02.07.15

RECOMMENDED READING

MPC MEMBERS

From (Markets - FED) and
(MA - MFAD)

FIVE QUESTIONS ABOUT ASSET PRICE MOVES DURING PREVIOUS FED TIGHTENING CYCLES

This note documents facts about the dynamics of US and UK asset prices during the Fed's tightening cycles of 1994/95, 1999/2000 and 2004/2006 – as well as the 'taper tantrum' of 2013.[1] We highlight both common patterns and heterogeneous responses across a range of asset markets in the run-up to and during the tightening of Fed policy. An improving economic backdrop was common to each episode and hence drives some of the similarities across cycles. Differences in communication strategies and the extent to which markets were surprised drive much of the differences in asset price dynamics across episodes.

(1) What were the characteristics of previous Fed tightening cycles?

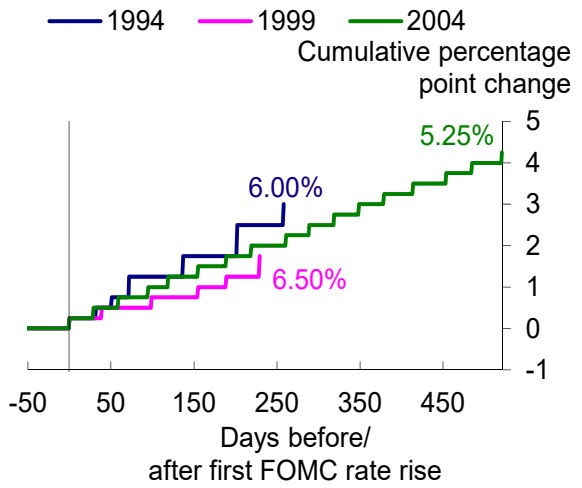
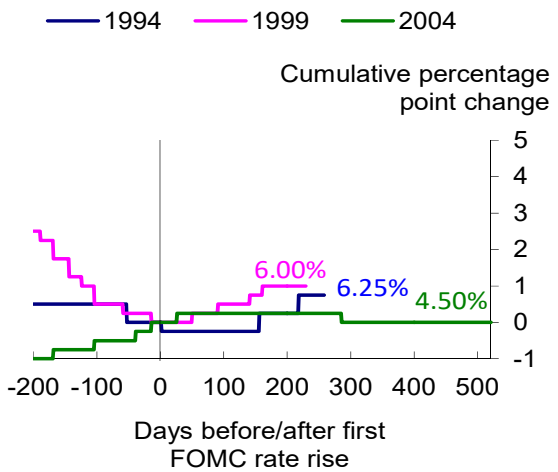
Previous Fed tightening cycles shared an improving economic backdrop, but they differed in terms of the extent and pace of tightening. Fed communication also differed across cycles, which had consequences in terms of expectations of tightening and the degree to which markets were surprised.

Characteristics of tightening

The three latest tightening cycles differed significantly in terms of the extent and pace of tightening (**Chart 1**), in part due to different starting points. The pace of tightening was fastest in 1994, when the average pace of tightening between +25bps and +125bps was 88bps per quarter. The whole cycle only lasted a year, over which the Fed increased rates by 300bps. The 1999 tightening cycle also lasted a year, but the total extent of tightening was just under half of that in 1994. The 2004 cycle lasted two years and rates were increased by 25bps at each 6-weekly FOMC meeting in this time, which lead to a pace of approximately 50bps per quarter. It is worth noting that the end-point is within a 1.25 p.p. range in all three cases, so the different extent of tightening seemed to reflect different starting points but perhaps a similar "neutral" rate.

Chart 2 shows the changes in UK's Bank Rate around previous US tightening cycles. In 1994, Bank Rate was lowered just a couple of days after the first Fed funds rate rise, although it rose later in the year. In 1999, the tightening cycles in the two countries were fairly closely aligned. Meanwhile during the 2004-06 US tightening cycle Bank Rate remained broadly flat. In part this could be due to the fact that the Bank began its tightening cycle in November 2003, over half a year before the US.

[1]This note complements work already done within the Bank on asset price moves during tightening cycles in the UK and other small open economies.

Chart 1: Previous Fed tightening cycles – change in Fed funds rate and 'end-point' level	Chart 2: Previous Fed tightening cycles – change in Bank Rate
	

Economic backdrop

As would be expected, recent US monetary policy tightening cycles[2] took place at a time of improving macroeconomic conditions. Unemployment had been declining and carried on falling throughout all three episodes (**Chart A7** in the Appendix). The inflation picture was more mixed. In the run up to the first rate rise, core PCE inflation was falling (but still high) in 1994, stable in 1999 and rising in 2004 (**Chart A8**).

FOMC communications

There were significant differences in the way the expected tightening of policy had been communicated by the FOMC, and in the extent to which markets had been expecting a rate rise and correctly pricing the subsequent pace of tightening.

The first rate rise in February 1994 took markets by surprise. **Chart 3** shows the difference between the meeting in which markets expected the first rate rise (FRR) to take place[3] and the meeting in which Fed funds rate was actually raised. So observations above the zero line mean investors were expecting the Fed to raise rates later than it eventually did. FOMC communications at the time were limited.[4] The subsequent pace of tightening also surprised market participants, as shown in **Chart 4**. The solid lines represent the expected pace of tightening in the first year following the FRR over time, while the dashed lines show the actual realised pace of tightening. It is clear that there was a sizeable gap between the realised pace and what was expected at the time of the FRR, which closed in the first three to four months of the tightening cycle.

In contrast, in 1999 the FOMC sent clear signals about its likely future actions[5]. **Charts 3 and 4** offer evidence of this, as we can see that markets had been expecting a hike in June for some time, and that the gap between expected and realised pace of tightening was rather small and closed smoothly over the cycle.

[2] We focus on the mentioned tightening episodes given the similarity of the monetary framework in place at the time with the current one, and for the usual data availability constraints

[3] This estimate is based on the prices of Fed funds futures contracts.

[4] In fact, the FOMC statement that accompanied the first rate rise was the first such statement that the FOMC published.

[5] For instance, in the last meeting before the first hike, the FOMC statement noted that the Committee had "adopted a directive that is tilted toward the possibility of a firming in the stance of monetary policy" and that it "recognizes the need to be alert to developments over coming months that might indicate that financial conditions may no longer be consistent with containing inflation."

