Milliman Financial Risk Management
London Market Monitor – 31 December 2018

Data sources: Bloomberg; Barclays; EIOPA; Oxford-Man Institute; ONS; Milliman FRM

Market Price Monitor

Local Equity Markets

- European equity markets slumped in December, on the back of lingering geopolitical concerns for Brexit, Italian politics and trade conflict, and a slowdown in European business confidence.
- The Euro Stoxx 50 and the FTSE index ended the month down by more than 5% and 3% respectively.
- All indices ended 2018 firmly in the negative territory, with the Euro Stoxx down by 12% year-to-date.

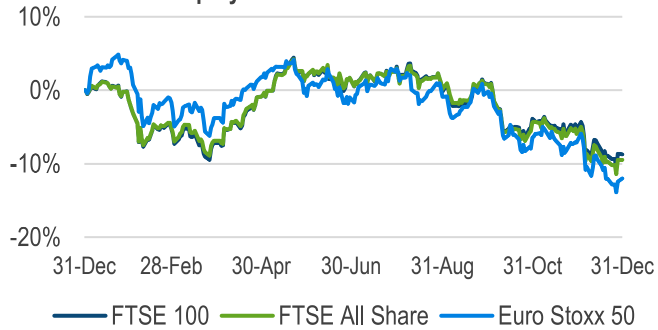
Global Equity Markets

- Equity markets around the globe also suffered large losses in December, with additional concerns for the Federal Reserve's monetary tightening policy and slower growth in the Chinese economy.
- The US and the Japanese markets lost by 9% and 10% respectively in the month.
- All market indices are negative for the year. The Japanese and the Emerging Market indices are down by around 15% year-to-date.

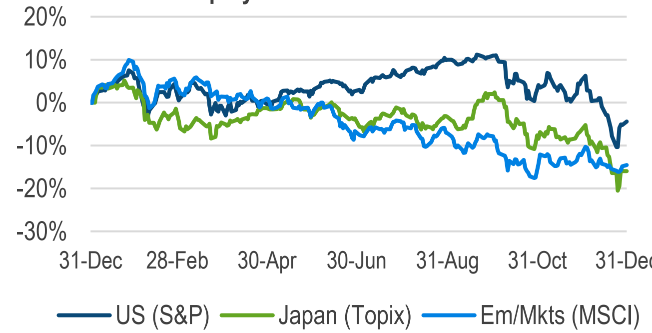
Bond/FX Markets

- Global and Sterling corporate bond returns both gained more than 1% in December.
- UK government bonds gained more than 2% in December.
- The Sterling depreciated against all major currencies, losing more than 3% versus the Japanese Yen.

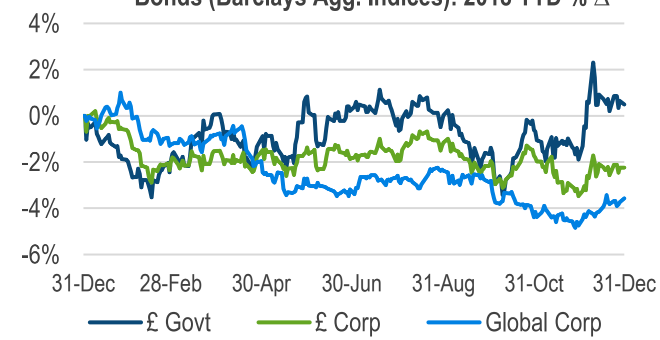
Local Equity Markets: 2018 YTD Total Return %



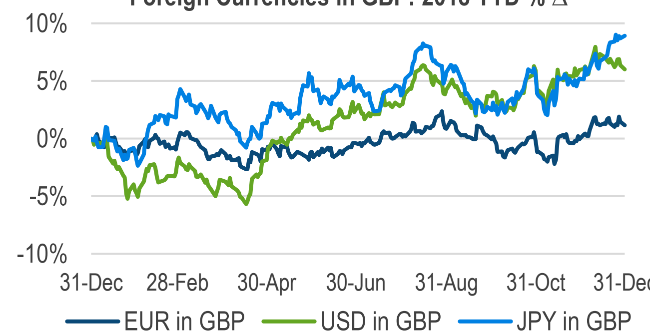
Global Equity Markets: 2018 YTD Total Return %



