What impact will QT have on financial markets?

Global financial markets

Authors: Vincent Heaney, Strategist, UBS AG; Kiran Ganesh, Strategist, UBS AG; Paul Donovan, Global Chief Economist GWM, UBS AG; Vinay Pande, Head of Trading Strategies, UBS Financial Services Inc. (UBS FS); Leslie Falconio, Sr. Fixed Income Strategist Americas, UBS Financial Services Inc. (UBS FS); Jerry Lucas, Strategist, UBS Financial Services Inc. (UBS FS); Dirk Effenberger, Strategist, UBS Switzerland AG; Luca Henzen, Analyst, UBS Switzerland AG; Linda Mazziotta, CFA, Analyst, UBS Switzerland AG

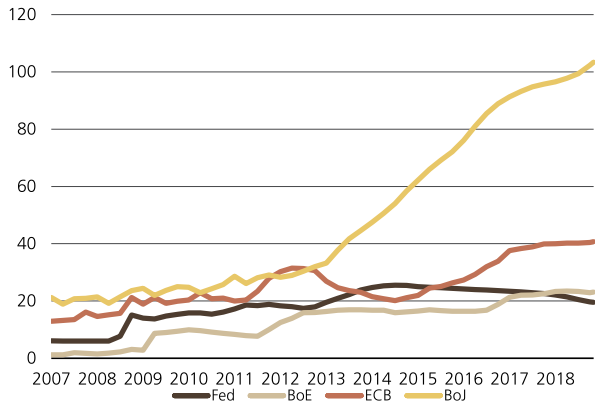
- Over the past ten years, asset returns have displayed a high correlation with central bank purchases. Investors are concerned that QT could significantly impact markets.
- Correlation does not imply causation. The direct effects of the Federal Reserve's QT on asset prices and the economy are likely to be limited.
- Central bank signaling of its intentions with QT will be important. Overall, investors should consider risks from QT alongside other probabilistic and 'event' risks to markets.
- Poor communication can damage investor sentiment in the near term. But with direct effects limited, QT should not persistently impact longer-term returns.

Quantitative easing (QE) was an unconventional response to an exceptional crisis. This process is now going into reverse, which is known as quantitative tightening (QT).

In aggregate, major central bank balance sheets will end 2019 smaller than they started. The US Federal Reserve is allowing its holdings to mature and is not replacing them (known as passive tightening) and may be about halfway through its balance sheet normalization process. The Bank of England and European Central Bank, meanwhile, are allowing their balance sheets to reduce relative to GDP, which is known as organic tightening. Elsewhere, the Bank of Japan looks likely to end the year as the only central bank which is still easing.

Fig. 1: The BoJ's balance sheet is bigger than Japan's economy

Major central banks' balance sheets as a % of GDP



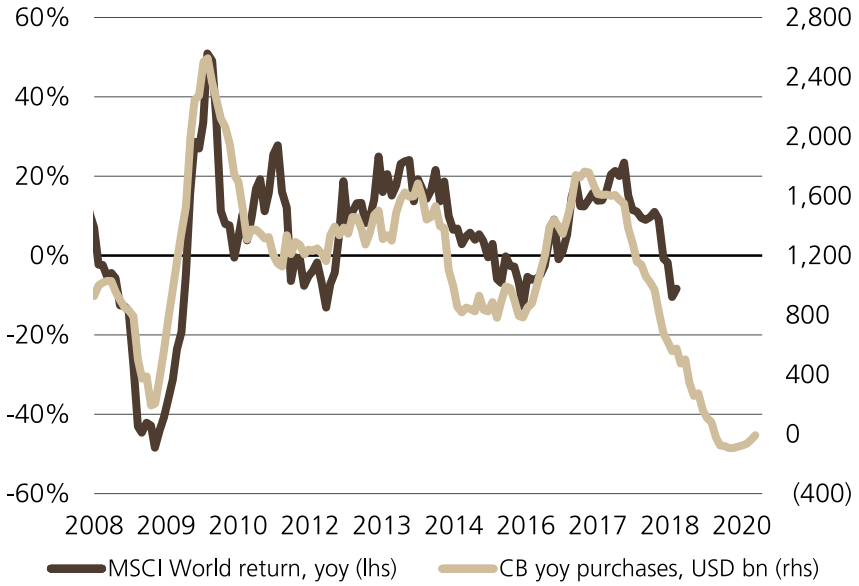
Source: UBS, Bloomberg, as of 12 February 2019

Investors are concerned that QT could significantly impact markets

Over the past ten years, asset returns have displayed a high correlation with central bank purchases (see Fig. 2 & 3). And recently, the Fed's balance sheet run-off was cited as a contributory factor in the sharp sell-off in risk assets in December, which left the S&P 500 almost 20% below its peak. Taking those two factors into consideration, it is clear that investors are concerned. After all, if QE had a significant impact on markets, then wouldn't QT have the reverse effect?