In 2004, the FOMC also gave guidance about the potential rate rise[6], as well as the likely "measured" extent of tightening. Once more, **Chart 3** shows that the FRR was actually expected for some time, and that the expected pace at the time of the first hike was not far from the pace that finally materialised.

Chart 3: Expectations of first rate rise

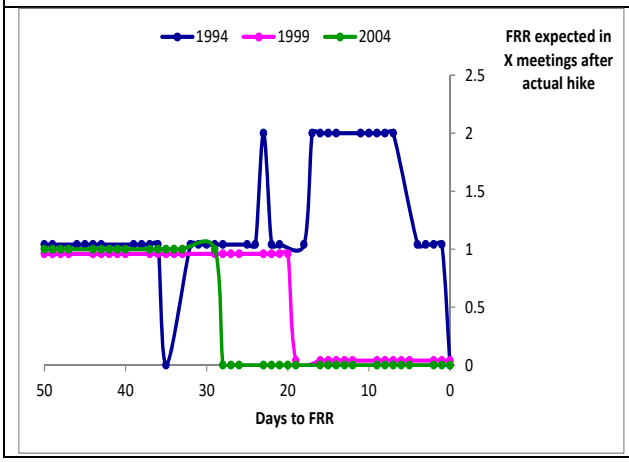
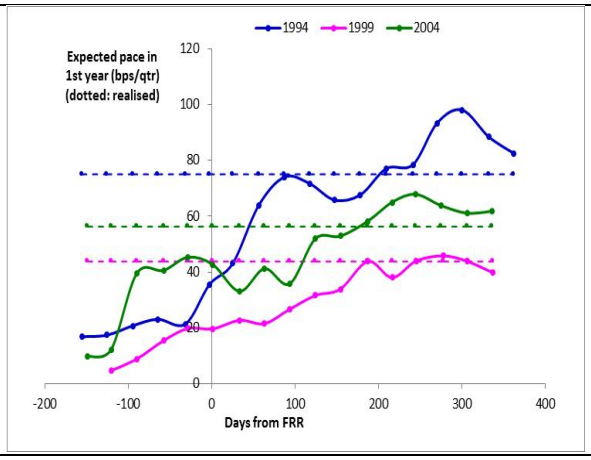


Chart 4: Expectations of pace in the year following the first rate rise



(2) How did the US and UK yield curves react?

There is a contrast between the 1994 tightening cycle and the taper tantrum on one hand, when yields increased sharply on impact, and the 1999/2004 cycles, when the reaction was more muted and yields even fell. This seems to reflect the degree of anticipation of Fed's actions. The reaction of estimates of term premia is heterogeneous; they remained broadly flat in 1994 and 1999, but fell sharply in 2004 and shot up during the 'taper tantrum'[7].

Chart 5: Changes in interest rates levels and IVs (2-day window)

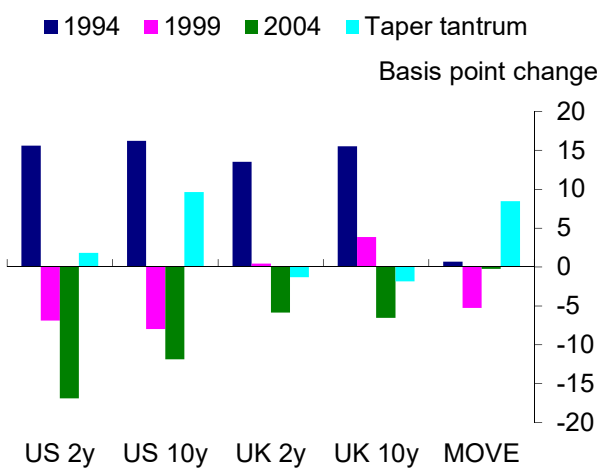
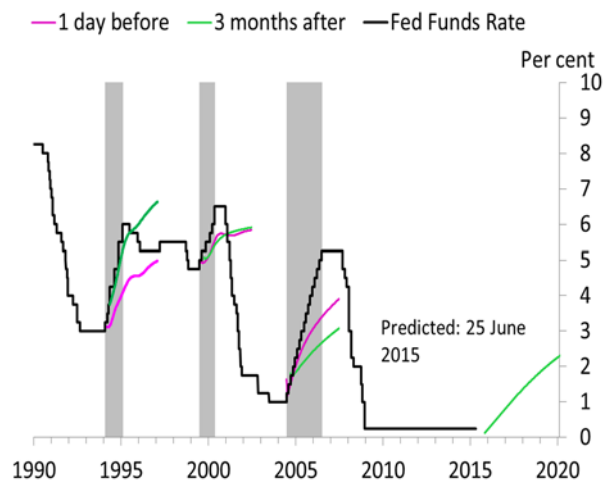


Chart 6: Yield curve reactions after past first rate rises



[6] In the last meeting before the rate rise, the statement included the phrase "policy accommodation can be removed at a pace that is likely to be measured," which was kept in the next twelve statements until January 2006 (rates were subsequently increased in 25bps increments until June 2006).

[7] Although the 'taper tantrum' does not configure an explicit tightening episode, we include it as an additional case given the current focus on Fed's communication and the fact that some background characteristics might be shared with the current conjuncture.

Both short and long-term US interest rates rose sharply after the first rate rise (FRR) in 1994 (**Chart 5**), and continued to increase throughout the cycle (**Charts 7 and 8**). Most of the increase seems to have responded to a re-assessment of the expected path of short term interest rates, as term premia estimates remained relatively flat[8]. These changes are consistent with the findings outlined above: the FRR came as a surprise (**Chart 3**), and markets kept on being surprised about the subsequent pace of tightening even after the FRR had already taken place (**Chart 4**).