Bonds (Barclays Agg. Indices): 2018 YTD % Δ



Foreign Currencies in GBP: 2018 YTD % Δ



Total Returns as of December 31, 2018

	FTSE 100	FTSE All Share	Euro Stoxx 50	US (S&P)	Japan (Topix)	Em/Mkts (MSCI)	£ Govt	£ Corp	Global Corp	EUR in GBP	USD in GBP	JPY in GBP
1 Month	-3.5%	-3.7%	-5.3%	-9.0%	-10.2%	-2.7%	2.4%	1.3%	1.2%	1.2%	0.1%	3.5%
3 Month	-9.6%	-10.2%	-11.5%	-13.5%	-17.6%	-7.5%	2.1%	-0.1%	-0.8%	0.9%	2.2%	6.0%
1 Year	-8.7%	-9.5%	-12.0%	-4.4%	-16.0%	-14.6%	0.5%	-2.2%	-3.6%	1.2%	6.0%	8.9%
YTD	-8.7%	-9.5%	-12.0%	-4.4%	-16.0%	-14.6%	0.5%	-2.2%	-3.6%	1.2%	6.0%	8.9%

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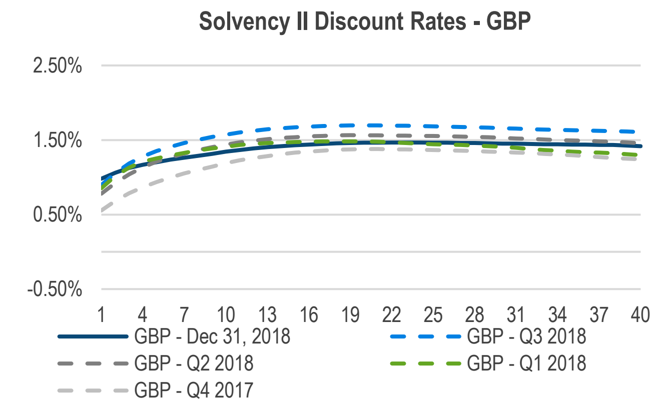
Solvency II Monitor - Rates

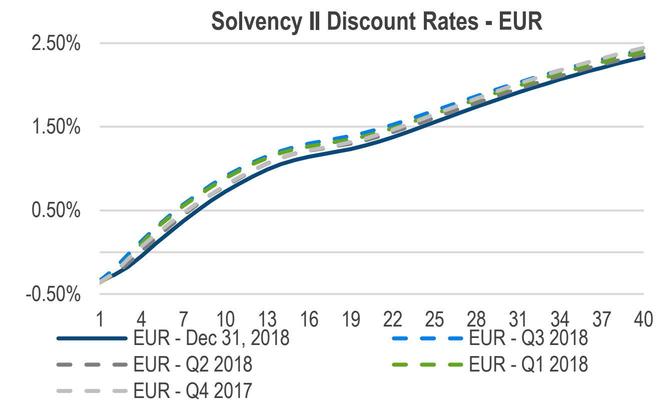
Risk Free Rates

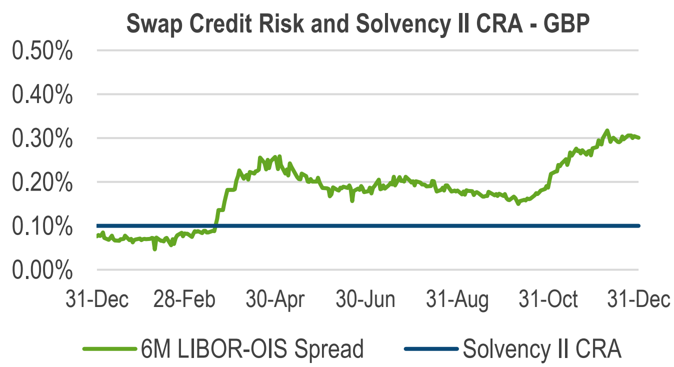
- For GBP, the rates decreased in all but the shortest terms in December, with the largest decline close to 30 basis points in the long end.
- The EUR rates also decreased for most of the curve, but to a less degree. The largest decline was less than 10 basis points.