Fig. 2: Central bank asset purchases correlated with global equity performance

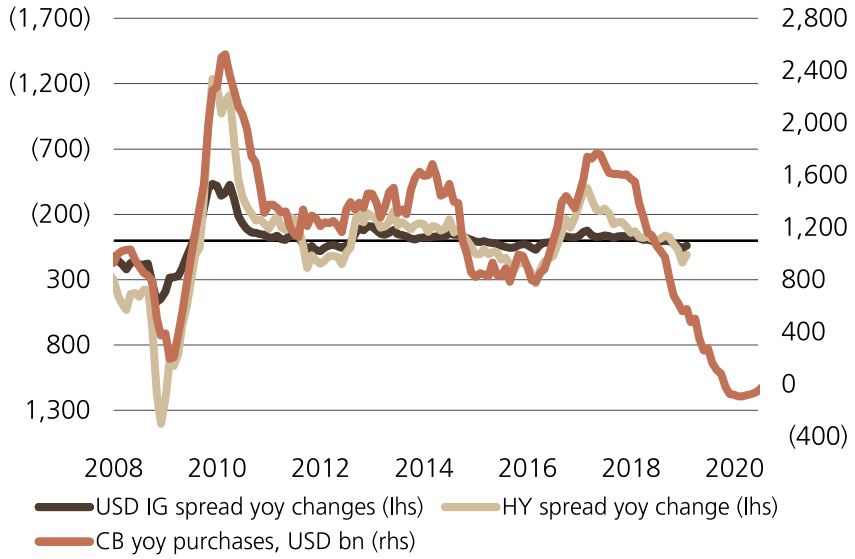
Central bank asset purchases, in USD bn, and MSCI World return, in %



Source: UBS, Bloomberg, as of 12 February 2019

Fig. 3: HY and IG bond yield spreads have been correlated with QE

Central bank asset purchases and USD IG, USD HY bond yield spreads, in %



Source: UBS, Bloomberg, as of 12 February 2019

Correlation need not imply causation

Correlation, however, does not necessarily imply causation. In this paper we show that the direct effects of the Fed's QT on asset prices and the economy are likely to be limited.

However, the Fed's signaling of its intentions with QT will be important. There is a chance that central banks and markets become misaligned in the short term, as we saw most recently in December 2018. That was largely due to Fed Chair Jay Powell's comments that balance sheet reduction was on "autopilot."

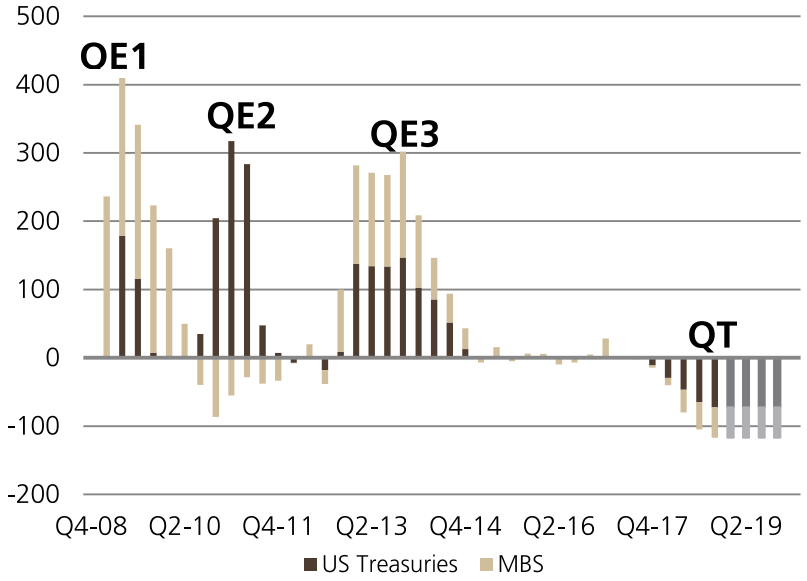
Overall, investors should consider risks from QT alongside other probabilistic and "event" risks to markets. But provided that central banks remain flexible and are willing to learn the lessons from such communication errors – as the Fed has shown in subsequent comments that it remains data-dependent – the risk should be temporary rather than structural (see *Indirect impacts: Getting the signal right*).

Limited direct impact of Federal Reserve QT

We believe that the overall direct impact of the Federal Reserve's quantitative tightening program is likely to be limited. As such, investors should not view it as a structural drag on asset returns.
We outline four main reasons for our view:

1) QT will be much smaller than QE
The Fed's balance sheet will not fall back to pre-crisis levels. The balance sheet expanded fivefold from USD 900bn pre-crisis to a peak in 2017 of USD 4.5trn. We believe QT will only reduce the balance sheet to about USD 3.5trn (see Fig. 4 & Table 1). With the reduction so much smaller than the expansion that preceded it, the direct impact of QT is likely to be significantly smaller than the impact of QE.

Fig. 4: The reduction of the Fed's security holdings to date has been less than half of the increase during QE1-3
Quarterly changes of the Fed portfolio, values in USD bn



Source: Bloomberg, UBS, as of 12 February 2019

Table 1: Evolution of the Fed's balance sheet

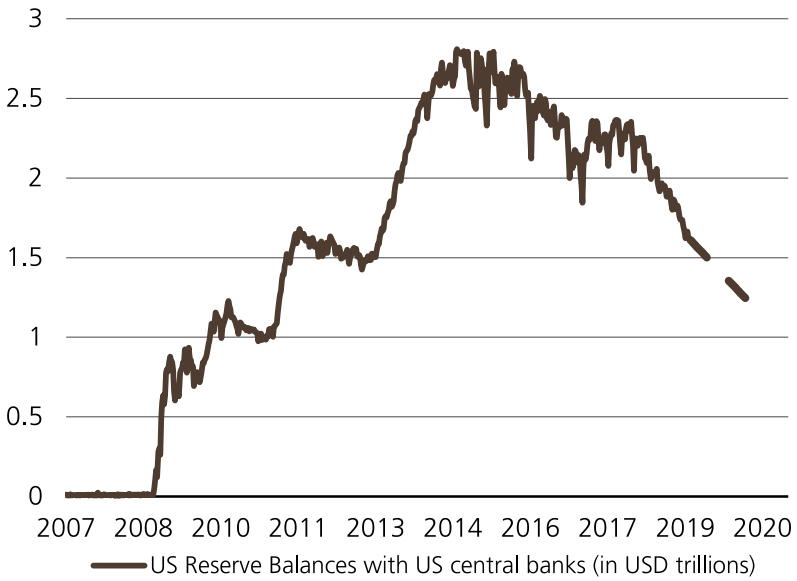
As of	Aug. 8, 2007	Sep. 2017	Jan. 2019	Mar. 2020
	Pre-crisis	Pre-runoff		
Total Assets	**865**	**4'456**	**4'040**	**3'561**
Treasuries	791	2'465	2'220	1'934
MBS	0	1'768	1'622	1'429
Other	74	222	198	198
Total Liabilities	**832**	**4'414**	**4'001**	**3'521**
Currency	777	1'533	1'656	1'795
Reserves	5	2'179	1'609	1'000
Reverse Repurchase Agreements	32	455	249	251
Treasury General Account	5	155	411	400
Other	13	92	75	75
Capital	**34**	**41**	**39**	**39**

