

Derivatives activity and monetary policy¹

Trading in futures and options on short-term interest rates has grown rapidly since the turn of the millennium. This feature provides some econometric evidence on the relationship between turnover in this market and changes in policy rates, both actual and expected. The volume of trading in exchange-traded money market derivatives appears to respond mainly to changes in expectations of future interest rates, which is in line with evidence suggesting that monetary policy has become more transparent and predictable relative to the 1980s and early 1990s. Increased uncertainty about future central bank actions is also associated with higher turnover.

JEL classification: E52, G12.

The outlook for monetary policy is an important driver of activity in the derivatives market. Although central banks typically control only a single, very specific short-term interest rate, their actions have an impact on the whole spectrum of yields and on other asset classes. This creates a natural demand for instruments that could be used to hedge against changes in policy rates or to take positions on policy shifts. Derivatives on short-term interest rates are attractive for both purposes, as trading in these instruments involves much smaller cash outlays for a given exposure to risk than borrowing and lending in the spot market. Moreover, they are also available to traders who, by virtue of their limited size or lower credit rating, cannot operate in the deep end of the spot market. Money market derivatives tend to be highly liquid, thus enabling traders to enter positions cheaply, quickly and with minimal impact on prices.

This feature explores the link between monetary policy and turnover in exchange-traded derivatives linked to the short-term interest rates of the G3 economies and provides some econometric evidence in this regard. It assesses the explanatory power for turnover and open interest of several variables measuring different aspects of market participants' perceptions of future central bank actions. Some of the variables, such as implied volatility, have been widely used in the literature; others, such as changes in expected rates or disagreement between economic forecasters, have rarely been considered in

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this context. The aim of this exercise is twofold. More immediately, the results should facilitate interpretation of the data on activity in exchange-traded derivatives, regularly published by the BIS. In addition, understanding the determinants of trading may give us a better sense of how the market functions and, hopefully, also of how it relates to other parts of the financial system.

The results indicate that changes in expectations about future interest rates tend to have a sizeable impact on activity in most exchange-traded money market derivatives. By contrast, anticipated changes in spot rates do not appear to have any effect on turnover. Interest rate movements that had not been anticipated by the beginning of the month seem to depress activity in some contracts but not in others. Higher uncertainty about the future course of monetary policy is associated with higher turnover, while differences in opinion between traders reduce trading in some key contracts.

For the United States, there is some evidence of a “division of labour” between federal funds contracts, which are preferred when positions on central bank policy in the very short term are being taken, and derivatives on three-month eurodollar deposits, which tend to be used to trade interest rate risk more generally. EONIA futures do not play the same role in the euro area as federal funds futures in the United States, as very short-term interest rate risk tends to be traded over the counter using EONIA swaps.

Money market derivatives in the G3

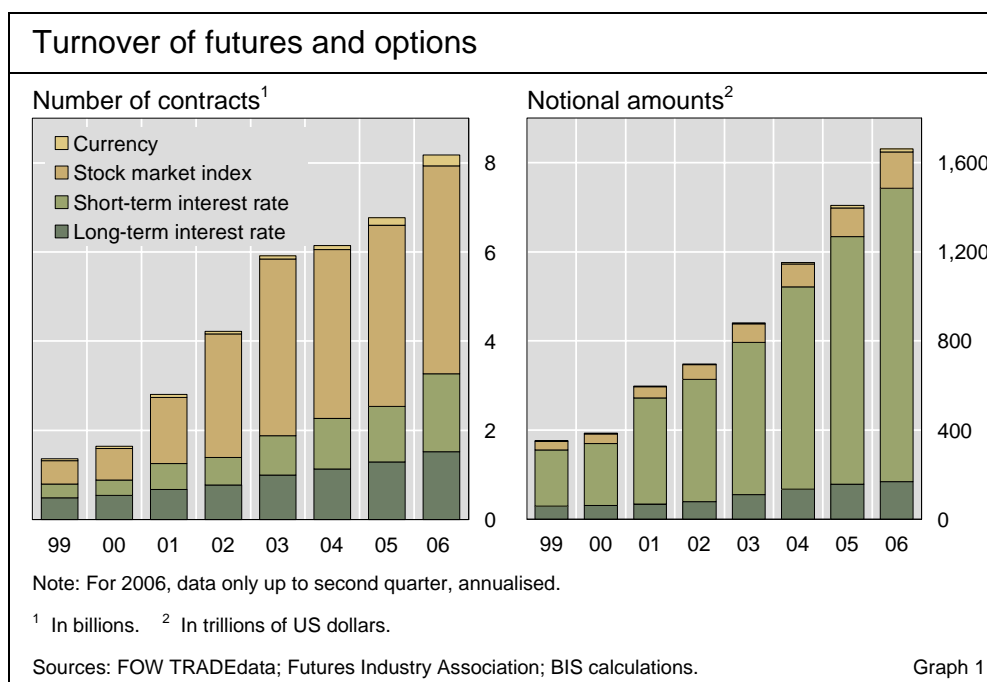
Futures and options on short-term interest rates are among the most actively traded financial contracts in the world. In the first half of 2006, one in every five financial derivatives traded on an organised exchange referred to a short-term interest rate (Graph 1).² Measures based on nominal amounts point to an even greater share of these instruments in total turnover, although issues arise concerning the measurement of the actual risks embodied in the contracts. Regardless of which measure is used, turnover in exchange-traded derivatives on short-term interest rates increased considerably in the early 2000s.

