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Currency Option Markets and Exchange Rates: A Case Study of the U.S. Dollar in March 1995

Allan M. Malz

Some market observers attribute the dollar's recent drop against the mark and yen to a type of currency option known as the knockout option. Although knockouts did contribute modestly to the dollar's fall, their impact was felt to a much greater extent in the option markets.

The U.S. dollar weakened sharply in the four trading sessions between March 2 and March 7, falling roughly 7 percent against the German mark and the Japanese yen (Chart 1) and declining against several other major currencies. This was the first time since its rise during the European monetary crisis of September 1992 that the dollar had moved so sharply over so short a period. Many explanations have been offered for this poor performance, ranging from long-term macroeconomic factors to short-term trading conditions in the currency markets. Among the most often cited—yet most widely misunderstood—of these market conditions is the influence of currency options.

In particular, market observers have focused on the role of a special type of currency option, the *knockout option*, in driving down the dollar. In this edition of *Current Issues*, we will show that although knockout options did contribute to the dollar's unusually steep fall in early March, the effect was probably small. Much more noteworthy was the impact on the *option markets* made by knockout options and the hedging reactions to dollar movements that the knockouts induced, as currency option prices *doubled* over these four trading sessions. This edition of *Current Issues* will highlight the key role that knockout options played in this unprecedented development.

The Knockout Option Market

Knockout options differ from standard currency options in that they are canceled if the exchange rate touches a certain level. (The two types of options are described in greater detail in Boxes 1 and 2.) Knockouts have grown increasingly popular recently; discussions with option dealers reveal that transactions in knockouts had increased to between 2 and 12 percent of all currency option trading by early 1995 from a negligible share just two or three years ago. As we will see, a share as small as even 2 percent can exert a disproportionate influence on option prices under market conditions like those of early March.

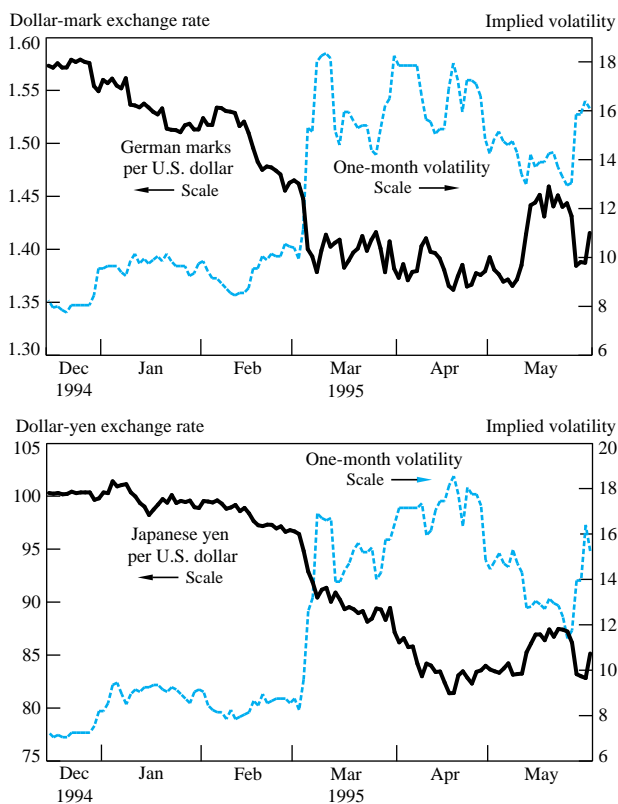
Option dealers and some nonfinancial corporations in Europe sell knockout options. Customers buy these options on the dollar against the yen, the mark, and other European currencies, as well as on European currencies against the mark, to protect themselves—or *hedge*—against currency risks less expensively than they could with standard currency options. By using knockouts, however, buyers also expose themselves to the risk of losses arising from their cancellation. For example, U.S. exporters might buy down-and-out dollar calls to protect themselves against a stronger dollar, but they would lose that protection if the dollar weakened substantially and the options were canceled.

Moreover, if the dollar whipsawed—that is, dropped and then rapidly snapped back to higher levels—the options would also be canceled and exporters could face losses from the higher dollar. Conversely,

Japanese exporters might buy down-and-out dollar puts to protect themselves against a falling dollar. If, however, the dollar dropped substantially, canceling the options, the exporters could also suffer losses.

Customers buy knockout options to hedge against adverse exchange rate moves; but why do *dealers* hedge options? The answer will help explain events in the currency markets in early March.

Chart 1
Exchange Rates and Implied Volatilities



Source: Reuters.

