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DYNAMIC HEDGING IN CURRENCY CRISIS[1]

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Abstract

Garber and Spencer have argued that dynamic hedging may lead to perverse results when interest rates are used to defend an exchange rate. This paper shows that interest rate changes have little effects on dynamic hedgers when volatility is high.

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Dynamic hedging, central bank intervention, currency crisis

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1. Introduction

It seems widely accepted that central banks cannot defend a currency against persistent attacks. This believe comes in two facets. For one thing, it is argued that the defense of a currency is too costly in terms of real output and employment. This point will not be dealt with here. Second, it is often claimed that, given the size of international financial markets, central banks are technically unable to defend parities against speculative attacks. Thus, often turnover figures are compared with the size of international reserves or the volume of international trade to show that central banks or international trade no longer matter when it comes to explaining exchange rates (see Eichengreen and Wyplosz 1993, 99 and Schulmeister 1987, 8-9).

A sophisticated variant of this argument has been presented by Garber and Spencer (1995) and (1996) who show that interest rates rises may trigger sales of the weak currency by those market participants who rely on dynamic hedging strategies. They cite sources according to which such sales have accounted for 10 percent of the selling during certain periods (Garber and Spencer 1995, 512). In addition, their simulations show that for a wide range of plausible parameter values interest rate increases are likely to have a perverse effect. Delta hedgers will be selling the currency which is meant to be protected by higher rates. This argument is certainly valid but it is doubtful whether it is

important enough quantitatively to make interest rate increases inadvisable.

2. Dynamic hedging when volatility is high

When calculating the effect of interest rate increases Garber and Spencer use a range of volatilities which may encompass all plausible values in normal times. In their benchmark case they use a value of 15 per cent for volatility (Garber and Spencer 1995, 504). In one of the simulations volatility varies between 5 and 20 per cent. It is questionable, however, whether these values are close to the 'true' volatility during the EMS crisis. When market participants are facing the possibility of a regime change the observed volatility of exchange rates may be a poor indicator. Therefore, Ayuso, Pérez Jurado and Restoy (1994) have tried to take into account the possibility of a discrete parity change when measuring volatility. Summarizing their results for Spain, they state that 'the exchange rate risk that characterized the period between June 1989 and August 1992 is approximately four times greater than what would be deduced from the simple estimation of the *within the regime* volatility' (Ayuso, Pérez Jurado and Restoy 1994, 14). For other countries they have derived similar results. In times of increased uncertainty during the EMS crisis the corrected measure of the conditional variance rose as high as 2oo% and above (Ayuso, Pérez Jurado and Restoy 1994, 27-33).

However, if volatility was considerably higher during the EMS crisis than assumed by Garber and Spencer their estimates have to

be corrected. Using the same option price formula as Garber and Spencer[1] and the same parameter values (except for volatility) it can be shown that rising interest rates will trigger hardly any short-selling by delta hedgers if volatility is high. The price of a put option is given by equation (1):

$$P_t = -[1-N(d_1)]\exp[-r_{ffr}T]S + [1-N(d_2)]\exp[-r_{DM}T]X \qquad (1)$$

where r_{ffr} and r_{DM} are instantaneous risk-free interest rates in France and Germany, S is the DM/ffr spot rate, X is the strike exchange rate, T gives the number of periods until the option expires. $N(d_1)$ and $N(d_2)$ are the values of the normal distribution evaluated at d_1 and d_2 with

$$d_1 = [\ln(S/X) + (r_{DM}-r_{ffr}+\sigma^2/2)T]/\delta\sqrt{T} \qquad (2)$$

$$d2 = d1 - \sigma\sqrt{T} \qquad (3)$$

Normally, σ is the instantaneous standard deviation of the exchange rate. However, in this paper it is interpreted as a measure of expected exchange rate volatility. The hedge ratio is given by the option's delta which is defined as

$$Delta = -[1-N(d_1)]\exp[-r_{DM}T] \qquad (4)$$

[1] Garber and Spencer (1995) use the Garman/Kohlhagen formula.

The delta has been computed for various measures of volatility using the following parameter values: r_{DM} = 0,03, S = X = 1, T = 1 month. As can be seen in figure 1, if volatility is very high (up to 200% in this example) the delta of a short put position is hardly affected at all by an interest rate increase from 0 to 100 per cent. This implies that, once market participants are expecting a parity change, volatility may rise to such extreme levels that other parameters do not affect the delta of a short put position very much. Consequently they do not significantly affect the hedging behavior of delta hedgers. To give a numeric example. Garber and Spencer (1995, 511) calculate that the rise of one-month sterling interest rates on September 16, 1992 from 10.4 to 28.9 per cent increased the hedge ratio by 22 per cent from 54 to 66 per cent. This calculation is based on a historic volatility of 15.8 per cent. If the same calculation is repeated with a volatility of 100 per cent the hedge ratio increases by a mere 3.1 per cent from 44.7 to 46.1 per cent.

More generally, it can be questioned, whether any well defined hedging strategy can be sustained during a currency crisis. During speculative attacks past volatilities lose their informational content. Precise volatility measures have to be replaced by crude estimates. Furthermore, bid-ask spreads are widening (see Goldstein et al. 1993, 58-9). Therefore, the continuous adjustment of positions may become too expensive. Consequently, dynamic hedging is often no longer possible. As

could be observed during the EMS crisis, many market participants closed their long positions in 'weak' currencies completely.[2] Thus, it is the increase in volatility at the onset of the currency crisis which triggers selling of dynamic hedgers who abandon their hedging strategy. Once the closing of open positions has been completed, perverse market responses to high interest rates by dynamic hedgers will be of minor importance.

3. Conclusions

To be sure, dynamic hedging of option portfolios can, indeed, lead to perverse market reactions when central banks try to defend parities with higher interest rates. However, for two reasons this effect is likely to be small. First, in currency crisis bid-ask spreads are widening, making a dynamic hedging strategy more expensive, if not impossible, for many market participants. Second, in currency crisis volatility, measured as conditional variance (or standard deviation), is rising sharply. This mitigates the effects of interest rate changes on the hedge ratio.

Finally, it should not be overlooked that the option market functions as a kind of buffer. If a speculator or an 'ordinary' hedger sells, say, one million francs in the spot market or the forward market, he creates an excess supply of one million

[2] This is described by Goldstein et al. (1993, 57) as '100 percent hedged positions'.

francs.[3] But if he buys options with a notional value of one million francs and if the seller of the option uses a dynamic hedging strategy, less excess supply will be created - only delta times one million francs. Thus, the market makers in the option market actually keep away some of the pressure on central bank reserves. Therefore, on the whole, the notion that dynamic hedging impairs the use of the traditional 'interest rate weapon' does not seem warranted.

[3] In the case of a spot market sale this is obvious. In the case of a forward market sale the buyer of forward francs will immediately sell the amount spot to cover the open position and will subsequently use a swap to convert the spot position into a synthetic forward position which matches the initial forward contract (see Krueger 1996).

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Figure 1 Interest rate sensitivity of put delta