Source: Fed Reserve Board, UBS, as of 12 February 2019

The most important variable in determining the end point for the balance sheet is the final level of reserves, i.e., liquid deposits held by banks and financial institutions as a credit balance at the Fed which are not lent out or invested. Prior to the crisis the Fed operated on scarce reserves, but at the January 2019 FOMC meeting the Fed confirmed that once balance sheet reduction ends, it will operate monetary policy in an "ample reserves" framework. Our estimate for the final level of reserves is USD 1trn.

Part of the rationale for continuing to run the system with a higher level of reserves than before the crisis is that the US economy is now larger in nominal terms and is more cash-based. That means the liquidity preference relative to GDP has risen. A recent Fed survey of 51 banks that account for two-thirds of the reserves in the banking system suggests a minimum demand for reserves of USD 600 billion, which is roughly USD 900 billion when grossed up to account for the whole banking system, close to our estimate of USD 1trn (see Fig. 5). We see this as a limit to how far the Fed balance sheet can shrink.

Fig. 5: UBS estimates the terminal level of reserves the Fed wants to leave in the system at about USD 1trn
US reserve balances with US central banks

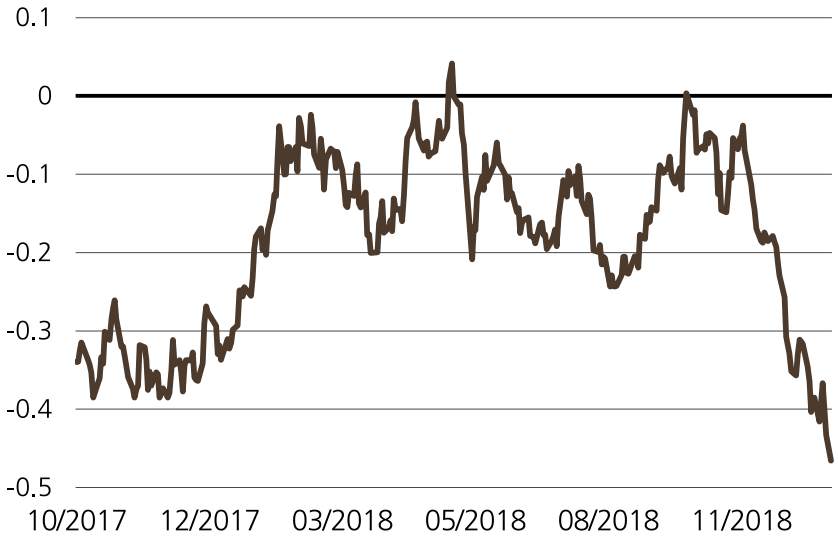


Source: Bloomberg, UBS, as of 6 January 2019

2) QT is unlikely to fully reverse the impact of QE on long-term interest rates

By buying long-term bonds and mortgage-backed securities, the Fed expected quantitative easing to push money into areas such as corporate bonds, thereby lowering corporations' borrowing costs and hopefully sparking the productive use of capital. The Fed's own research suggests that at its peak impact, QE lowered yields on 10-year US Treasuries by 100 basis points (bps), although other academic studies have disputed that the impact was this large.

Fig. 6: The term premium fell during the 4Q18 sell-off
Term premium ppt



Source: Bloomberg, UBS, as of 6 January 2019

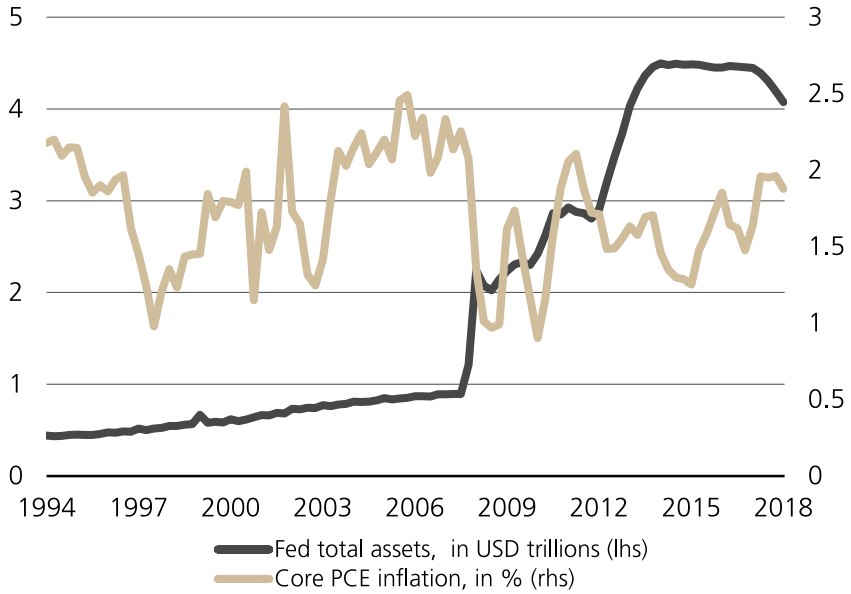
QT can be expected to reverse some of this impact, but we do not expect it to raise long-term rates by 100 bps. As noted above, the size of the balance sheet reduction will be far smaller than the expansion that preceded it. The evidence so far suggests that there has been no persistent trend toward a higher term premium. And, in fact, during 4Q18 when investors appeared most concerned that QT was having an adverse impact on risk assets, the term premium fell (see Fig. 6).

