

Macroeconomic announcements and implied volatilities in swaption markets¹

Some of the sharpest movements in the major swap markets take place during days of US economic data releases. These yield movements induce spikes in volatilities during those days. Swaption prices adjust to reflect the spikes: the volatilities implied by these prices tend to fall once the volatility spike induced by an announcement has passed. For a given type of announcement, the decline in implied volatility is consistent with the average size of the spike in realised volatilities.

JEL classification: G10, G14.

A large body of literature has identified macroeconomic announcements as among the most important information events in fixed income markets. One common finding is that the effect on yields of a given announcement depends on the magnitude of the surprise, ie the difference between the released number and the prevailing consensus forecast for this number. However, not much is known about the impact of such announcements on market uncertainty, especially as measured by the volatility implied in interest rate options.

This special feature looks at the swaptions market to analyse the effect of macroeconomic announcements on implied volatility. To do this, the analysis first identifies the subset of economic indicators that exert a significant impact on swap yields at a daily frequency in both the United States and the euro area. The effects of these indicators are then shown to translate into realised volatilities, leading to a pattern of volatility spikes on certain announcement days, with the size of a given spike depending on the type of announcement released that day and the magnitude of the surprise relative to the consensus forecast. Finally, we show that, as one would expect, the forward-looking volatilities implied by the prices of swaption contracts tend to fall once the volatility spike induced by the announcement is over. The actual size of a given data surprise seems to have little effect on how much such forward-looking volatilities decline after the announcement.

¹ The views expressed in this article are those of the author and do not necessarily reflect those of the BIS.

Which announcements matter? Reviewing the evidence

An extensive literature has measured the impact of macroeconomic announcements on financial prices. One common finding is that announcements about a small number of US macroeconomic variables tend to have significant effects on both domestic and euro area yields, while euro area macroeconomic announcements have only a small or negligible effect on either domestic or US rates. Using high-frequency data, Fleming and Remolona (1997) and Furfine (2001) study the impact of macroeconomic announcements on the US Treasury market. They find that the effect on yields depends on the data surprise – that is, the deviation of an announced macroeconomic statistic from its expected value as measured by analyst forecasts. Other recent papers have analysed the overseas transmission of the impact of macroeconomic announcements. Goldberg and Leonard (2003) find that US data releases on non-farm payrolls, the unemployment rate, initial unemployment claims and consumer sentiment tend to account for the largest moves in both US and German sovereign bond markets. Consistent with the view that US variables have more influence on yields than European ones, Pedersen and Wormstrup (2001) find that only a few euro area indicators affect euro area bond returns. Ehrmann and Fratzscher (2002) confirm that, even though the linkages between the two economic areas increased between 1993 and 2002, the impact of US data releases tends to be greater than that of euro area releases. In earlier studies, US announcements were also found to significantly affect the changes in Australian bond prices (Campbell and Lewis (1998)). The same conclusions were obtained by Gravelle and Moessner (2001) for Canadian short-term futures rates and for government bond yields between 1995 and 2000.

US macroeconomic announcements drive yield changes ...

... in the euro market as well as the US market

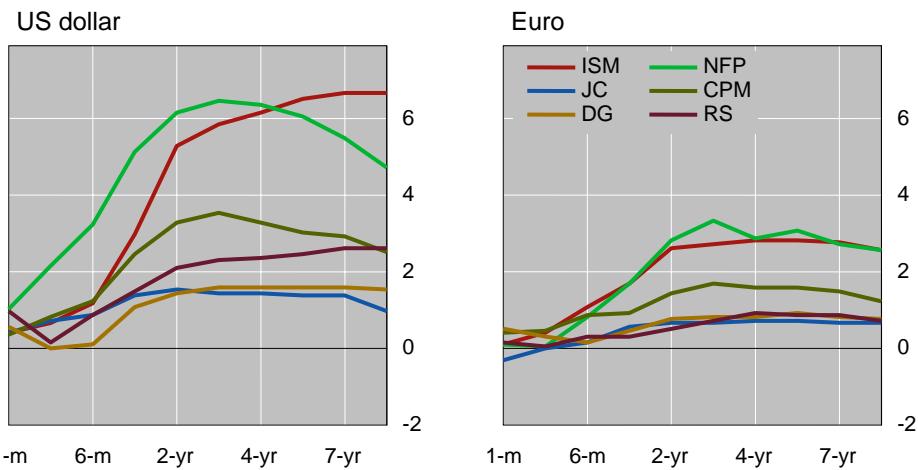
In this section, we confirm for swap yields the announcement effects that have been documented for US and euro area government bond yields. We examine 35 indicators, 16 belonging to the United States, five to the euro area as a whole, seven to Italy, five to France and two to Germany. "Surprises" are defined as the difference between the announced value for an indicator and the consensus forecast.² We standardise the surprises so as to compare the impact across announcements. In all cases, a positive surprise is defined as an event in which the value of the indicator differs from its expected value in a direction that indicates stronger economic growth or higher inflation than had been expected.

