cent. Corporate lending is growing fastest. This was accompanied by a marked acceleration of lending by housing intermediaries to households, which probably mirrors the situation in the housing market, with rising prices and a higher turnover for houses and tenant-owned dwellings.

All in all, the supply of credit still seems to be good in that the development of the credit aggregates shows an acceleration in the growth of lending to households as well as firms. This points to continued growth in retail trade and private consumption. The risk of an uncontrolled development of consumption financed with loans is judged to be slight in that households are mainly satisfying an accumulated demand for durable goods at a time when they are probably in a good position to pay.

Growth of the credit and money supply aggregates points to rising inflationary pressure in the future.

The growth of the credit and money supply aggregates is still comparatively high and points to rising inflationary pressure in the future. The narrow money supply (M0, defined as the resident non-bank sector's holdings of notes and coins) has been a good indicator of inflation about six quarters ahead. In April the 12-month rate of M0 growth was 7.6 per cent, which is somewhat lower than in March but considerably higher than in January and February (Annex: Fig. 18). The continued high rate suggests that the development of private consumption will remain strong.

The broad money supply (M3, which also includes the non-bank sector's bank deposits and certificates of deposit) is sometimes markedly affected by portfolio rearrangements between bank deposits and alternative assets that are not included in this aggregate. Even so, M3 is considered to be a useful indicator of inflation. In April the growth rate was 6.8 per cent, which is higher than the latest figure in the previous Report (Annex: Fig. 18). A large part of the upswing is judged to come from increased corporate deposits.

Both the credit and the money supply aggregates point to a continuation of the strong tendencies for retail trade and private consumption, as well as rising inflationary pressure in the future.

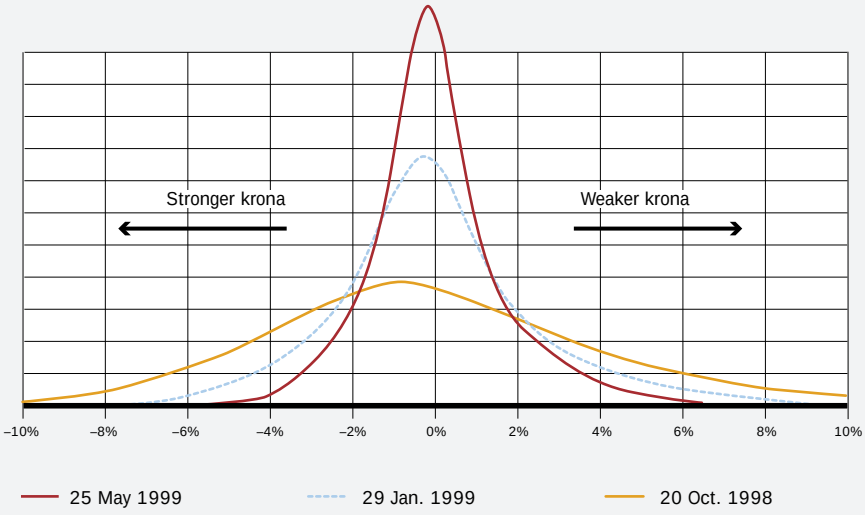
IMPLIED EXCHANGE RATE PROBABILITY DISTRIBUTIONS

In the period since the March Report the Swedish krona has been stable against the euro and global financial and currency markets have been comparatively calm. It may be of interest to study whether and, if so, in what way market assessments of uncertainty about the krona's exchange rate have changed recently, as well as current perceptions of the exchange rate's future path. In the March Report it was noted that a picture of market perceptions of the uncertainty about this path can be formed from currency option prices. This approach has now been developed, using option prices to derive *implied probability distributions for the exchange rate* . Distributions of this type can be interpreted as the market's *ex ante* assessment of the probability distribution for the future exchange rate.[9]

In that the price of an option can generally be written as a function of the probability distribution of the underlying asset, implied probability distributions can be estimated from observed market prices for options.[10] The implied exchange rate distribution accordingly conveys information of the same type as the OTC market prices for currency options (at-the-money volatility, strangle and risk reversal). The advantage of implied distributions is that they yield various quantitative indicators of the market's risk assessment and these can be interpreted in terms of probabilities, which is often more instructive than the information conveyed by quoted option prices.

The estimated distributions for SEK/EUR derived from one-month option prices on 20 October 1998, 29 January and 25 May 1999 are shown in Fig. B2.[11] For 20 October 1998 the estimated implied distribution is dis-

Figure B2.
Implied SEK/EUR probability distributions one month ahead on 20 October 1998, 29 January 1999 and 25 May 1999. One month forecast horizon. Yield in SEK/EUR*



* Return in relation to the forward rate, that is, the mean of the distribution.
Sources: Reuters and the Riksbank.

persed (a high standard deviation). At that time the financial markets were turbulent in connection with Russia's debt moratorium and the Swedish krona weakened. This naturally generated considerable uncertainty about the future exchange rate. When the financial unrest subsided after the turn of the year, uncertainty about the krona's future path decreased at the same time as the krona began to recover against the euro. This appreciation, which continued throughout January, may also have been supported by increased expectations that Sweden would be joining the euro area.