3) QT should not significantly impact liquidity and inflation

QT is also unlikely to have a significant impact on liquidity or inflation. Changes in liquidity or inflation conditions occur when there is a mismatch between supply of and demand for cash.

In the financial crisis, the liquidity preference rose, and so central banks "printed money" in response. With the financial crisis now more than a decade behind us, the liquidity preference has fallen, and so the Fed is responding by reducing the amount of cash reserves in the system. The reaction of central banks to changes in liquidity preference to keep the supply of and demand for cash in balance should therefore not affect liquidity or inflationary conditions. Indeed, ten years' worth of inflation data show that QE has not proven inflationary (see Fig. 7) and, similarly, QT should not have a depressing effect on inflation. In fact, if the Fed were not reducing liquidity supply now, cash supply would exceed cash demand and inflation could become a serious problem.

Fig. 7: Historically, the size of the Fed's balance sheet has not had a visible impact on inflation
Fed total assets, in USD trillions (lhs), core PCE inflation, in % (rhs)

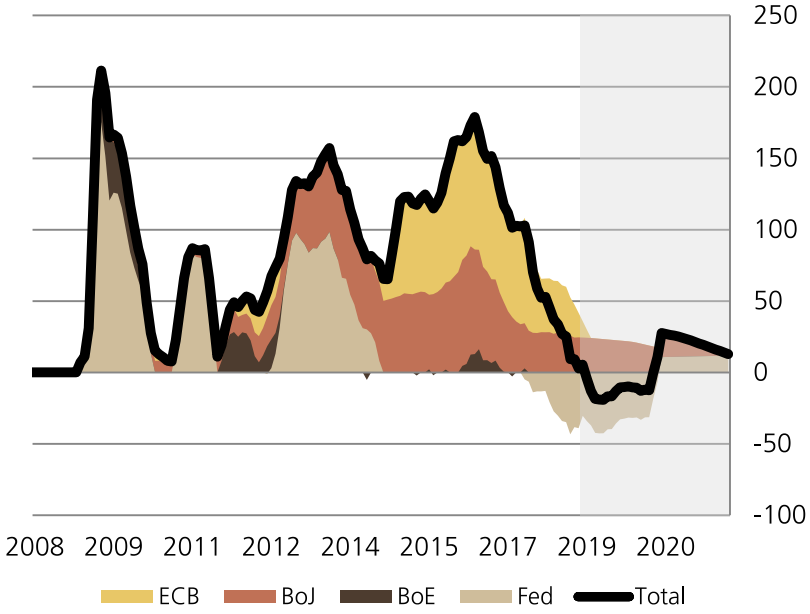


Source: Bloomberg, UBS, as of 31 January 2019

4) The Fed's balance sheet will start growing again in 2020

The Fed's quantitative tightening only started in October 2017, but we may now already be closer to the end of QT than the beginning. Uncertainty remains over both the final size of the Fed's balance sheet and the precise timetable for balance sheet normalization. But based on our estimate of USD 1trn of excess reserves, our base case is that the balance sheet runoff should end in March 2020 (see Fig. 8).

Fig. 8: Central banks' monthly net security purchases will be negative in 2019, but likely positive again in 2020
Monthly securities purchased by the major central banks, in USD billion



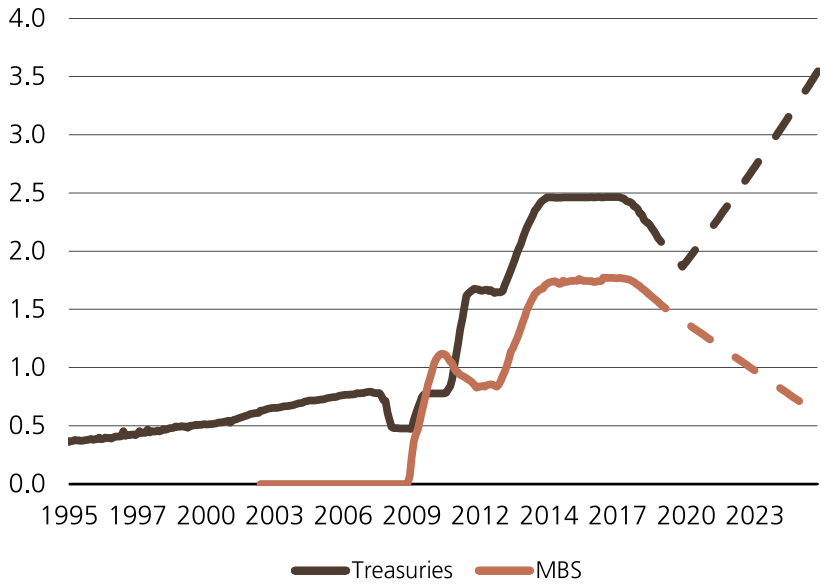
Source: Haver Analytics, UBS, January 2019

If we are right, by mid 2020, the Fed's balance sheet will start to expand again to prevent reserves from falling below its desired level. At this point the Fed will again begin purchasing Treasury securities – on average about USD 10 billion per month. Alternatively, if the Fed were to err on the side of caution and decide on a level of reserves of USD 1.25trn, the balance sheet unwind could finish as early as September 2019, although we consider this to be unlikely.