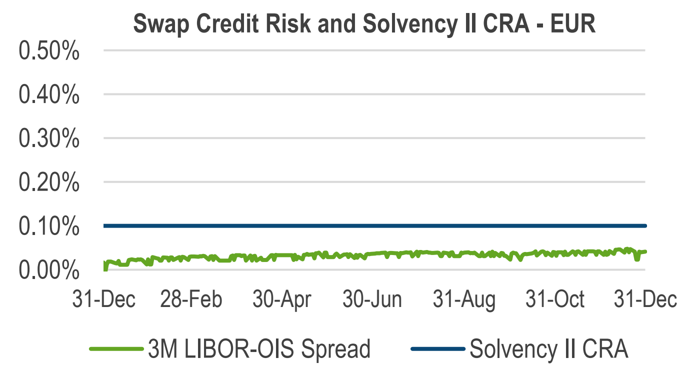
Credit Risk Adjustment

- The GBP CRA remains at 10 basis points. This will only change when the one-year average of LIBOR-OIS spread becomes greater than 20 basis points.
- EUR LIBOR-OIS continues to remain below the 10 basis points floor.









Change in GBP Discount and CRA (bps)

	1Y	Y5	Y10	Y20	Y30	CRA
Since Q3 2018	9	-15	-23	-23	-21	0
Since Q2 2018	20	-1	-10	-10	-8	0
Since Q1 2018	13	-5	-7	-2	5	0
Since Q4 2017	43	27	15	9	11	0

Change in EUR Discount and CRA (bps)

	1Y	Y5	Y10	Y20	Y30	CRA
Since Q3 2018	1	-19	-18	-15	-12	0
Since Q2 2018	2	-7	-6	-6	-4	0
Since Q1 2018	3	-19	-16	-11	-8	0
Since Q4 2017	3	-11	-8	-8	-10	0

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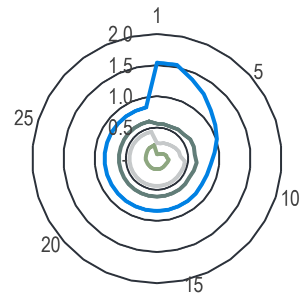
Solvency II Monitor - Spreads

Fundamental Spreads

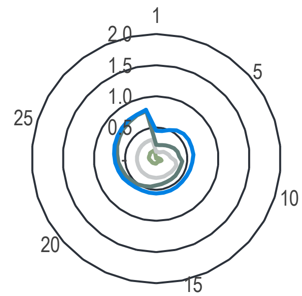
- The fundamental spread data shown is for end of November.
- There were no material changes compared to the end of October.

Fundamental Spreads %

GBP - Financial



GBP - Non-Financial



GBP Financial Fundamental Spread %

	1Y	Y5	Y10	Y20	Y30
AAA	0.07	0.11	0.18	0.17	0.22
AA	0.25	0.31	0.45	0.44	0.44
A	0.56	0.58	0.62	0.61	0.61
BBB	1.54	1.16	0.84	0.84	0.84

GBP Financial 'Before Floor' %

	1Y	*Y5*	*Y10*	*Y20*	*Y30*
AAA	*0.00*	*0.04*	*0.08*	*0.15*	*0.22*
AA	*0.04*	*0.07*	*0.11*	*0.19*	*0.27*
A	*0.07*	*0.14*	*0.22*	*0.36*	*0.49*
BBB	*0.17*	*0.28*	*0.39*	*0.57*	*0.69*

GBP Non-Financial Fundamental Spread %

	1Y	Y5	Y10	Y20	Y30
AAA	0.00	0.02	0.09	0.09	0.14
AA	0.11	0.16	0.34	0.31	0.31
A	0.22	0.29	0.41	0.53	0.78
BBB	0.45	0.59	0.57	0.59	0.80

GBP Non-Financial 'Before Floor' %

	1Y	*Y5*	*Y10*	*Y20*	*Y30*
AAA	*0.00*	*0.02*	*0.04*	*0.09*	*0.14*
AA	*0.00*	*0.04*	*0.09*	*0.19*	*0.27*
A	*0.04*	*0.15*	*0.28*	*0.53*	*0.78*
BBB	*0.11*	*0.23*	*0.36*	*0.59*	*0.80*

The **Solvency II risk-free discount rates** are based on applying the Smith-Wilson Extrapolation to LIBOR swap rates sourced from Bloomberg (current curve is for 31/12/18) and applying the Credit Risk Adjustment as defined in the Technical Specs.

The **Credit Risk Adjustment** is a component of the risk-free discount curve defined by EIOPA. It is calculated from actual experience in the 'LIBOR-OIS' spread (3 months for EUR, 6 months for GBP), and is bounded between 0.10 and 0.35. We show actual LIBOR-OIS spread levels and the defined CRA, for both GBP and EUR.