That uncertainty about the future exchange rate decreased early in 1999 is clear from the standard deviation of the implied distribution on 29 January 1999, which is considerably lower than on 20 October 1998. While the uncertainty had decreased in January, it will be seen from Fig. B2 that the distribution is positively skewed (the right-hand side of the distribution is longer and has a fatter tail). This in turn can be interpreted as indicating that a marked weakening of the krona one month ahead was considered more probable than a corresponding appreciation. Since the beginning of February the krona has been relatively stable, and exhibited a low volatility. The probability distribution for 25 May 1999 shows that the market considered that the uncertainty had continued to decrease since January. The distribution is even more compressed than it was on 29 January, though it is still positively skewed.

The implied distributions in Fig. B2 are snapshots of market expectations on those particular dates. It can also be of interest to study how the market's assessment of uncertainty has varied over a longer period. One approach involves studying the path of a confidence interval.[12] The interval is chosen so that it includes a fixed proportion of the probability distribution's mass, say 90 per cent. In other words, it can be interpreted as the interval within which the market believes that the exchange rate will end up in at the end of the forecast horizon with a 90 per cent probability. The interval accordingly provides an indication of the degree of uncertainty in the currency market over time. A broad interval signifies high market uncertainty about the future exchange rate.

The 90 per cent confidence interval for SEK/DEM[13] one month ahead is presented in Fig. B3 for the period from 1 August 1993 to 25 May 1999. It clearly demonstrates that uncertainty about the future exchange rate has varied over time. Option prices show that uncertainty about the future increases during periods of financial and currency market turbulence. This pattern was particularly clear in connection with the Mexican crisis around the turn of 1994 and the Russian crisis in the early autumn of 1998. Besides the increased uncertainty about the krona's future rate, there is a tendency for the krona to weaken against the German mark in turbulent periods. As last autumn's financial

market unrest subsided, the krona did strengthen against the euro (and thereby against the German mark) and the market perceived a diminishing degree of uncertainty. This means that market players no longer perceive the same probability as before of large short-run fluctuations in the value of the krona

The implied SEK/EUR distribution does indicate, however, that a marked depreciation of the krona in the coming month is considered to be somewhat more probable at present than a marked appreciation.

9 Note, however, that what is estimated is just the *risk-neutral* distribution, that is, just the distribution that would obtain if the market players had a neutral attitude to risk.

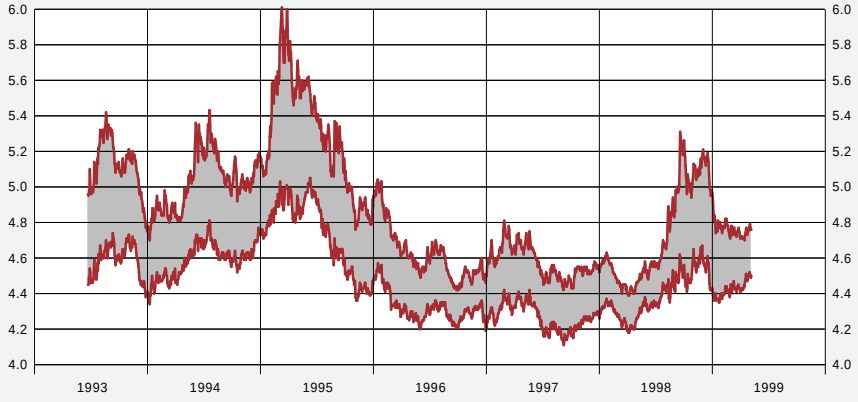
10 More specifically, we have estimated implied distributions for the future exchange rate with the method described in Malz, A.M. (1997), Option-implied probability distributions and currency excess returns, *Federal Reserve Bank of New York Staff Report* no. 32; the method is also described and the interpretation of the results is discussed in Aguillar, J. & Hördahl, P. (1999), Option Prices and market expectations, *Quarterly Review 1*, Sveriges Riksbank.

11 For the period up to the end of 1998, options data for SEK/DEM were used and the results were transformed into SEK/EUR with the DEM/EUR conversion rate (1.95583).

12 Note that as the implied distributions are risk-neutral, the mean value invariably equals the forward rate.

13 We used the SEK/DEM rate because in this case we are studying a time series that goes further into the past.

Figure B3.
Estimated 90 per cent confidence interval for SEK/DEM one month ahead from 1 August 1993 to 25 May 1999



Sources: Reuters and the Riksbank.