We run regressions that take as dependent variables the daily changes in eurodeposits and swap rates, with maturities ranging from one to six months

² All surprises are taken from Bloomberg. For the United States they include: consumer price index (CPI), Institute for Supply Management (ISM) index, jobless claims, non-farm payrolls, durable goods orders, GDP, housing starts, Chicago Purchasing Managers (CPM) index, index of leading indicators, producer price index (PPI), retail sales, factory orders, capacity utilisation, industrial production, balance of trade, productivity. For the euro area: CPI, consumer confidence, industrial confidence, industrial production index, PPI. For Italy: preliminary CPI, consumer confidence, business confidence, producer price index, industrial production index, hourly wages, retail sales. For Germany: retail sales, Ifo index. For France: CPI, consumer confidence, consumer spending, industrial production, PPI.

Swap yield change following a one standard deviation positive surprise¹

In basis points



ISM = US Institute for Supply Management index (formerly known as NAPM); NFP = US non-farm payrolls; JC = US jobless claims; CPM = Chicago Purchasing Managers index; DG = US durable goods orders; RS = US retail sales.

¹ For all variables except jobless claims, the graph shows the impact on yields of a one standard deviation increase in the unconditional mean of the variables. For jobless claims, it displays the impact of a one standard deviation fall in the unconditional mean.

Sources: Bloomberg; BIS calculations.

Graph 1

for eurodeposit rates and from one to 10 years for swap rates. The regressors are the contemporaneous values of the 35 data surprises.³ The sample runs from January 2000 to May 2004. Because the surprises have been standardised, the coefficients of these regressions can be interpreted as the change in yields, measured in basis points, induced by a one standard deviation contemporaneous surprise.

Confirming the results of previous studies, six US news variables are found to exert a significant impact on both US and euro area swap rates, while no euro area news variable plays a statistically significant role in the yield changes in either area.⁴ Graph 1, left-hand panel, shows that US non-farm payrolls and the US Institute for Supply Management (ISM) index are the most influential variables, while the effects of jobless claims, the Chicago Purchasing Managers (CPM) index, durable goods orders and retail sales announcements are smaller and of approximately similar magnitude. The right-hand panel of the graph shows that the impact of these announcements on euro area swap rates tends to be smaller, nearly half that observed for US rates.⁵

³ The same regressions were run including among the regressors a small number of lags of the daily changes in the swap rates, thus controlling for the existence of some degree of predictability in such series. Results did not change significantly.

⁴ These results are not reported.

⁵ It is quite interesting to observe that non-farm payrolls and the ISM index have the same impact on the euro area rates, while the former variable exerts a stronger effect on US swap yields.

Impact of economic announcements on volatilities

While many studies have analysed how data announcements move yields, only a few have focused on their effect on second moments of financial returns. Andersen et al (2003) observe that *realised* volatility, as measured by squared yield changes, spikes just after the announcements, reflecting the change in yields. They also show that, on average, the positive spike in volatility occurring on release days lasts longer than the impact of the announcement on returns. Ederington and Lee (1996) had earlier shown that *implied* volatilities, ie the volatility extracted from option prices, tend to rise in the days preceding a data release. They also found that there is a sharp drop in implied volatilities just after announcements, because the announcement itself helps resolve uncertainty.

What then is the relationship between the behaviour of realised volatility and that of implied volatility? Realised volatility is an *ex post* measure of volatility. As such, its behaviour would depend not only on the type of announcement but also on how large the surprise in the announcement turned out to be. By contrast, implied volatility is an *ex ante* measure. It is supposed to reflect the expected average realised volatility over the remaining life of the option contract.⁶ As such, the behaviour of implied volatility would depend on the type of announcement but not necessarily on the size of the surprise on a given announcement day, which is unknown *a priori*. In principle, the implied volatility before an announcement will reflect the average volatility spike generated by such an announcement. After the announcement, the implied volatility for a given option contract should fall to reflect the fact that there is now one less volatility spike to consider during its remaining life. As a first approximation, how large the surprise turns out to be should be irrelevant. We formally test this hypothesis in the final section.

As shown in the previous section, swap yields rise after a positive surprise and fall after a negative surprise. The jump in yields translates into a positive spike in realised yield volatility. In the case of US swap rates between January 2000 and May 2004, we measure realised volatilities as the absolute values of yield changes for swap yields on maturities of one, five and 10 years. As shown in Table 1, the change recorded for realised volatilities on days characterised by the release of one of the six news items, relative to the realised volatility prevailing on any other day of the sample, is always positive and significant. The biggest spikes are observed for the release of non-farm payrolls (between 8% and 18% for the three rates), jobless claims (between 3% and 5%) and retail sales (around 4.5% for all three rates).