EIOPA fundamental spreads show the credit spread corresponding to the risk of default or downgrading of an asset. This is shown here across financial and non-financial assets, credit quality steps 0-3 and durations of 1-30 years. The data is provided by EIOPA and as of 30/11/18. **Fundamental spread** = maximum (probability of default + cost of downgrade; 35% of long-term average spread). In the tables we show the '**before floor'** measure = probability of default + cost of downgrade.

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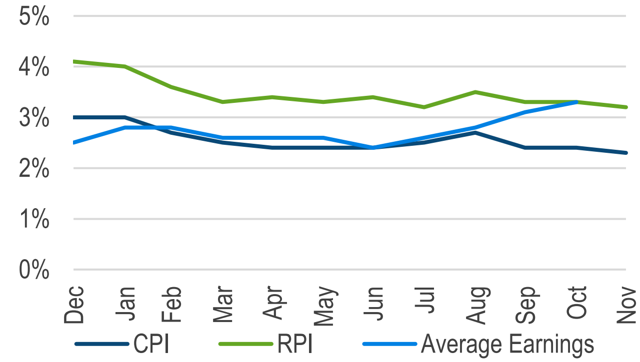
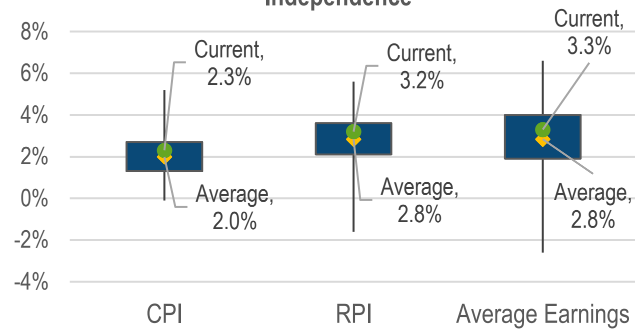
UK Inflation Monitor

- CPI and RPI price inflations both decreased by 10 basis points to 2.3% and 3.2% in November.
- In contrast, the earnings inflation in October increased by 30 basis points to 3.3%. This is the highest level seen in the last 12 months.
- According to the ONS: *The largest downward contributions to change in the 12-month rate came from falls in petrol prices and across a variety of recreational and cultural goods and services. These downward effects were offset by increased tobacco prices and, to a lesser extent, price rises in a variety of other categories.*
- The market implied view of future inflation remained unchanged.

UK Inflation Rate: Experience over Past Year

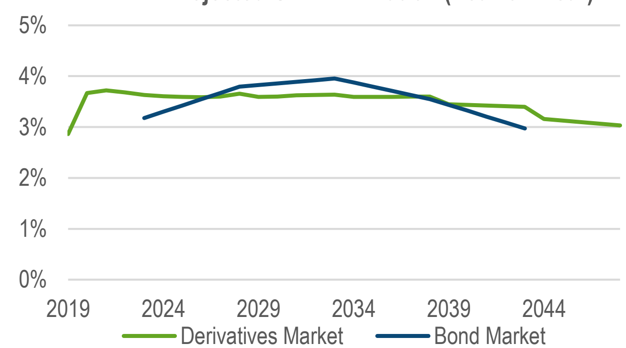


Max, Min and 50% Range: Since BoE Independence



Historical UK GDP Growth (Year-on-Year)

Projected UK RPI Inflation (Year-on-Year)



Historical year-on-year inflation rate is assessed by the % change on:
- **Consumer Price Index (CPI)** – measuring the monthly price of a basket of consumer goods and services
- **Retail Price Index (RPI)** – similar to CPI, but the main difference due the addition of mortgage payments, council tax and other housing costs
- **Average Earnings** – measuring the average total weekly employee remuneration over the previous 3 months.

Projection year-on-year inflation rate is the forward rate calculated from market data:
- **Derivatives Market View** – constructed from zero coupon inflation par swap rates against the RPI index at various tenors
- **Bond Market View** – constructed from the difference between the nominal rates implied by the conventional gilts and the real rates implied by the index-linked (RPI) gilts.