Short-term interest rate risk can also be traded over the counter (OTC) using a variety of instruments such as forward rate agreements, swaps, caps, floors and collars. Unfortunately, data on activity in OTC contracts are available only at relatively low frequencies and with a very coarse instrument breakdown.³ As a consequence, the analysis that follows is limited to exchange-traded futures and options, with only passing references to the OTC market.

Importance of derivatives on short-term interest rates

² I consider only futures and options on overnight and three-month interest rates, although traders reportedly also use contracts on two-year treasuries to take positions on central bank actions.

³ For example, the BIS semiannual survey on OTC derivatives activity breaks down interest rate derivatives into swaps, forward rate agreements and interest rate options. It does not differentiate between contracts on short-term interest rates and those on longer-term rates. Further information on this survey is available at <http://www.bis.org/press/p060519a.htm>.



Contracts on overnight rates permit clean positioning on central bank actions ...

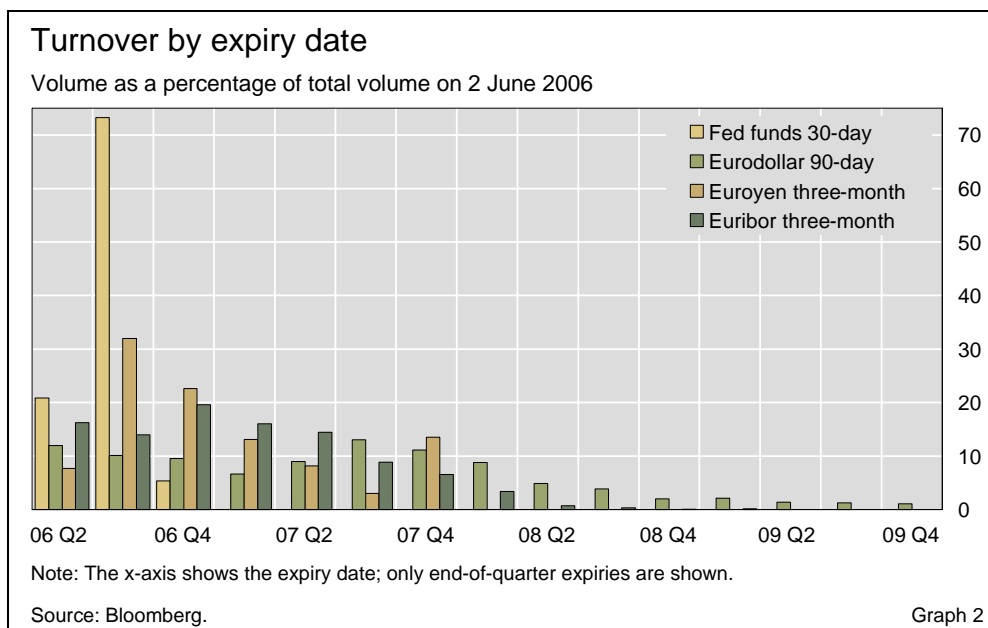
The derivatives most immediately related to central bank actions are contracts on overnight interest rates. Perhaps the best known of such contracts are federal funds futures and options, which are based on the average overnight rate in the month of expiry. Indexing to monthly averages rather than rates at a given point in time eliminates most of the impact on settlement prices of day-to-day fluctuations in overnight rates that are unrelated to monetary policy.