Chart 7: US 2-y rates over whole cycle (solid: spot rate, dotted: term premia)

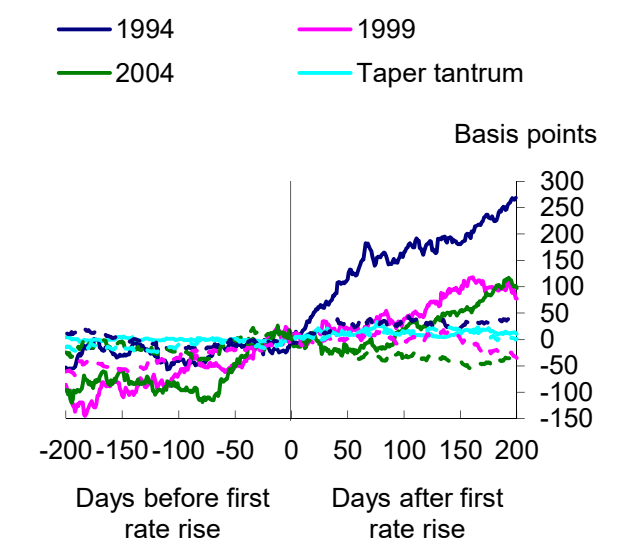
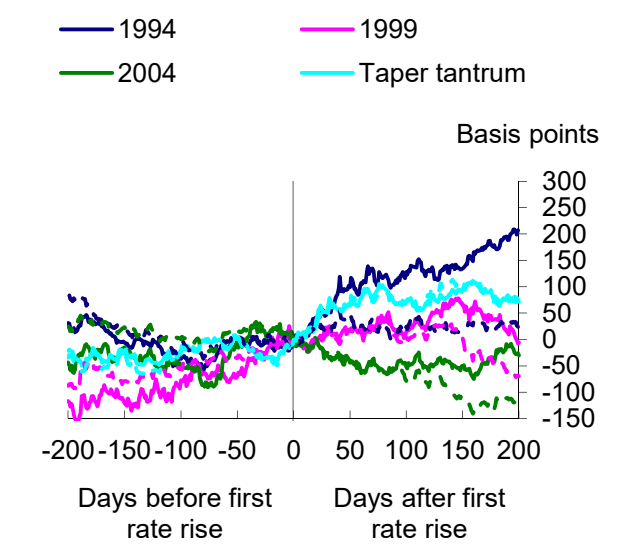


Chart 8: US 10-y rates over whole cycle (solid: spot rate, dotted: term premia)



In contrast, there were slight falls in both short- and long-term US interest rates on the announcement of the FRR in 1999 (**Chart 5**), but these were very short lived (**Charts 7 and 8**). Looking at the cycle as a whole, 2-year spot rates increased smoothly (**Chart 7**). Longer-term interest rates increased only slightly in 1999, with term premia being little changed and then declining (**Chart 8**). Once more, the muted reaction on impact and the smooth reassessment of the expected rates outlook over the cycle is consistent with **Charts 3 and 4**, as the FRR was priced in advance.

The reaction of yield curves during the 2004 tightening cycle is perhaps the most difficult to interpret, given sharp fall in term premia. On impact, both short and long term rates fell sharply (**Chart 5**), but given that the FRR was expected it seems that it might be the result of a fall in term premia or a consequence of the communication used by the Fed. In terms of changes during the entire cycle, short rates increased notably (despite a slight fall in term premia), while long rates fell slightly as a result of a sharply falling term premia (configuring what Greenspan labelled a "conundrum"[9]) and increasing expectations about the path of short term rates (**Charts 7 and 8**).

We can see in **Charts 5 and 8** that the taper tantrum spurred a large increase in long term rates, mostly owing to a rise in term premia. In contrast, short term rates remained broadly unchanged (**Charts 5 and 7**).

In terms of the co-movement of US and UK interest rates, **Chart 16** shows that it was high for long-term yields during each US tightening cycle, as well as during the 2013 taper tantrum. A caveat is that the split between

[8] These estimates are obtained using the whole sample and hence cannot be interpreted as an accurate measure of real time changes in term premia following Fed actions.
9 One of the explanations for the fall in term premia is linked to aggressive buying of US Treasuries by foreign official investors (see Kaminska and Zinna (2014)).

expected rates and term premia is different in 2004, as UK term premia did not fall as sharply as in the US. The co-movement in short-term interest rates (**Chart 9**) mirrors the synchronicity of the tightening cycles, as it is high in 1994 and 1999 but very low in 2004.

Chart 9: US (solid) and UK (dotted) 2-y rates over whole cycle

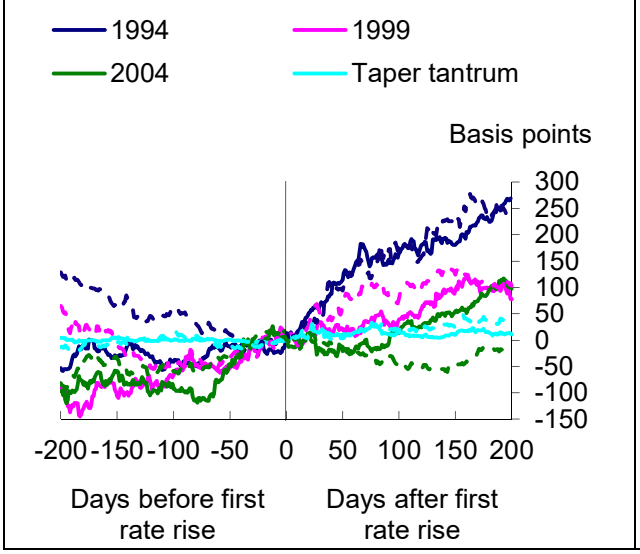
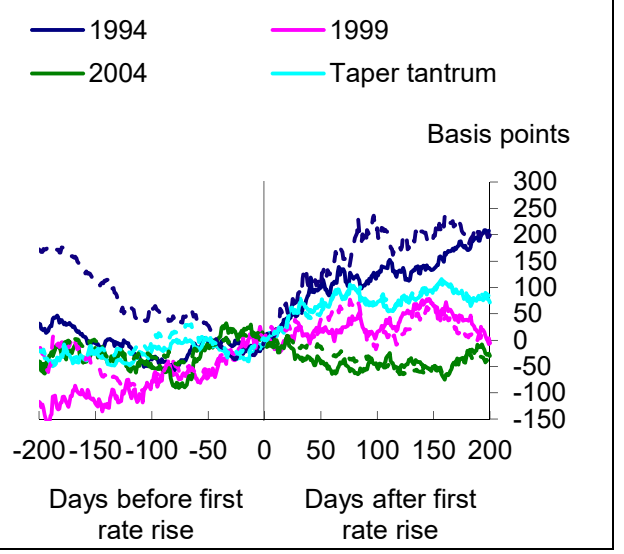


Chart 10: US (solid) and UK (dotted) 10-y rates over whole cycle



(3) How did the dollar react to the tightening cycle?

The dollar appreciated in the run-up to previous Fed tightening cycles, but typically depreciated after the first rate rise, even in the face of increasing short term interest rates.