Mortgage-backed securities (MBS)

One area where QT could have a more notable direct impact is on the MBS market. The Fed has clearly and consistently stated that it wants to return to an all-Treasury balance sheet. When balance sheet run-off is complete the Fed will reinvest the cash from maturing/prepaid MBS into Treasuries. The pace at which it will do this is hard to predict, but assuming a pre-payment rate of 12% would suggest USD 10-12bn per month. With combined purchases of over USD 20 billion Treasuries per month, and over USD 10bn of MBS per month not being reinvested, clearly there is potential for the basis between Treasuries and MBS to widen.

Fig. 9: The mix between Treasuries and MBS on the Fed's balance sheet will shift
Treasuries, MBS, in USDtrn



Source: UBS, Federal Reserve Board

However, it is difficult to position for such a potential widening a year in advance. Basis widening could be swamped by other factors. For example, if Fannie Mae and Freddie Mac are combined and privatized, MBS liquidity could improve, but they may also be seen as less creditworthy if they lack a clear government backstop.

ECB/BoJ balance sheet reduction is a greater threat

Although we do not think the Fed's QT is likely to have a major direct impact on asset prices or the economy, we believe that QT by the ECB or BoJ would have a greater impact on asset prices if and when the ECB and/or the BoJ start to reduce their reinvestment of the proceeds from maturing assets or sell assets. In the Eurozone and Japan the magnitude of QE, relative to their overall economies, has been much larger, in part because both of these economies were more cash-based than the UK and the US. The ECB and the BoJ were also much bolder in the range of instruments they bought, extending into corporate bonds, and, in Japan's case, equities.

The ECB's Benoit Coeure has previously argued that the ECB could affect long-term yields materially with modest interventions, because it now owns a very significant proportion of the market. However, Coeure's conclusion that "this means that, in the future, the Eurosystem can retreat as buyer in the market without risking an unwarranted decompression of the term premium" appears optimistic. If the ECB is correct that its size means its actions have a disproportionate effect, it appears logical that this would hold true as it unwinds its program.

The situation could be further complicated by market liquidity. European corporate bond markets are not as liquid as the US Treasury market. The ECB has also conducted its purchases according to the size of each Eurozone country's economy

– a calculation known as the capital key – rather than the size and liquidity of its fixed income markets. Importantly, the less liquid instruments bought by the private sector as liquidity preference declines will not necessarily match the less liquid instruments sold (or rolled off, or not bought) by the ECB as it unwinds QE.

However, whatever the effect of balance sheet reduction may be, the ECB is unlikely to start anytime soon. It has only recently stopped QE, and with Eurozone growth momentum currently waning, no move to start normalizing rates is likely before 2020. The BoJ, meanwhile, is still adding liquidity.

Indirect impacts: Getting the signal right

While the direct impact of QT appears limited, the correlation between central bank purchases and asset price returns over the past decade needs an explanation.

One way that QE worked was through the portfolio balance channel. Money flowed from highly liquid asset markets (Treasuries) into higher-yielding but less liquid assets such as corporate credit and emerging markets. Lower credit spreads supported increased corporate bond issuance, in turn allowing larger share buyback programs and supporting equity prices.

With QT working in the opposite way through the portfolio balance channel, it appears logical that more peripheral, liquidity-sensitive asset markets might be vulnerable. QT has for example been cited as a contributory factor in last year's turmoil in some emerging market assets. However, it is difficult to disentangle this impact from the fact that US interest rates and the US dollar were also rising, which typically creates cyclical headwinds for EM economies with significant USD-denominated liabilities. QT was therefore not the single big factor that was affecting asset prices.

In our view, one of the most important channels by which QE impacts assets is the signaling effect. This has helped anchor investor expectations and lower risk premiums. Policy announcements were intended to show the Fed would take decisive and prolonged action and to have the maximum effect possible on investor sentiment. The ECB has employed a similar approach, most notably in Mario Draghi's 2012 "whatever it takes" speech.

Announcements of QT in contrast are designed to have the minimum impact on investor sentiment. Flagged well in advance and very gradual in nature, central bankers hope – as former Fed chair Janet Yellen described it – that unwinding their balance sheets will be as interesting as watching paint dry. Hence the tapering of bond purchases was gradual and balance sheet run-off is also a prolonged process.

There is clearly a risk that a central bank could misread the market and issue the wrong signals. For instance, in December equity markets suffered their worst reaction to a Fed rate hike since 1994 when Chair Jerome Powell said that the Fed's balance sheet reduction was on "auto-pilot".

Central bank signaling of course needs to address the overall stance of monetary policy, and this will have ramifications for both rates and the balance sheet. The Fed currently estimates that US monetary policy is neither strongly accommodative, nor restrictive for economic growth. In our base case, to which we assign a 60% probability, the Fed's assessment should prove largely correct, which suggests the Fed should avoid a further policy mistake. We also see a 15% probability that the Fed resumes policy tightening, but amid an ongoing cyclical upswing with no adverse impact on risk assets.

Other scenarios carry a greater risk that the Fed and the market become misaligned. We see a 15% probability that US growth is weaker than expected and that the Fed is seen as having already raised rates too much. This could potentially lead to an earlier end to balance sheet normalization. We see a 10% chance that labor market tightness forces the Fed to end its pause sooner than anticipated and tighten policy further, with an adverse impact on growth and markets.

However, in this regard QT is analogous to other risk factors that markets face – whether it is a breakdown in trade negotiations, a further US government shutdown or a hard Brexit. Provided therefore that central banks remain flexible and are willing to learn the lessons from communication errors, the risk from QT should be temporary rather than structural. Poorly managed communications can damage investor sentiment in the near term, but with direct impacts limited, both fundamentals and longer-term returns should not be impacted by QT.