Futures on overnight interest rates have been much less successful outside the United States. Although two exchanges list futures contracts on EONIA, the benchmark overnight rate for the euro area, volumes are minimal. Instead, overnight interest rate risk is mainly traded over the counter using EONIA swaps, whose volumes have doubled since the turn of the millennium, with a sharp spike in the second half of 2003.⁴ Similar instruments are also traded in other currencies such as the Japanese yen.

... but are less liquid than derivatives on three-month rates ...

Although futures and options on overnight rates permit a cleaner positioning on central bank actions than derivatives on longer-term rates, their attractiveness for hedging purposes is limited by the fact that there are very few debt contracts based on such rates. Instead, interest payments on short-term and floating rate debt in the major currencies are often linked to three-month Libor. This may explain why turnover in derivatives on three-month rates, such as the eurodollar, Euribor or euroyen contracts, is much higher than that in any other money market derivative in the same currency. For example, approximately 120,000 federal funds futures and options with a notional amount of more than \$600 billion were traded on an average day in the first half of 2006, compared to 3 million (\$3 trillion) eurodollar derivatives.

⁴ In an EONIA swap, two parties exchange a payment linked to EONIA against a fixed amount set at the inception of the contract. A turnover index (albeit no notional amounts) for these products is published by the ECB in its annual Money Market Surveys (eg ECB (2006)).



Derivatives on three-month interest rates are also more liquid for longer expiries than contracts on overnight rates. For example, the breakdown of turnover by expiry date on a randomly chosen day in the spring of 2006 plotted in Graph 2 shows more or less active trading in all quarterly expiries up to December 2007 of eurodollar, Euribor and euroyen futures, but little in longer-dated contracts. By contrast, there was little trading in federal funds maturities other than June and September 2006.⁵ Similarly, almost half of the activity in the EONIA swap market is in contracts expiring in one month or less and very little trading is in expiries of more than one year.

... especially for longer maturities

Both the differences in contract design and the maturity breakdown suggest that derivatives on overnight rates are preferred for taking speculative positions on central bank actions, while contracts on three-month rates are used to trade interest rate risk more generally. Such a “division of labour” would be consistent with findings on the predictive quality of prices from these two instruments. For example, Gürkaynak et al (2002) show that, for short horizons of up to three months, federal funds futures dominate other contracts as predictors of future federal funds rates.