The dollar appreciated in the six to nine months before the start of each of the three latest tightening cycles. In the six months before the first rate rise, the dollar ERI increased by around 2% in 1994 and 2004, and by 5% in 1999. But after the first rate rise, this dollar appreciation tended to unwind (**Chart 11**). Three months after the start of tightening, the dollar ERI had fallen by 1-2% in 1994 and 2004, and 5% in 1999. This is despite the sharp rise in US interest rates in 1994, when the 2-year yield increased by 178bps. The dollar ERI moved in a similar fashion in the months around the taper tantrum in 2013.

Chart 14 shows the performance of the sterling-US dollar exchange rate around the first US rate rise in 1994, as well as the 2-year spot US-UK interest rate differential. The dollar depreciated against sterling following the first rate rise, despite the interest rate differential remaining fairly stable.

Indeed, as shown in **Chart 13**, most of the moves in the sterling-US dollar exchange rate around the three tightening cycles and the taper tantrum can be attributed to moves in the FX risk premium, given that interest rate news are close to zero or go in the opposite direction to changes in the exchange rate.

Chart 11: US dollar ERI

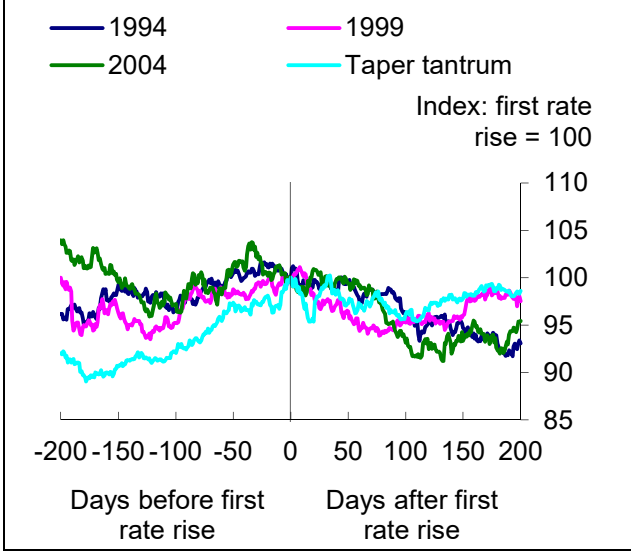


Chart 12: $ ERI and Fed funds rate

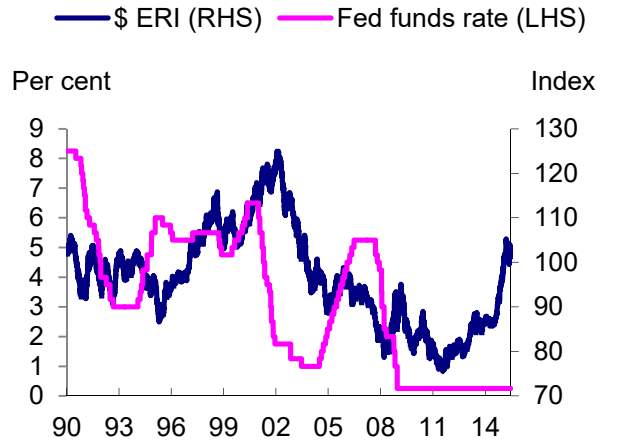


Chart 13: Change in USDGBP and 2-year US-UK interest rate news

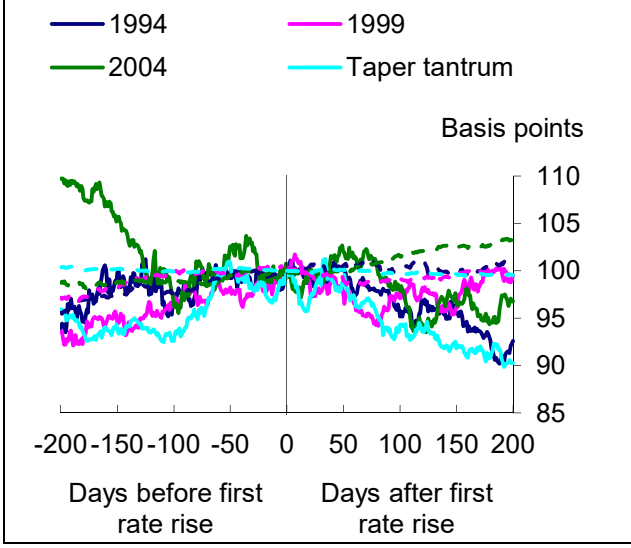
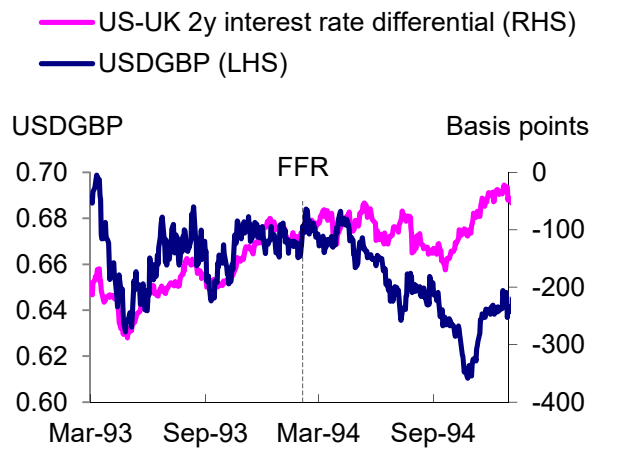


Chart 14: USDGBP and 2-year US-UK interest rate differential around the 1994 rate rise



(4) What was the reaction of implied volatility and other asset classes?

Equity indices increased in the run-up to previous Fed's tightening cycles as US outlook improved. The performance was mixed afterwards, but the S&P did not experience large falls in any of the cycles. Interest rates implied volatility spiked after the 1994 Fed tightening and the taper tantrum, while it remained at previous levels after the first rate rise in 1999 and 2004. Perhaps in contrast to a common view, the VIX remained relatively stable during the latest three Fed tightening cycles and during the taper tantrum. EM equities fell after the FRR in 1994/taper tantrum, but remained stable and even increased after the FRR in 1999/2004.

Equities and corporate spreads

US and UK equity markets have tended to increase in the run-up to the first rate rise, coinciding with an improvement of the US economic outlook. Their performance following the first rate rise has been more mixed. The S&P 500 fell in the weeks following the announcement of the first rate rise or tapering. Three months after the first rate rise, the S&P 500 was 6-7% lower in 1994 and 1999, and around 2% lower in 2004 and, notably,

during the taper tantrum. US equities have then tended to rebound around four months after the first rate hike. Over the whole tightening cycle, the S&P 500 was flat in 1994, and up 7% and 12% in 1999 and 2004, respectively. This is likely to reflect different relative importance of an improved economic outlook and higher discount rates.

