

To sum up, short-term interest rates are assumed to be stable in the forecast period, which follows from the assumption of an unchanged repo rate. Some increase in long bond rates, in Sweden as well as abroad, is foreseen in the coming two years.

The Swedish krona is judged to remain weak initially and then strengthen; towards the end of the forecast period the rate of appreciation is assumed to be slower.

HISTORICAL VOLATILITY AND FUTURE PATH OF THE KRONA

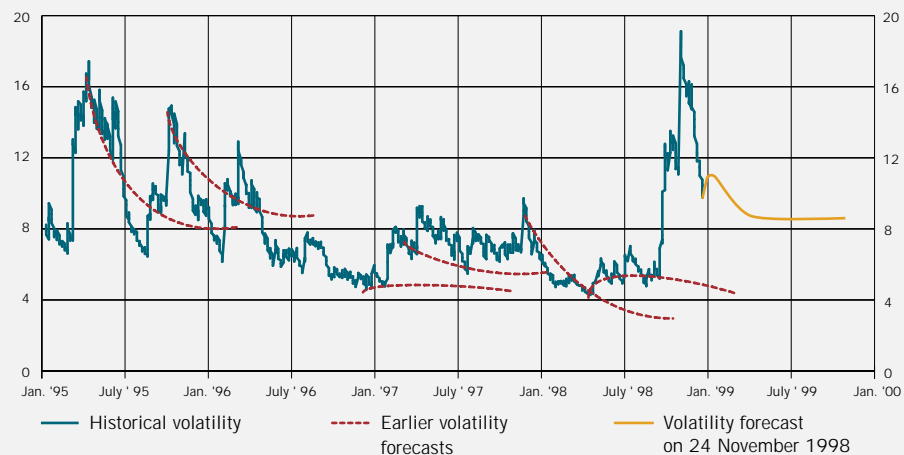
Volatility is a term for the variation in the price of an asset. In this study, the volatility of the krona exchange rate is measured as the size of unexpected movements in the SEK/DEM exchange rate.¹⁹ The krona has become somewhat more stable in recent years but the financial market turmoil this autumn has left its mark (Fig B1). After three years during which krona volatility averaged about 8 per cent, in recent weeks its volatility has risen at times to almost 20 per cent in annual terms.²⁰

So what will krona volatility be like in the future? Will it remain high or return to more normal levels? Nothing is certain, of course, but the market's expectations of future volatility can be estimated from market prices for currency options.²¹ It will be seen from Fig B1 that krona volatility has been high this autumn but has recently decreased markedly. It will also be seen

that market participants count on a continuation of the fall to an annual volatility rate of around 8 per cent, after which the rate will remain at that level in the coming year.²² The figure also shows that a relatively steep fall in krona volatility in the coming year was likewise expected in earlier periods of considerable market unrest. In the absence of new shocks that drove volatility up again, these market expectations were largely fulfilled. A similar, though less pronounced, pattern is discernible in periods when volatility was comparatively low; option prices have then tended to indicate expectations of rising krona volatility.

The present situation with high krona volatility and a weak exchange rate is broadly consistent with the historical picture.²³ Marked fluctuations in the SEK/DEM rate have frequently coincided with a relatively weak krona, as will be seen from Fig B2. An exception is the

Figure B1.
Historical and forecast volatility of SEK/DEM rate.
Annual percentage



Note. Volatility forecast from option prices in turbulent periods.
Source: The Riksbank.

end of 1997, when the SEK/DEM rate became less volatile at a time when the krona weakened. This deviation can be related to the debate at that time about the start of EMU leading to a marginalisation of the krona. It seems intuitively reasonable to suppose that the greater a currency's fluctuations, the larger will be any risk premium that investors demand to hold that currency.²⁴ A higher exchange risk premium tends in turn to weaken the currency; it may also exert upward pressure on the domestic interest rates, though this effect has been small in recent years.

Option prices indicate current expectations of a fall in the volatility of the SEK/DEM rate, though only to levels that are somewhat higher than before this autumn's financial turmoil. Given the historical relationship between the krona's level and its volatility, this suggests that the krona should appreciate when the financial unrest has subsided and investors again focus on more fundamental factors in the setting of prices.

19 More specifically, volatility is estimated in this analysis with a GARCH(1,1) model (Generalized AutoRegressive Conditional Heteroskedasticity). Empirical studies show that the dynamics of volatility are captured satisfactorily in GARCH models; see e.g. Bollerslev, Chou & Kroner (1992), ARCH modelling in finance, *J. of Econometrics*, 52, pp. 5–59.

20 In an international perspective, the krona's average volatility has not been abnormal; it is similar to that of other countries where inflation is targeted. The average annual volatility of GBP/DEM, for instance, has been much the same as for SEK/DEM in the past three years.

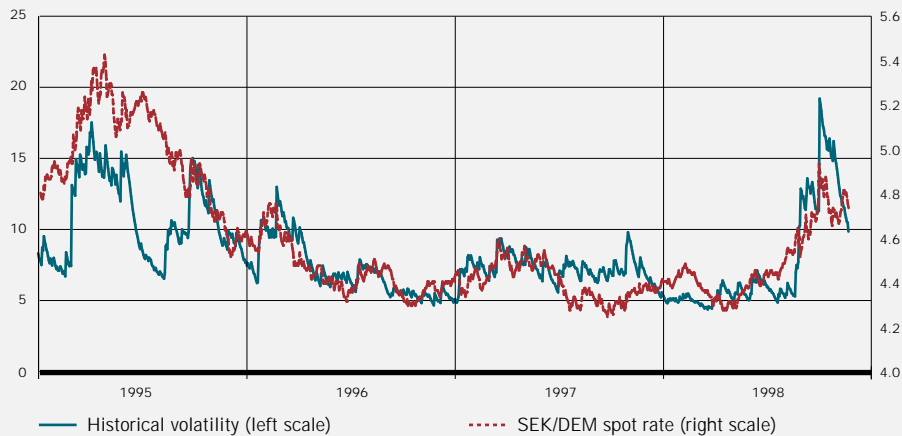
21 Expected volatility is defined here as the estimated forward volatility curve; see Aguilar, Javiera & Hördahl, Peter (1998), Exchange rates and currency options as EMU indicators, *Quarterly Review* 2, Sveriges Riksbank.

22 The pattern with an expected fall in volatility is not confined to the SEK/DEM exchange rate; it is also evident for other currency pairs, for example the DEM/USD rate.

23 This pattern is also evident in the AUD/USD rate, as well as in the FIM/DEM rate up to Finland's adherence to the ERM.

24 For references to studies of the correlation between exchange rate levels and volatilities based on risk premium models, see e.g. Bollerslev et al. (1992).

Figure B2.
Level and volatility of
SEK/DEM rate.
Annual percentage



Source: The Riksbank.