Hypothesis: “division of labour” between different contracts

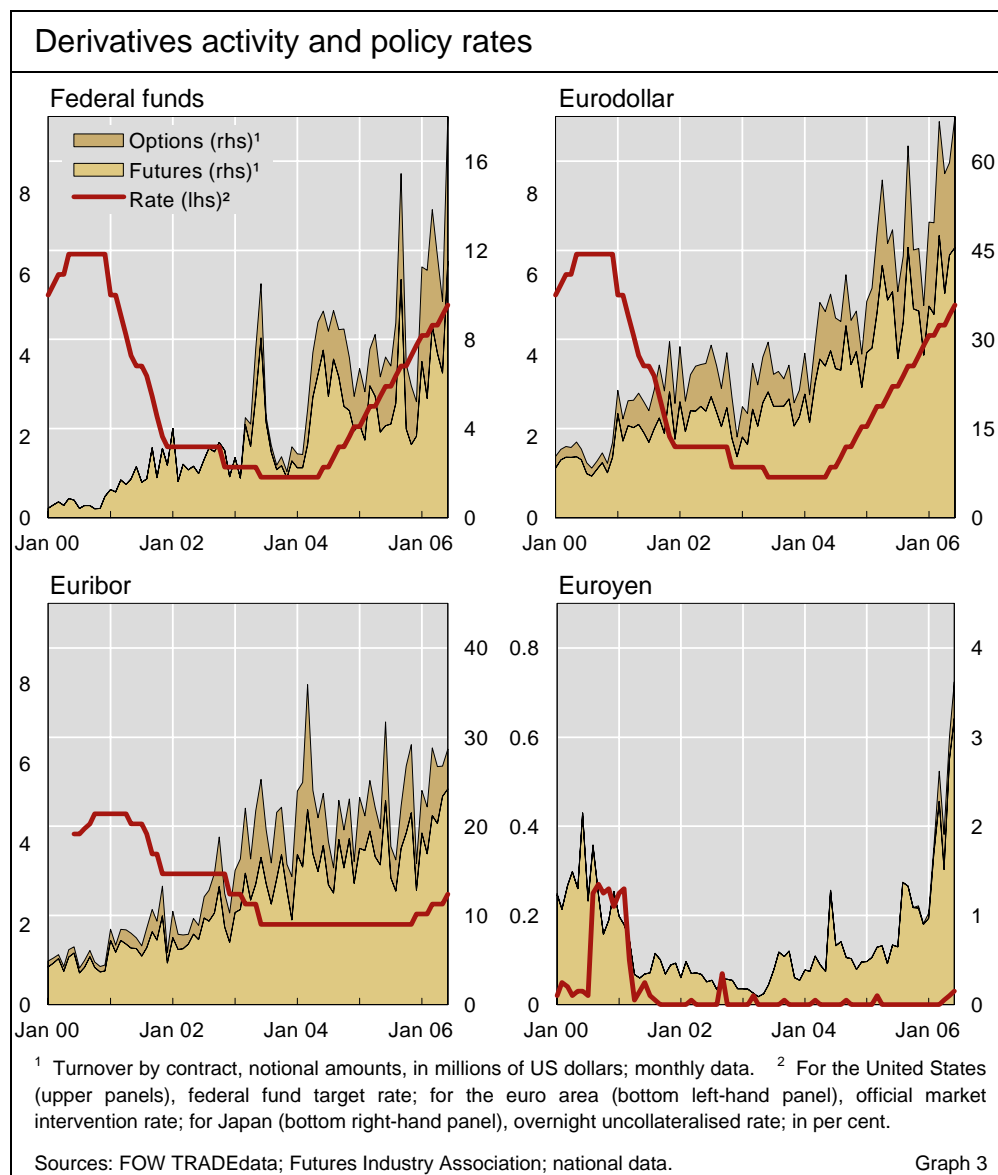
A visual examination of the relationship between turnover in different exchange-traded derivatives contracts on short-term interest rates and policy rates in the respective currency (Graph 3) broadly supports this hypothesis. Turnover in both federal funds derivatives (top left-hand panel) and eurodollar contracts (top right-hand panel) appears to be closely related to monetary policy. For example, turnover in both contracts increased sharply in late 2000 and early 2001, roughly coinciding with the time when the Federal Reserve began to cut interest rates. Likewise, activity in both contracts picked up

Turnover surges particularly during shifts in monetary policy

⁵ Futures on short-term interest rates are listed for much longer horizons than those shown in Graph 2. For example, eurodollar futures expiring any quarter during the coming 10 years are listed at any given point in time although there is extremely little trading in contracts maturing in more than a few years. Federal funds futures are listed for each of the coming 24 months, but there is very little trading in expiries other than the next two end-of-quarter months.

markedly during the deflation debate of 2003 and when the Fed began to tighten policy in the middle of 2004. However, while monetary policy appears to be the main driver of activity in federal funds futures and options (which began trading in March 2003), it seems to be only one of several determinants of trading in eurodollar derivatives. Turnover in these contracts is less volatile and surges in activity tend to be longer-lasting than could be explained by trading ahead of central bank policy shifts alone.

A positive relationship between derivatives activity and changes in interest rates is also visible in the euro area. Trading in contracts on three-month Euribor accelerated in early 2000 and 2003 prior to rate cuts by the ECB (bottom left-hand panel). By contrast, no clear relationship between rate changes and exchange-traded derivatives trading is apparent in Japan (bottom right-hand panel). This is not surprising given that short-term interest rates remained at virtually zero between April 2001 and July 2006 and there was hardly any short-term (nominal) interest rate risk during most of that period.