Investment grade US dollar corporate spreads of non-financial companies remained stable in the run-up to the latest two tightening cycles and the taper tantrum, but there were heterogeneous moves following Fed tightening: spreads increased slightly in 1999, fell in 2004 and increased sharply after the taper tantrum in 2013 (although they partially unwound that rise later on, see **Chart A2**).

Chart 15: S&P 500

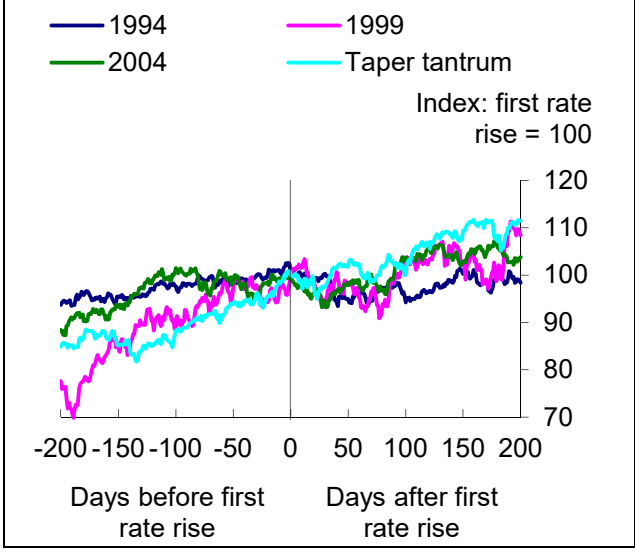
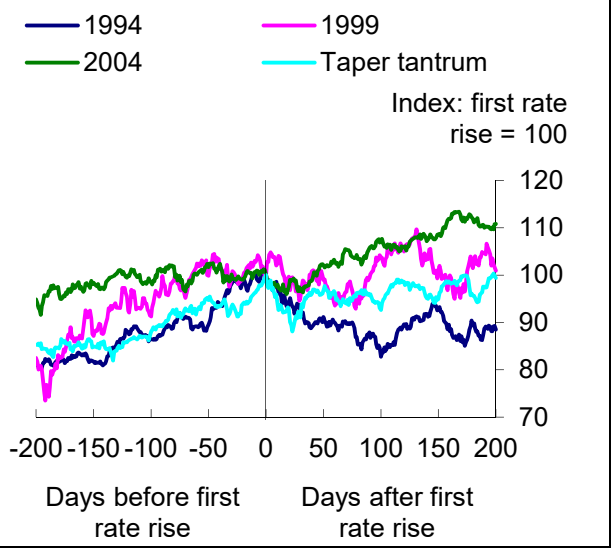


Chart 16: FTSE 100



Implied volatility

Chart 17 shows the behavior of the MOVE index around previous Fed tightening cycles, which is a measure of option-implied volatility of US Treasuries.[10] During both the 1994 tightening cycle and the taper tantrum, interest rate volatility increased sharply after the first rate rise/FOMC communication, with the MOVE around 40bps higher after three months in both cases. In 1999 and 2004 interest rate implied volatility remained relatively stable throughout the tightening cycle. A similar pattern is observed across the three tightening cycles when a measure of the 3m5y interest rate implied volatility is used, as previously shown in The observed pattern is likely to be linked to the extent to which market participants were surprised by the timing of the first rate rise and the expected pace of tightening thereafter, as outlined in Question 1.

In contrast, the VIX (a measure of S&P 500 implied volatility) remained relatively low and stable throughout the three tightening cycles (except perhaps 1999) and the taper tantrum (**Charts 18** and **21**). In all four instances, the VIX ticked up slightly following the first rate rise/FOMC communication, but remained in line with previous levels. Even during the 1994-95 tightening cycle, the VIX closed above 20 on only two occasions, two months after the first rate rise.

[10] Based on a weighted average of implied volatility derived from one-month options on 2, 5, 10 and 30-year US Treasuries.

Chart 17: MOVE index

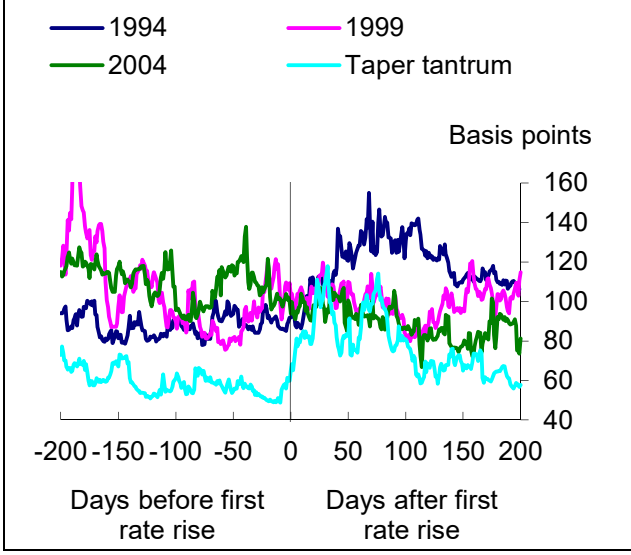
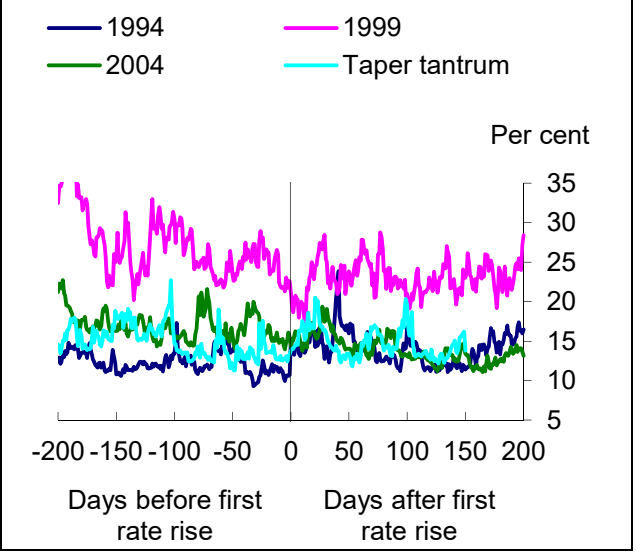


