts. Past movements are not necessarily indicative of future movements.

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Luxembourg Office (HQ)

Societe Anonyme
6B Route de Treves L-2633
Senningerberg
Luxembourg

T +352 42 26 11 111 F +352 42 26 399

info@arkus-fs.com

London Office

150 Minories
London
EC3N 1LS

T +44 (0) 207 264 2027

www.arkus-fs.com