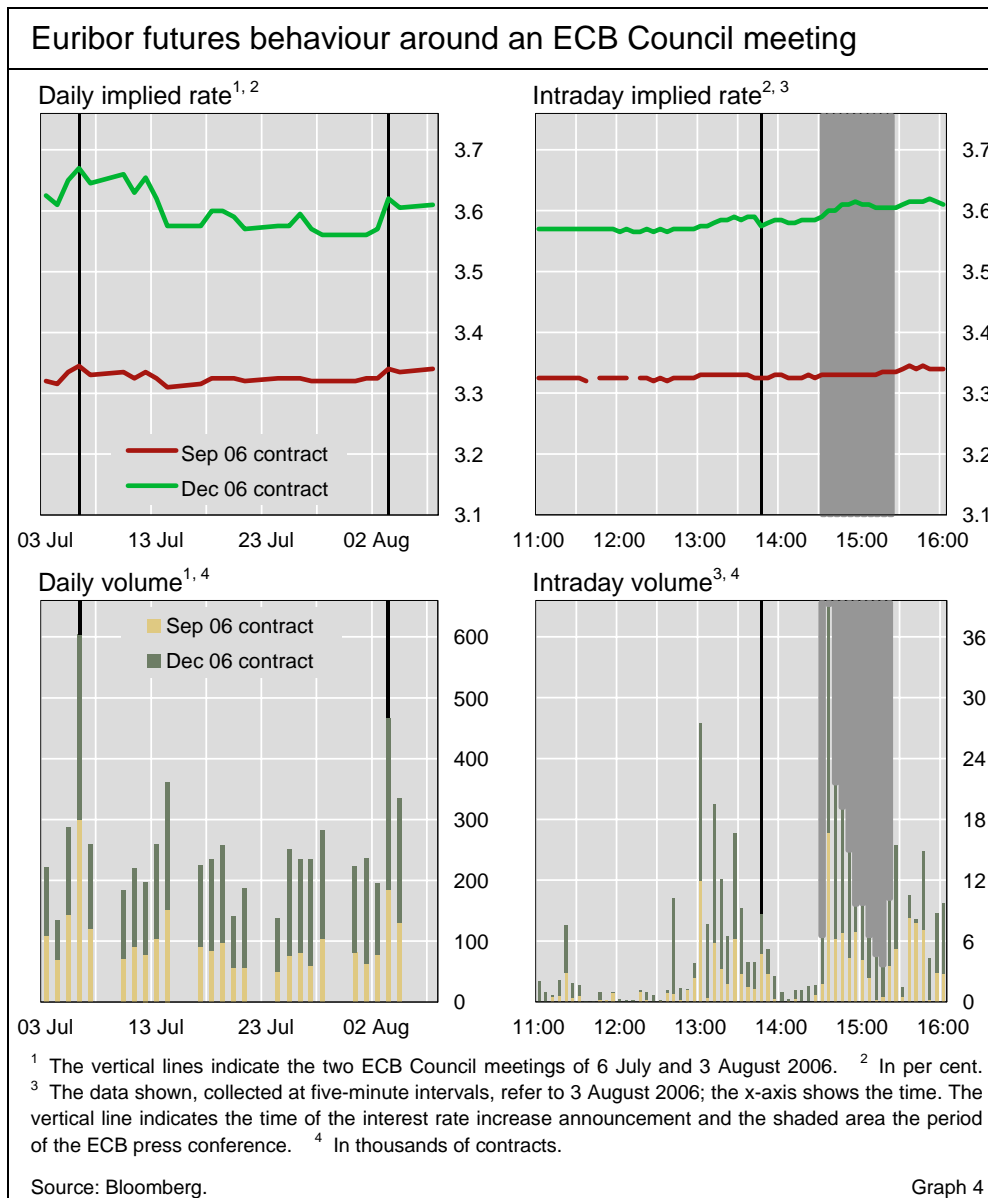


Disentangling the market's expectations of monetary policy

An examination of derivatives activity and interest rate changes at a monthly level provides a first impression of the influence of monetary policy on derivatives trading. One has to look at higher frequencies, however, to understand how traders' perceptions about monetary policy affect activity in derivatives on short-term interest rates.

High-frequency analysis ...

Graph 4 shows the evolution of prices and quantities of the September and December contracts on three-month Euribor around the ECB Governing Council meeting on 3 August 2006, when the ECB lifted the minimum bid rate for its main refinancing operations from 2.75% to 3%. The left-hand panels show daily data, while the right-hand panels plot intraday numbers around the time of the announcement (marked by a black vertical line) and the press conference (shaded area). At 13:00 Frankfurt time on that day, 45 minutes ahead of the ECB announcement, the Bank of England raised its base rate to 4.75%, a move that took most market participants by surprise. This hike was



... shows little effect of anticipated rate changes ...