Hedging Knockout Options

Dealers hold “inventories” of bought and sold standard and knockout options on currencies that they must protect against losses arising from changes in exchange rates, option prices, interest rates, and the maturities of the options. They usually hedge standard options by buying or selling currencies incrementally as exchange rates change, a technique called *dynamic hedging*. For example, dealers selling dollar puts also sell dollars to hedge the puts against losses should the dollar depreciate and the puts expire in-the-money. That way, they will have sold, at more favorable exchange rates, at least some of the dollars delivered to them by the option holders.

Likewise, dealers must protect the knockout options they sell against losses arising from changes in market prices and option maturities. Unfortunately, these options, particularly down-and-out puts, are much more difficult to hedge. In fact, some dealers consider down-and-out puts essentially unhedgeable. Nonetheless, a sort of “best practice” has arisen among dealers for managing their risks through a combination of bought and sold standard currency options. This practice is designed to offset changes in the value of the down-

Box 1: Standard Currency Options

A standard currency option is a contract giving the option holder the right to buy (known as a call) or sell (known as a put) an agreed-upon currency at an agreed-upon exchange rate, called the *strike*. For example, the holder of a call on \$1.00 denominated in German marks with a strike of DM 1.60 has the right to buy \$1.00 at maturity for DM 1.60 from the seller or writer of the option. Conversely, the holder of a put on \$1.00 denominated in Japanese yen with a strike of ¥100 has the right to sell \$1.00 at maturity for ¥100 to the option writer.

To realize a profit, the holder must exercise the option—that is, take or make delivery of the currency at a favorable price. This can happen only if the option expires *in-the-money*. For instance, the DM 1.60 call would be in-the-money if the dollar-mark exchange rate exceeded the DM 1.60 strike; the ¥100 put would be in-the-money if the dollar-yen exchange rate fell below the ¥100 strike. A call option with a strike above the exchange rate is called *out-of-the-money*; a put option is out-of-the-money if its strike is below the exchange rate.

Dealers usually express currency option prices as *implied volatilities*. Implied volatility is often interpreted as an estimate of the degree of uncertainty in the marketplace about future exchange rates. For example, a one-year call on \$1.00 denominated in marks might be quoted as costing 20 percent in implied volatility terms. An implied volatility of 20 percent would indicate that the market is much more uncertain about where the exchange rate will end up in a year than an implied volatility of 10 percent would indicate.

and-out put arising from changes in market conditions with equal but opposite changes in the value of the bought and sold standard options.

To illustrate, let's look at a dealer who has sold a down-and-out put on \$1.00 with the strike at DM 1.60, the outstrike at DM 1.40, and a remaining maturity of one month. If the dealer believed the dollar unlikely to go much lower than DM 1.45, the dealer might have hedged by buying a one-month standard put on \$1.00 with a strike of DM 1.60 and selling a standard dollar put on \$4.00—four times the face value of the down-and-out put—with the strike at DM 1.44. Chart 3 shows that the value of this combination of options—the sold down-and-out put, the purchased \$1.00 put,

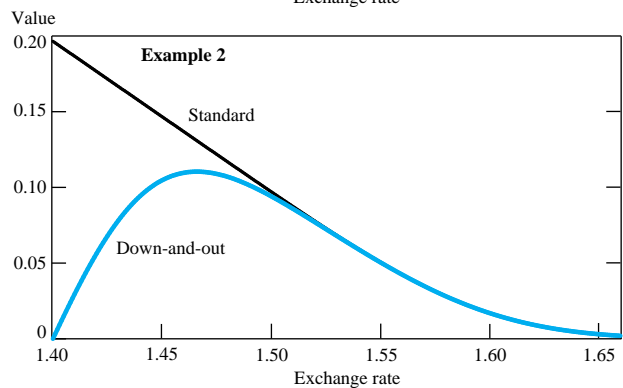
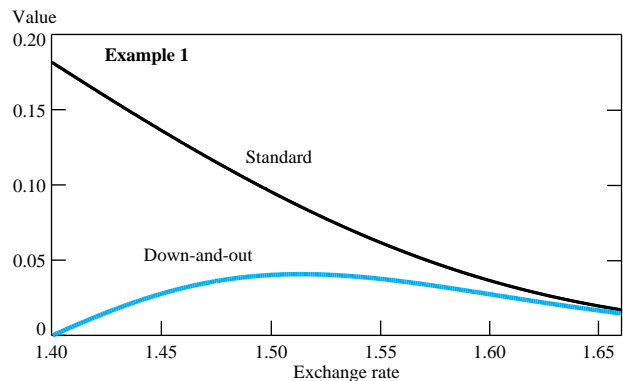
Knockout options differ from standard currency options in that they are canceled if the exchange rate touches a certain level.

and the sold \$4.00 put—changes very little for a wide range of exchange rates above DM 1.45 and implied volatilities below 10 percent.