Chart 18: VIX

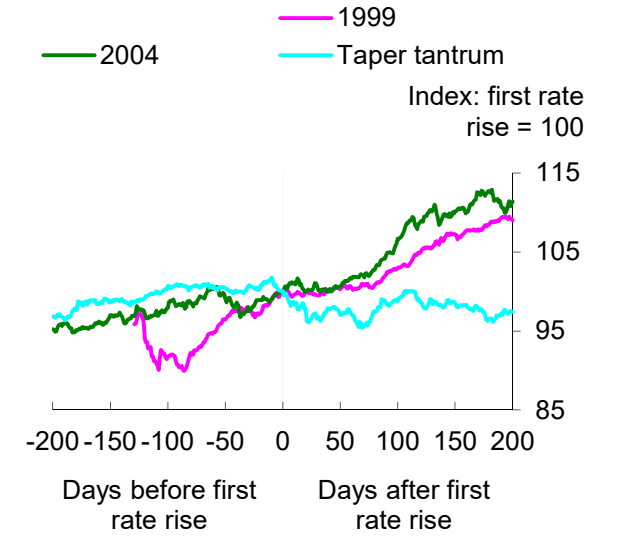


Emerging markets

Emerging market (EM) equities fell by 1.3% in the two days after the first rate rise in 1994. In the three months that followed, EM equities were 18% lower. Similarly following the hint of the possibility of a tapering in asset purchases by the Fed in May 2013, equities fell by 2.1% on impact and 11.8% after three months. EM equities were broadly flat in the months that followed the 1999 rate rise, and began to rise after four months. Meanwhile in the 2004 cycle, EM equities continued their upward trend despite the tightening of policy by the Fed.

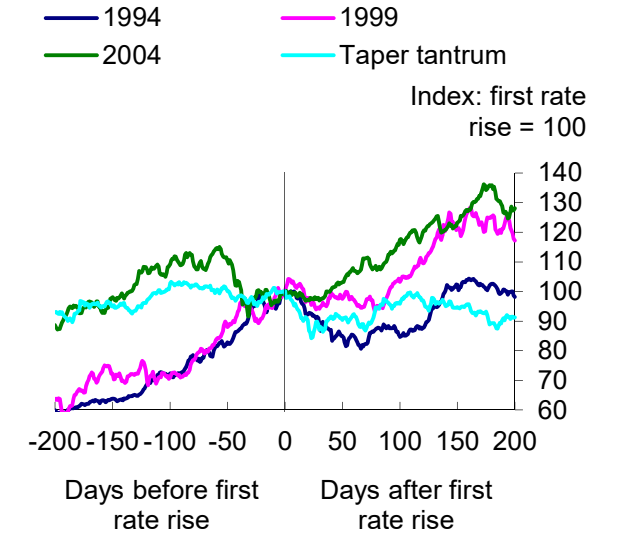
For most of our the dominant concern currently is not the first Fed rate rise, but rather the pace of tightening thereafter. There have already been a slowing of inflows to EMs, reportedly in anticipation of the prospective Fed tightening. That said, contacts generally think EMs are in a better position to deal with Fed tightening now compared to the taper tantrum. Emerging market currencies already adjusted a lot in 2013 and many countries had benefited from lower oil prices since then.

Chart 19: EM FX*



*Data are not available for the 1994 tightening cycle

Chart 20: EM equities



(5) How is now different/what can we expect when the Fed raises rates?

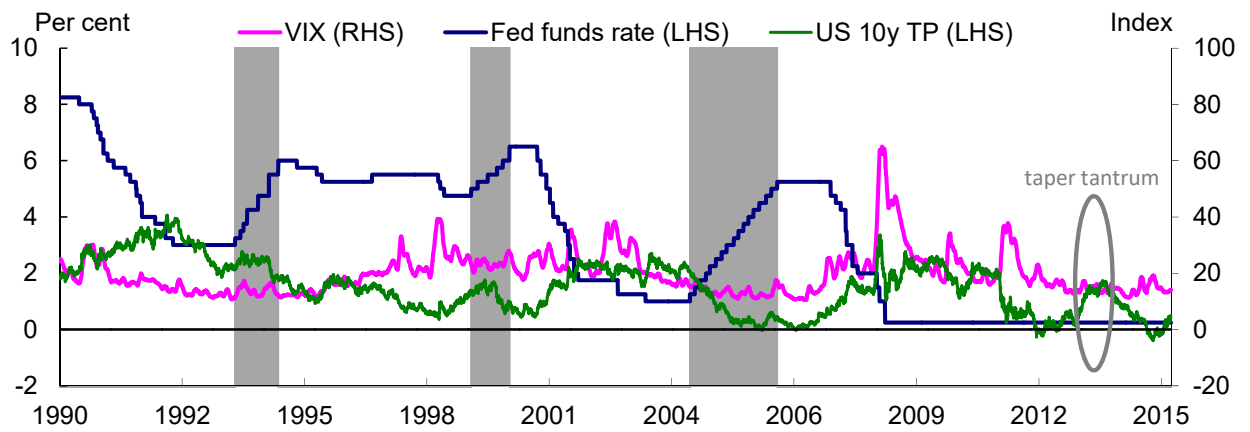
Looking at the reaction to previous Fed tightening cycles across asset classes we find that:

- There is heterogeneity in the reaction of bond yields and implied volatilities (IVs), probably linked the degree of anticipation of Fed's actions. There is a contrast between the reaction to the FRR in 1994 and the 'taper tantrum' episode on one side (in which bond yields and IVs spiked), and the FRRs in 1999 and 2004 on the other (when the reaction was more muted and yields actually fell). There is also heterogeneity in the reaction of term premia estimates.

- The dollar appreciated in the run-up to previous Fed tightening cycles, but typically depreciated after the first rate rise, even in the face of increasing short term interest rates.

- Equity indices increased in the run-up to previous Fed's tightening cycles as US outlook improved. The performance was mixed afterwards, but the S&P did not experience large falls in any of the cycles. The VIX remained relatively stable during the latest three Fed tightening cycles and during the taper tantrum.