... but strong response to news about future rate changes

Responses indicate high predictability of central bank actions

Ambiguous relationship between turnover and uncertainty

Differences in opinion may lead to speculative trading

followed by a slight increase in the rate implied by Euribor futures expiring in December and led to some repositioning in euro-denominated contracts too. The ECB's announcement at 13:45 was almost perfectly anticipated by market participants and therefore had little impact on futures prices. Turnover increased somewhat in the first five minutes after the release, but quickly fell afterwards. By contrast, statements by the ECB's President at the press conference one hour later were interpreted by many traders as indicating that interest rates might rise again and earlier than previously expected, which led to an increase in the rates implied by the prices of the December contract and a spike in activity. Overall, turnover on the day of the Council meeting was much higher than that on any day during the previous four weeks. While activity was strong in both the September and the December contracts, trading in the latter increased by a larger amount.

The trading pattern observed around the ECB Council meeting of 3 August is typical of those for other meetings, in the euro area as well as in other regions: trading appears to be triggered less by the actual policy move than by changes in expectations about future interest rates. Of course, this holds only if rate decisions are anticipated by the market, which is usually the case in most industrial countries today.⁶ Anticipation effects may take place well in advance of the actual rate change. In some cases, data releases or central bank communications affect forward rates many years into the future, although the breakdown by contract expiry shown in Graph 2 indicates that market participants do not use money market futures to take positions over such long horizons.

Revisions in the point estimates of future interest rates are unlikely to be the only drivers of derivatives activity: the uncertainty associated with these expectations is also likely to be important. However, the relationship between uncertainty and activity is by no means straightforward. Jeanneau and Micu (2003) argue that higher uncertainty increases hedging demand but has ambiguous effects on speculative activity. On the one hand, uncertainty creates trading opportunities, but, on the other, it also increases the risk associated with each transaction. In their empirical work, the authors document a statistically significant relationship between implied volatility as a proxy for uncertainty and activity in stock index contracts but not in futures and options on government bonds.

Another factor that could affect trading in derivatives on short-term interest rates is differences in opinion among traders, as opposed to a generalised increase in uncertainty.⁷ Although most information affecting interest rates, such as macroeconomic data releases or central bank announcements, is

⁶ A wide body of literature shows that monetary policy has become more transparent relative to the 1980s and early 1990s, and that this has increased the predictability of central bank actions. See BIS (2004, pp 73–80) for some evidence concerning predictability and an overview of the issues related to central bank transparency.

⁷ Differences in opinion and uncertainty are related, but distinct, concepts. For example, traders may differ in their (strongly held) views on a particular aspect of monetary policy even if there is little uncertainty otherwise. Theoretical models which analyse the relationship between differences in opinion and trading volume are Shalen (1993) and Harris and Raviv (1993).

public, traders could well differ in their assessment of this news. Indeed, one might argue that having a different perspective on the outlook for asset prices is a key reason for market participants to engage in speculative trading. In contrast to insider information, which tends to be incorporated into prices very quickly, differences in opinion may persist over prolonged periods of time and may therefore be associated with higher volumes even at lower frequencies (see also BIS (2005)).

Explaining activity with changing perceptions of monetary policy

This section offers a more systematic analysis of turnover based on regressions that incorporate the effect of traders' anticipation of interest rate moves, the uncertainty surrounding these expectations, and possible differences in opinion among market participants concerning future central bank actions. The analysis is done on a contract by contract level, as different contracts may serve different purposes. The estimation period ranges from February 1999 (March 2000 for Euribor contracts) to June 2006. Trading in federal funds options started only in March 2003, and trading in euroyen options and EONIA futures dried up during the sample period, so it was not possible to include these contracts in the analysis.⁸

The rate of growth of average daily turnover in each month is regressed on its own lagged values as well as a series of explanatory variables capturing different aspects of traders' perceptions of monetary policy. Changes in traders' expectations of future interest rates are measured by changes in implied three-month rates ($\Delta futrates$) two months ahead.⁹ In order to capture nearer-term developments in rates, the regressions also include contemporaneous changes in one-month interest rates, decomposed into anticipated ($\Delta antrates$) and unanticipated ($\Delta unantrates$) components. Since futures and options can easily be used to enter both long and short positions, the absolute change of interest rates is used instead of the signed change.