Appendix

UBS Chief Investment Office's ("CIO") investment views are prepared and published by the Global Wealth Management business of UBS Switzerland AG (regulated by FINMA in Switzerland) or its affiliates ("UBS").
The investment views have been prepared in accordance with legal requirements designed to promote the **independence of investment research.**
Generic investment research – Risk information:

This publication is **for your information only** and is not intended as an offer, or a solicitation of an offer, to buy or sell any investment or other specific product. The analysis contained herein does not constitute a personal recommendation or take into account the particular investment objectives, investment strategies, financial situation and needs of any specific recipient. It is based on numerous assumptions. Different assumptions could result in materially different results. Certain services and products are subject to legal restrictions and cannot be offered worldwide on an unrestricted basis and/or may not be eligible for sale to all investors. All information and opinions expressed in this document were obtained from sources believed to be reliable and in good faith, but no representation or warranty, express or implied, is made as to its accuracy or completeness (other than disclosures relating to UBS). All information and opinions as well as any forecasts, estimates and market prices indicated are current as of the date of this report, and are subject to change without notice. Opinions expressed herein may differ or be contrary to those expressed by other business areas or divisions of UBS as a result of using different assumptions and/or criteria. In no circumstances may this document or any of the information (including any forecast, value, index or other calculated amount ("Values")) be used for any of the following purposes (i) valuation or accounting purposes; (ii) to determine the amounts due or payable, the price or the value of any financial instrument or financial contract; or (iii) to measure the performance of any financial instrument including, without limitation, for the purpose of tracking the return or performance of any Value or of defining the asset allocation of portfolio or of computing performance fees. By receiving this document and the information you will be deemed to represent and warrant to UBS that you will not use this document or otherwise rely on any of the information for any of the above purposes. UBS and any of its directors or employees may be entitled at any time to hold long or short positions in investment instruments referred to herein, carry out transactions involving relevant investment instruments in the capacity of principal or agent, or provide any other services or have officers, who serve as directors, either to/for the issuer, the investment instrument itself or to/for any company commercially or financially affiliated to such issuers. At any time, investment decisions (including whether to buy, sell or hold securities) made by UBS and its employees may differ from or be contrary to the opinions expressed in UBS research publications. Some investments may not be readily realizable since the market in the securities is illiquid and therefore valuing the investment and identifying the risk to which you are exposed may be difficult to quantify. UBS relies on information barriers to control the flow of information contained in one or more areas within UBS, into other areas, units, divisions or affiliates of UBS. Futures and options trading is not suitable for every investor as there is a substantial risk of loss, and losses in excess of an initial investment may occur. Past performance of an investment is no guarantee for its future performance. Additional information will be made available upon request. Some investments may be subject to sudden and large falls in value and on realization you may receive back less than you invested or may be required to pay more. Changes in foreign exchange rates may have an adverse effect on the price, value or income of an investment. The analyst(s) responsible for the preparation of this report may interact with trading desk personnel, sales personnel and other constituencies for the purpose of gathering, synthesizing and interpreting market information. Tax treatment depends on the individual circumstances and may be subject to change in the future. UBS does not provide legal or tax advice and makes no representations as to the tax treatment of assets or the investment returns thereon both in general or with reference to specific client's circumstances and needs. We are of necessity unable to take into account the particular investment objectives, financial situation and needs of our individual clients and we would recommend that you take financial and/or tax advice as to the implications (including tax) of investing in any of the products mentioned herein.

This material may not be reproduced or copies circulated without prior authority of UBS. Unless otherwise agreed in writing UBS expressly prohibits the distribution and transfer of this material to third parties for any reason. UBS accepts no liability whatsoever for any claims or lawsuits from any third parties arising from the use or distribution of this material. This report is for distribution only under such circumstances as may be permitted by applicable law. For information on the ways in which CIO manages conflicts and maintains independence of its investment views and publication offering, and research and rating methodologies, please visit www.ubs.com/research.

Additional information on the relevant authors of this publication and other CIO publication(s) referenced in this report; and copies of any past reports on this topic; are available upon request from your client advisor.

Important Information about Sustainable Investing Strategies: Incorporating environmental, social and governance (ESG) factors or Sustainable Investing considerations may inhibit the portfolio manager's ability to participate in certain investment opportunities that otherwise would be consistent with its investment objective and other principal investment strategies. The returns on a portfolio consisting primarily of ESG or sustainable investments may be lower than a portfolio where such factors are not considered by the portfolio manager. Because sustainability criteria can exclude some investments, investors may not be able to take advantage of the same opportunities or market trends as investors that do not use such criteria. Companies may not necessarily meet high performance standards on all aspects of ESG or sustainable investing issues; there is also no guarantee that any company will meet expectations in connection with corporate responsibility, sustainability, and/or impact performance.

Distributed to US persons by UBS Financial Services Inc. or UBS Securities LLC, subsidiaries of UBS AG. UBS Switzerland AG, UBS Europe SE, UBS Bank, S.A., UBS Brasil Administradora de Valores Mobiliarios Ltda, UBS Asesores Mexico, S.A. de C.V., UBS Securities Japan Co., Ltd, UBS Wealth Management Israel Ltd and UBS Menkul Degerler AS are affiliates of UBS AG. UBS Financial Services Incorporated of Puerto Rico is a subsidiary of UBS Financial Services Inc. UBS Financial Services Inc. accepts responsibility for the content of a report prepared by a non-US affiliate when it distributes reports to US persons. All transactions by a US person in the securities mentioned in this report should be effected through a US-registered broker dealer affiliated with UBS, and not through a non-US affiliate. The contents of this report have not been and will not be approved by any securities or investment authority in the United States or elsewhere. UBS Financial Services Inc. is not acting as a municipal advisor to any municipal entity or obligated person within the meaning of Section 15B of the Securities Exchange Act (the "Municipal Advisor Rule") and the opinions or views contained herein are not intended to be, and do not constitute, advice within the meaning of the Municipal Advisor Rule.