Chart 21: Fed funds rate, VIX and US 10y Treasuries' term premia since 1990



Shaded areas correspond to Fed tightening cycles

To the extent that the heterogeneity in past asset price reactions to Fed's tightening cycles might reflect different communication strategies, we then might expect the impact of the forthcoming cycle's first rate rise to be limited, given Fed's efforts to ensure that it is well telegraphed. However, it is not just communications about the lift-off date that will be crucial; perhaps the most difficult communications challenge will be to manage expectations of the subsequent pace of rate hikes. (As said, some MI contacts have raised this point, and Bill Dudley of the NY Fed has already indicated that the pace of rate hikes will itself depend on the reaction of financial markets to Fed's actions.)

Moreover, there are various aspects that make the current conjuncture different from the past[11]. First, estimates of term premia are very low by historical standards (**Chart 21**) and Fed tightening may be associated with them rising closer to historical averages (Fed officials such as Yellen and Dudley have been vocal about this concern). Relatedly, the current size of Fed's balance sheet might mean that yields rise more than otherwise if rate hikes translate to expectations of asset sales. In addition, after a long period at their effective lower bound, an increase in policy rates could perhaps be particularly significant if it is seen as something of a regime

[11] When it comes to key differences of the current conjuncture with respect to the last tightening cycle in 2004, there are two that stand out: first, the absence of aggressive buying of US Treasuries by foreign official investors; secondly, although levels of risk aversion remain low, they do not seem to be as low as during 2004-2005. Both these factors could mean that there is potential for bonds' term premia to be more reactive this time.

change. Finally, the current uncertainty surrounding the “neutral” level of policy rates, and the possibility that it is well below past levels might configure a key difference with respect to previous tightening cycles.

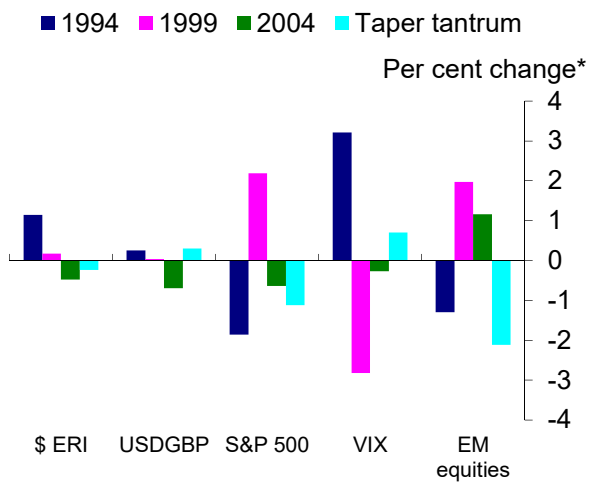
Macro Financial Analysis Division (MA) and Foreign Exchange Division (Markets)
30 June 2015

Annex

Summary table: Characteristics of tightening cycles and reaction in asset prices

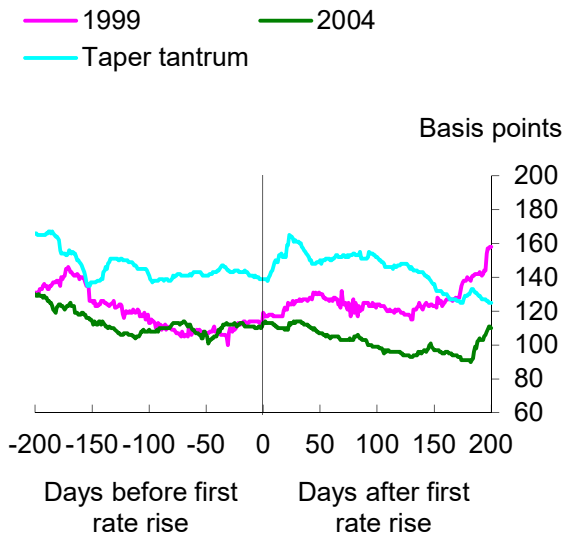
	1994		1999		2004		Taper tantrum	
	4 Feb 1994	1 Feb 1995	30 Jun 1999	16 May 2000	30 Jun 2004	29 Jun 2006	22 May 2013	N/A
Starting point	3.00%		4.75%		1.00%		0.25%	
End point	6.00%		6.50%		5.25%		N/A	
Extent	300 bps		175 bps		425 bps		N/A	
Length (quarters)	4		4		8			
Average pace (bps per quarter between +25bps and +125bps)	88 bps		33 bps		53 bps		N/A	
Average pace in first year of tightening (bps per quarter)	75 bps		44 bps		56 bps		N/A	
Quarters since previous rate cut	-38		-16		4		18	
Was the first rise a surprise?	Yes		No		No		N/A	
Moves following first rate rise	*2 days*	*3 months*	*2 days*	*3 months*	*2 days*	*3 months*	*2 days*	*3 months*
$ ERI	1.1%	-1.6%	0.2%	-5.1%	-0.5%	-1.3%	-0.2%	-2.6%
USDGBP	0.3%	-0.4%	0.0%	-4.4%	-0.7%	0.4%	0.3%	-3.2%
USDEUR	1.6%	-3.6%	0.9%	-3.1%	-0.6%	-2.0%	-0.2%	-3.4%
US 2y	16 bps	178 bps	-7 bps	9 bps	-17 bps	-21 bps	2 bps	20 bps
US 10y	16 bps	142 bps	-8 bps	13 bps	-12 bps	-63 bps	10 bps	107 bps
UK 2y	14 bps	144 bps	0 bps	85 bps	-6 bps	-33 bps	-1 bps	15 bps
UK 10y	16 bps	181 bps	4 bps	56 bps	-7 bps	-34 bps	-2 bps	86 bps
S&P 500	-1.9%	-6.8%	2.2%	-6.1%	-0.6%	-1.9%	-1.1%	-1.6%
VIX	3 pp	4 pp	-3 pp	4 pp	0 pp	-2 pp	1 pp	3 pp
MOVE	1 bps	41 bps	-5 bps	-6 bps	0 bps	-7 bps	8 bps	39 bps
EM equities	-1.3%	-18.0%	2.0%	-4.4%	1.2%	7.8%	-2.1%	-11.8%

Chart A1: FX and equities – 2-day window



*change in VIX is expressed in percentage points

Chart A2: Non-financial IG USD corporate spreads around previous Fed tightening cycles*