In line with common practice in the literature, the uncertainty surrounding future monetary policy is proxied by the volatility implied by the prices of at-the-money options ($\Delta impvol$). In principle, options on overnight rates, which are likely to be more closely related to central bank actions, would have been preferable, but such contracts were not traded for the entire sample period in any of the three major currencies. Implied volatility from eurodollar and Euribor options is used instead. For Japan, there is no uninterrupted series for implied

Regressions of turnover ...

... on changes in expected interest rates ...

... investor uncertainty ...

⁸ It is not clear whether turnover of money market derivatives has a unit root, as the corresponding tests give conflicting results. However, regressions in first differences of log turnover appear to be better specified than regressions in levels, which tend to have highly autocorrelated residuals. Nevertheless, the results concerning the relationship between expected rate changes and turnover also hold when the regressions are performed in levels and a linear trend is included to capture the structural growth of the market.

⁹ Implied forward rates need not coincide with expected rates due to the presence of term premia. However, differencing should eliminate most of the effect of term premia, which tend to vary over business cycle frequencies.

volatility as trading in euroyen options dried up during the middle years of the sample.¹⁰

... and dispersion of opinion indicator ...

Trader disagreement on the future course of monetary policy is proxied by the (cross-sectional) standard deviation of the individual forecasts for three-month interest rates compiled by Consensus Economics in any given month (*diffopinion*).¹¹ Although the economists included in the panel are not traders, most tend to be employed by firms with large trading operations. Nevertheless, it is possible that the data are distorted by strategic positioning which may affect the results of the estimations.¹² In addition, macroeconomic forecasts are usually made at frequencies lower than one month and are then updated using simple rules of thumb, which could introduce some inertia into the data.

... underline role of changes in expectations ...

The results from the estimations largely confirm the view that changes in expected interest rates rather than actual changes affect trading in derivatives on short-term interest rates, at least for some contracts (Table 1). The coefficient of $|\Delta futrates_i|$ is positive and statistically highly significant for

Monetary policy and derivatives activity: estimation results						
	Eurodollar		Federal funds	Euribor		Euroyen
	Futures	Options	Futures	Futures	Options	Futures
$\Delta turnover_{t-1}$	-0.33*** (-4.26)	-0.33*** (-3.63)	-0.36*** (-3.82)	-0.74*** (-8.94)	-0.46*** (-3.73)	-0.22** (-2.03)
$\Delta turnover_{t-12}$	0.37*** (5.07)	0.33*** (3.75)	0.22** (2.45)	0.18** (2.23)	0.15 (1.51)	0.13 (1.17)
$ \Delta futrates_i $	0.55*** (4.86)	0.57*** (3.81)	0.42* (1.77)	0.17 (1.44)	1.02** (2.47)	0.37 (0.51)
$ \Delta unanrates_i $	-0.32** (-2.49)	-0.30* (-1.81)	-0.21 (-0.80)	-0.11 (-0.81)	-0.15 (-0.39)	-0.07 (-0.08)
$ \Delta anrates_i $	0.08 (1.23)	0.07 (0.86)	-0.03 (-0.13)	0.37 (1.44)	0.32 (-0.45)	0.18 (0.61)
$\Delta impvol_t$	0.010*** (3.17)	0.008** (1.99)	0.028*** (4.10)	0.001 (0.21)	0.022 (1.62)	.
$diffopinion_t$	-0.43** (-2.26)	-0.44* (-1.75)	-0.08 (-0.21)	0.25 (-0.70)	-0.37 (-0.49)	-0.11 (-0.08)
Adjusted R ²	0.50	0.36	0.33	0.68	0.27	0.01
Durbin-Watson	2.06	2.08	1.97	1.99	2.21	2.02
Sample period	1999:2– 2006:6	1999:2– 2006:6	1999:2– 2006:6	2000:3– 2006:6	2000:3– 2006:6	1999:2– 2006:6
No of observations	89	89	89	76	76	89

Note: Dependent variable: $\Delta turnover$. t-values in brackets. *, ** and *** denote significance at the 10%, 5% and 1% confidence level, respectively.