External Asset Managers / External Financial Consultants: In case this research or publication is provided to an External Asset Manager or an External Financial Consultant, UBS expressly prohibits that it is redistributed by the External Asset Manager or the External Financial Consultant and is made available to their clients and/or third parties. **Austria:** This publication is not intended to constitute a public offer under Austrian law, but might be distributed for information purposes to clients of UBS Europe SE, Niederlassung Österreich, with place of business at Wächtergasse 1, A-1010 Wien. UBS Europe SE, Niederlassung Österreich is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht), to which this publication has not been submitted for approval. **Bahrain:** UBS is a Swiss bank not licensed, supervised or regulated in Bahrain by the Central Bank of Bahrain and does not undertake banking or investment business activities in Bahrain. Therefore, clients have no protection under local banking and investment services laws and regulations. **Brazil:** Distributed by UBS Brasil Administradora de Valores Mobiliários Ltda. and/or by UBS Consenso Investimentos Ltda., entities regulated by Comissão de Valores Mobiliários ("CVM"). **Canada:** In Canada, this publication is distributed to clients of UBS Wealth Management Canada by UBS Investment Management Canada Inc.. China: This report is prepared by UBS AG or its offshore subsidiary or affiliate (collectively as "UBS Offshore"). UBS Offshore is an entity incorporated out of China and is not licensed, supervised or regulated in China to carry out banking or securities business. The recipient should not contact the analysts or UBS Offshore which produced this report for advice as they are not licensed to provide securities investment advice in China. UBS Investment Bank (including Research) has its own wholly independent research and views which at times may vary from the views of UBS Global Wealth Management. This report shall not be regarded as providing specific securities related analysis. The recipient should not use this document or otherwise rely on any of the information contained in this report in making investment decisions and UBS takes no responsibility in this regard. **Czech Republic:** UBS is not a licensed bank in the Czech Republic and thus is not allowed to provide regulated banking or investment services in the Czech Republic. Please notify UBS if you do not wish to receive any further correspondence. **Denmark:** This publication is not intended to constitute a public offer under Danish law, but might be distributed by UBS Europe SE, Denmark Branch, filial af UBS Europe SE, with place of business at Sankt Annae Plads 13, 1250 Copenhagen, Denmark, registered with the Danish Commerce and Companies Agency, under the No. 38 17 24 33. UBS Europe SE, Denmark Branch, filial af UBS Europe SE is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the German Federal Financial Supervisory Authority (Bundesanstalt

für Finanzdienstleistungsaufsicht, BaFin). UBS Europe SE, Denmark Branch, filial af UBS Europe SE is subject to the joint supervision of the BaFin, the central bank of Germany (Deutsche Bundesbank) and the Danish Financial Supervisory Authority (DFSA) (Finanstilsynet), to which this document has not been submitted for approval. **France:** This publication is distributed by UBS (France) S.A., French "société anonyme" with share capital of € 132.975.556, 69, boulevard Haussmann F-75008 Paris, R.C.S. Paris B 421 255 670, to its clients and prospects. UBS (France) S.A. is a provider of investment services duly authorized according to the terms of the "Code Monétaire et Financier", regulated by French banking and financial authorities as the "Autorité de Contrôle Prudentiel et de Résolution". **Germany:** This publication is distributed to clients of UBS Europe SE, with registered office at Bockenheimer Landstrasse 2-4, 60323 Frankfurt am Main, an entity supervised by the Bundesanstalt für Finanzdienstleistungsaufsicht. **Greece:** UBS Switzerland AG and its affiliates (UBS) are not licensed as a bank or financial institution under Greek legislation and do not provide banking and financial services in Greece. Consequently, UBS provides such services from branches outside of Greece, only. This document may not be considered as a public offering made or to be made to residents of Greece. **Hong Kong:** This publication is distributed to clients of UBS AG Hong Kong Branch by UBS AG Hong Kong Branch, a licensed bank under the Hong Kong Banking Ordinance and a registered institution under the Securities and Futures Ordinance. India: Distributed by UBS Securities India Private Ltd. 2/F, 2 North Avenue, Maker Maxity, Bandra Kurla Complex, Bandra (East), Mumbai (India) 400051. Phone: +912261556000. SEBI Registration Numbers: NSE (Capital Market Segment): INB230951431, NSE (F&O Segment) INF230951431, BSE (Capital Market Segment) INB010951437. **Indonesia, Malaysia, Philippines, Thailand:** This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/delete it and inform UBS immediately. Any and all advice provided and/or trades executed by UBS pursuant to the material will only have been provided upon your specific request or executed upon your specific instructions, as the case may be, and may be deemed as such by UBS and you. The material may not have been reviewed, approved, disapproved or endorsed by any financial or regulatory authority in your jurisdiction. The relevant investments will be subject to restrictions and obligations on transfer as set forth in the material, and by receiving the material you undertake to comply fully with such restrictions and obligations. You should carefully study and ensure that you understand and exercise due care and discretion in considering your investment objective, risk appetite and personal circumstances against the risk of the investment. You are advised to seek independent professional advice in case of doubt. **Italy:** This publication is distributed to clients of UBS Europe SE, Succursale Italia, Via del Vecchio Politecnico, 3 - 20121 Milano, branch of UBS Europe SE, a German bank duly authorized by the "Bundesanstalt für Finanzdienstleistungsaufsicht" (BaFin) to the provision of financial services, supervised by both BaFin and"Consob". **Jersey:** UBS AG, Jersey Branch, is regulated and authorized by the Jersey Financial Services Commission for the conduct of banking, funds and investment business. Where services are provided from outside Jersey, they will not be covered by the Jersey regulatory regime. UBS AG, Jersey Branch is a branch of UBS AG a public company limited by shares, incorporated in Switzerland whose registered offices are at Aeschenvorstadt 1, CH-4051 Basel and Bahnhofstrasse 45, CH 8001 Zurich. UBS AG, Jersey Branch's principal place business is 1, IFC Jersey, St Helier, Jersey, JE2 3BX. **Luxembourg:** This publication is not intended to constitute a public offer under Luxembourg law, but might be distributed for information purposes to clients of UBS Europe SE, Luxembourg Branch, with place of business at 33A, Avenue J. F. Kennedy, L-1855 Luxembourg. UBS Europe SE, Luxembourg Branch is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the German Federal Financial Services Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin), and is subject to the joint supervision of BaFin, the central bank of Germany (Deutsche Bundesbank), as well as of the Luxembourg supervisory authority, the Commission de Surveillance du Secteur Financier (the "CSSF"), to which this publication has not been submitted for approval. **Mexico:** This information is distributed by UBS Asesores México, S.A. de C.V. ("UBS Asesores"), an affiliate of UBS Switzerland AG, incorporated as a non-independent investment advisor under the Securities Market Law due to the relation with a Foreign Bank. UBS Asesores is a regulated entity and it is subject to the supervision of the Mexican Banking and Securities Commission ("CNBV"), which exclusively regulates UBS Asesores regarding the rendering of portfolio management, as well as on securities investment advisory services, analysis and issuance of individual investment recommendations, so that the CNBV has no surveillance faculties nor may have over any other service provided by UBS Asesores. UBS Asesores is registered before CNBV under Registry number 30060. You are being provided with this UBS publication or material because you have indicated to UBS Asesores that you are a Sophisticated Qualified Investor located in Mexico. The compensation of the analyst(s) who prepared this report is determined exclusively by research management and senior management of any entity of UBS Group to which such analyst(s) render services. **Nigeria:** UBS Switzerland AG and its affiliates (UBS) are not licensed, supervised or regulated in Nigeria by the Central Bank of Nigeria (CBN) or the Nigerian Securities and Exchange