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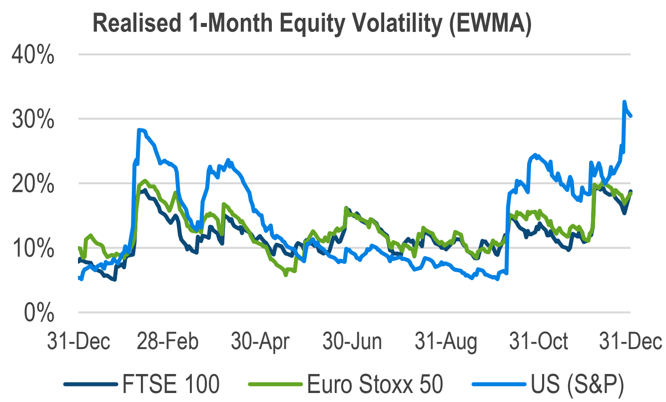
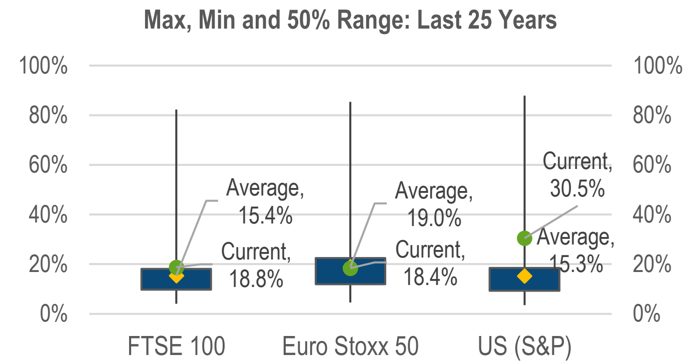
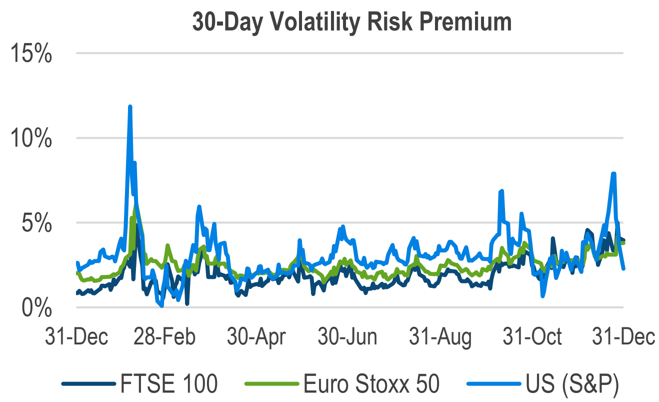
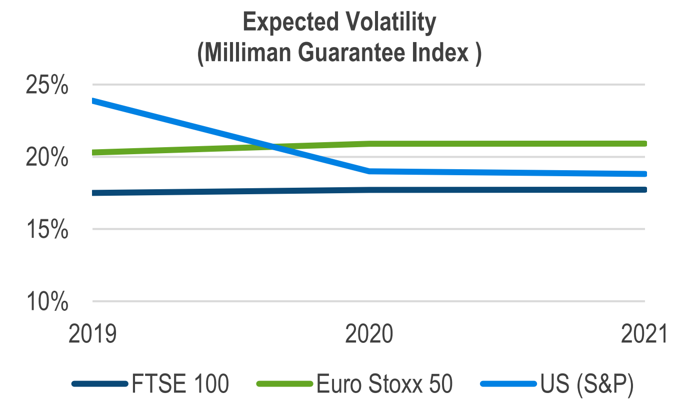
Volatility and Hedging Cost Monitor

- Realised volatility across the globe rose sharply again in December, as equity markets saw heavy losses.
- The US and the European market saw their volatilities breaching the 30% and 20% levels during the month, setting the record for year.
- The volatility risk premium increased during the month, with a temporary spike occurring in the US market near the month end.









Actual realised equity volatility is measured by the weighted standard deviation of 1 month daily index change. The Exponentially Weighted Moving Average (EWMA) methodology places more importance to the recent returns in the calculation of the volatility.

Volatility Risk Premium is estimated as the difference between 30-day implied volatility and projected realised volatility (on data from the Oxford-Man Institute). This reflects the additional cost of hedging from purchasing a basket of options, in comparison to managing a dynamic delta hedge with futures (ignoring rolling transaction costs).

Expected realised volatility is an intermediate result from the Milliman Guarantee Index™ (MGI), which provides volatility parameters for variable annuity guarantee (VA) valuation and risk management. The levels shown are on an expected basis, and do not reflect any risk adjustment.

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