Table 1

¹⁰ Implied volatility is another borderline case where unit root tests deliver ambiguous results. To avoid any spurious relationship stemming from non-stationarity, implied volatility enters the regressions as first differences.

¹¹ See BIS (2005) for a similar analysis for stock index derivatives.

eurodollar futures and options as well as for Euribor options. For eurodollar contracts, a 10 basis point change in implied forward rates raises turnover growth by approximately 5 percentage points. The impact on turnover in Euribor options is even larger. The estimation results for other contracts yield less clear results. The coefficient on $|\Delta futrates_i|$ is only weakly significant in the equation for federal funds futures and not significant at all in the case of Euribor and euroyen futures. In the latter case, this is probably related to the low level of and variation in Japanese interest rates, both actual and expected, over the period, which is also reflected in the very low explanatory power of the regression.

As expected, anticipated rate changes have no discernible impact on turnover in any contract. By contrast, unanticipated rate changes appear to reduce monthly turnover in eurodollar futures and options. At first glance, this may seem at odds with the earlier analysis based on high-frequency data. However, one should note that higher trading in the immediate aftermath of an interest rate surprise may be offset by lower volumes further down the road. A similar effect where a coefficient is positive at daily and negative at monthly frequencies has been documented by Jeanneau and Micu (2003) for the relationship between volatility and turnover.

... rather than actual moves

An increase in uncertainty over future central bank policy is associated with heavier trading in money market contracts for all three US contracts but does not appear to affect trading in futures and options on Euribor. Finally, the dispersion of interest rate forecasts is negative and statistically significant for both eurodollar contracts but not in the other regressions. Again, the sign is not in line with the priors suggested by the literature. It is possible that conflicting expectations dampen trading because they deter non-informed traders.

The regression results are broadly in line with the “division of labour” hypothesis that states that different contracts are used for different purposes. As mentioned above, the hypothesis states that traders use federal funds contracts for taking positions on relatively immediate changes in policy rates but use eurodollar contracts to trade interest rate risk more generally. This would imply that changes in expected rates several months ahead have a stronger effect on eurodollar than on federal funds trading, which is confirmed by the regressions. However, we would also expect changes in short-term interest rates that had not been anticipated at the beginning of the month but perhaps were anticipated immediately before the rate change to be associated with higher federal funds turnover. The lack of significance of the coefficient on $|\Delta unanrates_i|$ does not directly contradict this, but neither does it support it. Higher-frequency data may be necessary to settle this issue.

Weak support for “division of labour” hypothesis

¹² See Laster et al (1999) for a model and empirical evidence of strategic behaviour on the part of macroeconomic forecasters.

Conclusions

Results are in line with more transparent central banks ...

In a world with more transparent central banks and monetary policy that is increasingly predictable, actual rate changes should convey little new information to traders and have limited impact on turnover. Instead, market participants are more likely to adjust their positions in response to news about future interest rates. These predictions are largely borne out by the data, which show a statistically significant relationship between turnover and changes in expectations of future interest rates in several money market contracts. Anticipated rate changes, by contrast, do not seem to have any significant effect on turnover. A third result, namely that changes in interest rates that had not been anticipated by the beginning of the month appear to dampen turnover in some contracts but have no effect on turnover in others, does not contradict the notion that central banks have become more predictable. However, it would be interesting to see whether this result also holds at higher frequencies which permit a cleaner distinction between what has been anticipated and what not at the moment of the interest rate announcement.

... and different uses of various contracts

The econometric analysis is also broadly in line with a “division of labour” between different contracts, although the evidence in favour of this hypothesis is not very strong either. In part, this may be due to the use of monthly data. Moving to higher frequencies could give a better idea of the use of different contracts, although it would be hard to transfer the results of such an exercise back to the monthly level required when interpreting the regular BIS statistics on exchange-traded derivatives.

The low frequency and limited instrument breakdown of the available data on OTC derivatives stand in the way of an extension of the present analysis to that market segment. This is unfortunate, since futures and options traded on organised exchanges compete with relatively similar products that are traded over the counter. A much better understanding is required of why some products are traded OTC and others on exchanges, in particular in relatively standardised product categories.

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