Commission (SEC) and do not undertake banking or investment business activities in Nigeria. **Portugal:** UBS Switzerland AG is not licensed to conduct banking and financial activities in Portugal nor is UBS Switzerland AG supervised by the portuguese regulators (Bank of Portugal "Banco de Portugal" and Portuguese Securities Exchange Commission "Comissão do Mercado de Valores Mobiliários"). **Singapore:** This material was provided to you as a result of a request received by UBS from you and/or persons entitled to make the request on your behalf. Should you have received the material erroneously, UBS asks that you kindly destroy/delete it and inform UBS immediately. Clients of UBS AG Singapore branch are asked to please contact UBS AG Singapore branch, an exempt financial adviser under the Singapore Financial Advisers Act (Cap. 110) and a wholesale bank licensed under the Singapore Banking Act (Cap. 19) regulated by the Monetary Authority of Singapore, in respect of any matters arising from, or in connection with, the analysis or report.. Spain: This publication is distributed to its clients by UBS Europe SE, Sucursal en España, with registered office at Calle María de Molina 4, C.P. 28006, Madrid, entity supervised by the Bundesanstalt für Finanzdienstleistungsaufsicht (BaFin) and Banco de España, to which this publication has not been submitted for approval. Additionally it is authorized to provide investment services on securities and financial instruments, regarding which it is supervised by the Commission Nacional del Mercado de Valores (CNMV) as well. UBS Europe SE, Sucursal en España is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea duly authorized and regulated by BaFin. **Sweden:** This publication is not intended to constitute a public offer under Swedish law, but might be distributed by UBS Europe SE, Sweden Bankfilial with place of business at Regeringsgatan 38, 11153 Stockholm, Sweden, registered with the Swedish Companies Registration Office under the Reg. No 516406-1011. UBS Europe SE, Sweden Bankfilial is a branch of UBS Europe SE, a credit institution constituted under German law in the form of a Societas Europaea, duly authorized by the German Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin). UBS Europe SE, Sweden Bankfilial is subject to the joint supervision of the BaFin, the central bank of Germany (Deutsche Bundesbank) and the Swedish financial supervisory authority (Finansinspektionen), to which this document has not been submitted for approval. **Taiwan:** This material is provided by UBS AG, Taipei Branch in accordance with laws of Taiwan, in agreement with or at the request of clients/prospects. **UAE:** UBS is not licensed in the UAE by the Central Bank of UAE or by the Securities & Commodities Authority. The UBS AG Dubai Branch is licensed in the DIFC by the Dubai Financial Services Authority as an authorised firm. **UK:** Approved by UBS Switzerland AG, authorised and regulated by the Financial Market Supervisory Authority in Switzerland. In the United Kingdom, UBS Switzerland AG is authorised by the Prudential Regulation Authority and subject to regulation by the Financial Conduct Authority and limited regulation by the Prudential Regulation Authority. Details about the extent of our regulation by the Prudential Regulation Authority are available from us on request. A member of the London Stock Exchange. This publication is distributed to retail clients of UBS London in the UK. Where products or services are provided from outside the UK, they will not be covered by the UK regulatory regime or the Financial Services Compensation Scheme.

Version 02/2019. CIO82652744