We now analyse how implied volatility behaves on announcement days. First, we estimate implied volatilities from swaption contracts written on swap rates for maturities of one, five and 10 years, and with expirations ranging from

The
announcements
also affect
volatilities ...

... but implied
volatilities differ
from realised
volatilities

⁶ In general, implied volatility will also be affected by the preferences of investors, in particular by how risk-averse they are.

Average spike in realised volatility on US announcement days ¹			
In per cent per annum			
	1-year rate	5-year rate	10-year rate
US non-farm payrolls	18.35	10.90	7.96
ISM survey	1.70	4.95	4.28
CPM index	2.10	1.20	1.11
US durable goods orders	0.34	1.93	1.20
US retail sales	4.62	4.79	3.95
US jobless claims	5.18	3.51	3.18

¹ Change in realised volatility on days on which economic announcements occur.

Sources: Bloomberg; BIS calculations.

Table 1

Dummy variables capture the announcement effects ...

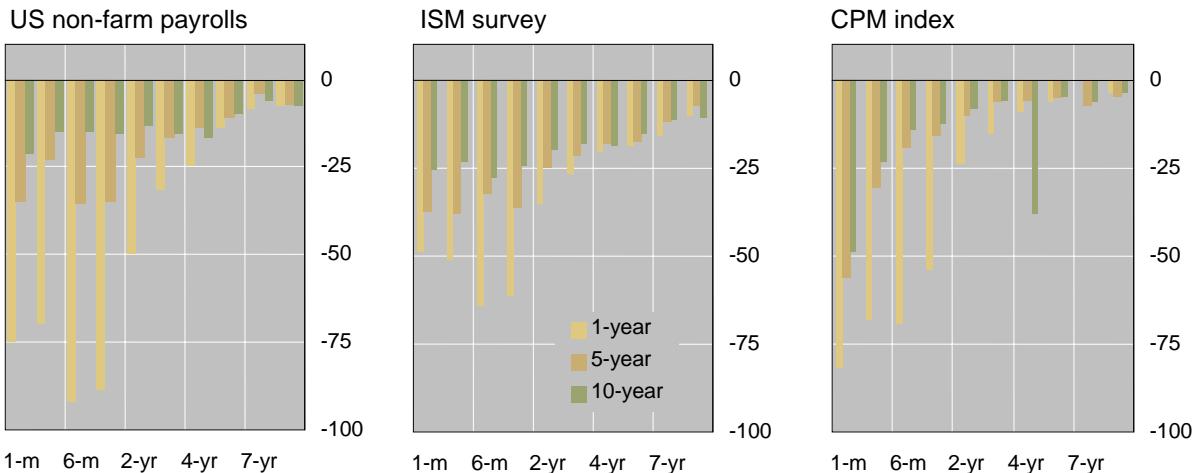
one month to one year.⁷ We then regress daily changes in such volatilities on dummy variables for announcement days, with each type of announcement represented by its own dummy variable. The dummy variable is unity on the announcement day of a given type of announcement and zero for all other days. Graph 2 reports the results for three of the six major economic announcements that we have identified. Consistent with previous findings, the impact of announcement days on implied volatilities is always strongly negative and the pattern tends to be similar across maturities and time horizons. Across the term structure, implied volatilities for the one-year US swap rate tend to have the strongest reaction to data surprises, with the non-farm payroll figure causing a decline of nearly 100 basis points in the implied volatilities of six-month and one-year options on the one-year rate. In the case of euro swaps, volatilities of interest rates respond significantly only to one announcement, the ISM survey, with US non-farm payrolls having only a marginal impact (not reported). In addition, the effects of US announcements on these implied volatilities (also not reported) tend to be much smaller than in the case of US rates. Consistent with what has been found for swap yield changes, no European news release has a statistically significant effect on the implied volatilities of euro area swap rates.

Are the declines in implied volatilities consistent with the average volatility spikes associated with the types of announcements released on those days? In other words, can we expect these declines not to vary from one release date to the next for a given type of announcement? This would be the case if specific announcements did not lead agents to revise their beliefs about future volatility or to modify the compensation they require for the risk of such volatility.⁸

⁷ A swaption is an option on a swap rate, ie an option on a portfolio of forward Libor rates. A European-type payer swaption gives the owner the right to enter a swap at a predetermined fixed rate, where he/she pays the fixed leg of the contract and receives the floating leg, ie the Libor rate, at the expiration (maturity) of the option. For example, at the beginning of the contract, a swaption on the one-year swap rate with a time to maturity of two years and a strike price of 4% gives the owner the right to enter, after two years, a one-year swap contract under which he/she pays 4% and receives the sequence of floating Libor rates at semiannual intervals.