*Data are not available for the 1994 tightening cycle

Chart A3: Interest rates – 3-month window

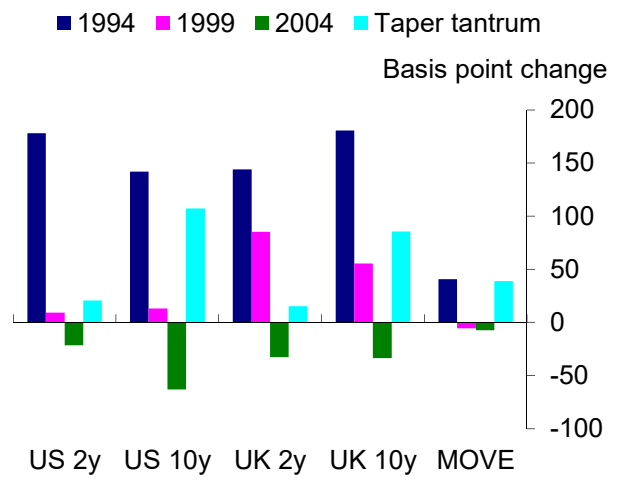
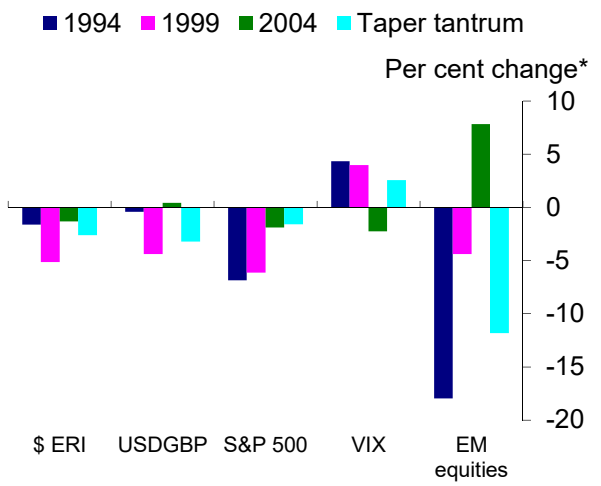


Chart A4: FX and equities – 3-month window



*change in VIX is expressed in percentage points

Chart A5: Interest rates – whole cycle

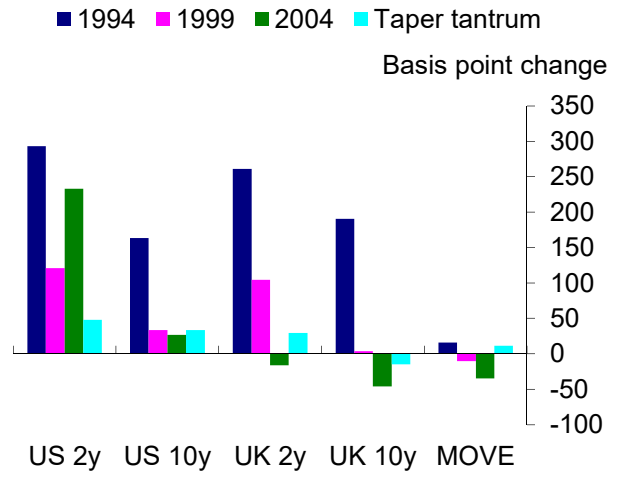
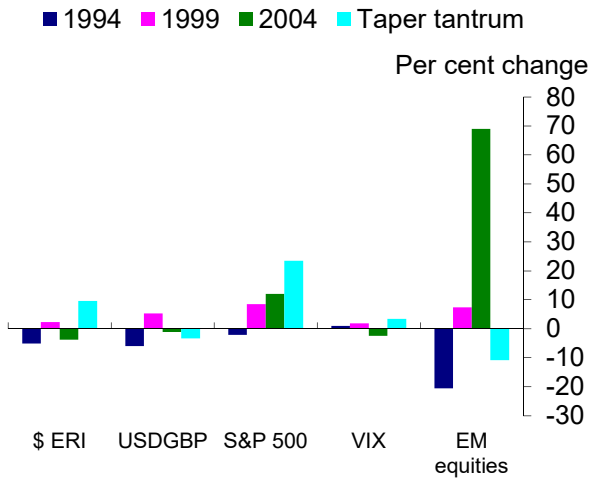


Chart A6: FX and equities – whole cycle



*change in VIX is expressed in percentage points

Chart A7: Change in US unemployment around previous tightening cycles

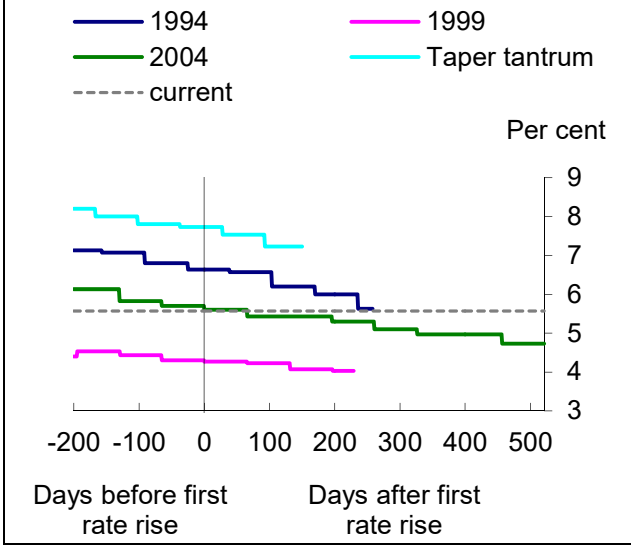
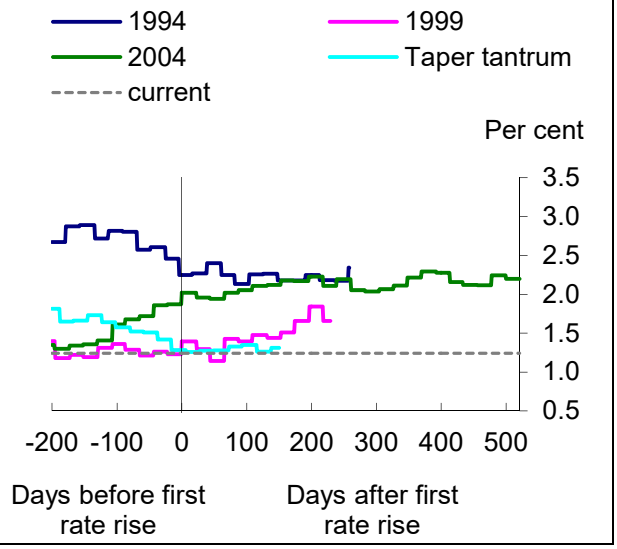



Chart A8: Change in US core PCE around previous tightening cycles