⁸ We formally check the consistency between the spike in realised volatility and the fall in implied volatility as follows: on each day before an announcement, we build a forecast of the

Impact of US economic announcements on implied volatilities¹



¹ Change in implied volatilities, expressed in basis points, on days on which economic announcements occur. The bars indicate the maturity of the swap rates, while the horizontal axis indicates the maturity of the swaption.

Sources: Bloomberg; BIS calculations.

Graph 2

Does the size of the surprise matter for implied volatilities?

The analysis carried out so far shows that implied volatilities in swaptions fall significantly on announcement days. The analysis has not taken into account the surprise in the announcements on those days. Indeed, previous research carried out on yield changes, as opposed to volatility changes, has highlighted the importance of the size of economic surprises, ie the bigger the surprise the bigger the impact on yields. As already noted, however, in the case of implied volatilities, only the ex ante expectation of realised volatility should matter, unless the size of the surprise changes market participants' views about future volatility.

To see whether the size of announcement surprises matters for the behaviour of implied volatilities on announcement days, we run additional regressions. As before, these regressions take as dependent variables the observed changes in implied volatilities for each of the three yields and for each of the three swaption maturities, and as independent variables dummy variables for announcement days. This time, however, we add to these regressions the absolute values of the corresponding standardised surprises. If the coefficients associated with the standardised surprises turn out to be significantly different from zero, we would then conclude that the size of the

change in implied volatility which will take place after the announcement by subtracting the expected spike in the realised volatility, taken from Table 1 and rescaled to reflect the maturity of the swaption, from the implied volatility prevailing on that day. We then compare, for each type of announcement, the difference between the realised and the predicted changes in the implied volatility. In nearly two thirds of the comparisons (the total number of comparisons was 54) we cannot reject the hypothesis that our forecast is statistically indistinguishable from the actual values of the changes in implieds. See Tarashev et al (2003) for an application to the US, UK and German stock indices.

Regression of the change in implied volatilities on announcement dummies and economic surprises¹

In basis points

		1-year rate		5-year rate		10-year rate	
		1-m ²	6-m ²	1-m ²	6-m ²	1-m ²	6-m ²
US non-farm payrolls	A	-70	-55	-44	-27	-55	-26
	S	-18*	33*	-32*	-2*	-10*	3*
ISM survey	A	-84	-29	-67	-29	-60	-24
	S	29*	-23*	1*	-6*	0*	-3*
CPM index	A	-82	-29	-67	-29	-61	-24
	S	32*	19*	12*	9*	1*	1*
US jobless claims	A	-84	-29	-68	-29	-61	-23
	S	-5*	3*	-2*	3*	-9	1*
US retail sales	A	-84	-32	-68	-29	-61	-24
	S	-15*	-47	-16	-15	-6*	-3*
US durable goods orders	A	-85	-30	-68	-29	-61	-24
	S	-53	-5*	-23	0*	-24	-3*

¹ The dummy is unity on a day when an announcement occurs and zero on all other days. A = change in implieds due to the announcement dummy; S = change due to the size of the standardised surprises. The asterisk indicates that the coefficient is not statistically different from zero. ² Maturity of the swaption.

Table 2

surprise does matter and that it contains relevant information about future volatilities.

... and the surprise
on a given day
tends not to matter

Results based on the implied volatilities of the US swap rates show that the coefficient associated with the absolute value of the surprise is negligible for five of the six analysed announcements (non-farm payrolls, ISM survey, CPM index, jobless claims, durable goods orders; see Table 2). This result means that knowing the size of the surprise in any of these five announcements does not translate into a significant advantage in forecasting future volatilities. Only in the case of the retail sales announcement does the size of the surprise seem to matter. However, the effect is the opposite of what we would expect: a bigger surprise leads to a sharper decline in implied volatility, suggesting that future volatilities are expected to be smaller. Nonetheless, for the most part, the decline in implied volatilities on announcement days does not depend on how large the announcement surprise turns out to be.

Conclusions

We confirm previous findings that show how the releases of a small number of US economic variables produce significant changes in both US and euro area interest rates. We have not been able to find any euro area news that affects either domestic or US rates. We also show that for at least six specific US announcements, implied volatilities extracted from interest rate swaptions tend to fall on announcement days. The declines are in line with the realised volatility spikes that these announcements produce on average, suggesting that the behaviour of implied volatilities can be explained largely by the removal of an expected volatility spike from the relevant horizon for swaptions.

In particular, we show that the size of the economic surprise on a given announcement day does not help forecast the change in implied volatilities.

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