This is a simplified example of how dealers hedge knockout options. Most dealers have even more complex strategies for buying and selling standard options as prices change and the maturities of the down-and-out puts draw closer; they also take into account the risks generated by other options in their inventories. The example does, however, capture the four essential features of dealers' hedging strategies: (1) the sale of large amounts of standard puts with strikes near the outstrike of the down-and-out put, (2) the subordinate role of dynamic hedging, (3) less frequent hedge adjustment, and (4) protection only within a particular range of exchange rates.

Down-and-out calls are easier to hedge than down-and-out puts. Dealers can dynamically hedge a sold down-and-out call by buying dollars initially and selling them incrementally if the exchange rate falls, rather than hedging with options. However, because cancellation would leave dealers with long dollar positions that no longer hedge anything, dealers generally attach stop-loss orders to sell the dollars as quickly as possible if the outstrike is touched.

Chart 2
Value of Standard and Down-and-Out Puts as the Exchange Rate Changes



Source: Author's calculations.

Notes: In both examples, the strike price is DM 1.60, the outstrike is DM 1.40, and the volatility is 10 percent. Example 1's time to maturity is six months; example 2's is one month.

Box 2: Knockout Options

Knockout options are similar to standard currency options except that they are canceled—that is, *knocked out*—if the exchange rate touches, even briefly, an agreed-upon level called the *outstrike*. When this occurs, the holder cannot exercise the option if it remains or subsequently goes in-the-money. Knockout options are less expensive than standard currency options precisely because of this risk of early cancellation.

Two types of knockout options were important in the recent period of dollar weakness. *Down-and-out calls* on the dollar have a positive payoff to the option holder if the dollar strengthens but are canceled if the dollar falls. *Down-and-out puts* have a positive payoff to the option holder if the dollar weakens but may be canceled if the dollar weakens beyond an agreed-upon point, since the outstrike is in-the-money. (Chart 2 compares the values of standard and down-and-out puts.)

March 1995: Currency Market Behavior in the Crunch

To fully appreciate what happened in March, let's return briefly to the example in the previous section. What might the seller of the down-and-out put have done as the dollar began in late February to slide toward DM 1.45, the point below which the down-and-out put plus its hedge were no longer protected against exchange rate moves? If the dealer thought the dollar would weaken at worst, say, to DM 1.42, the dealer might have bought back the large standard DM 1.44 put and sold a large standard DM 1.41 put, establishing a new protected range above DM 1.42. Or, if the dollar looked set to weaken even more, to DM 1.40 or lower, canceling the down-and-out put, the dealer simply could have bought back the large standard DM 1.44 put.

For either plan to work well, the dealer would have to buy back the DM 1.44 put *before* the dollar fell below DM 1.45, making the DM 1.44 put very expensive. If the dollar dropped suddenly and sharply, the dealer could buy back the DM 1.44 put, but only at a significant loss. If we take this example one step further, the worst-case scenario would be a sharp drop in the dollar occurring simultaneously with an increase in implied volatility, a combination of events that would make the option to be bought back even more costly. The loss from buying back the costlier DM 1.44 put would then be much greater than the gains from the cancellation of the down-and-out put.

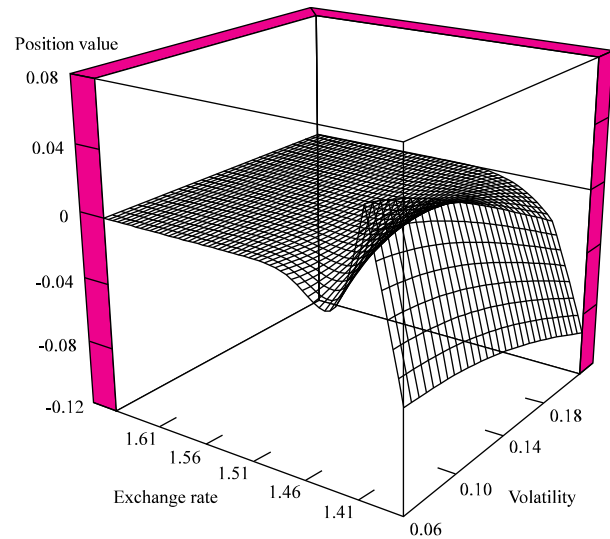
This worst-case scenario is exactly what happened in the currency markets in early March. As we have suggested, sellers of down-and-out puts manage their risks by also selling large volumes of standard puts,

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which are exercised only if the dollar depreciates sharply. In late February 1995, some dealers had on their books a substantial quantity of down-and-out dollar puts and a smaller quantity of down-and-out dollar calls with outstrikes between DM 1.45 and DM 1.35 or ¥95 and ¥85.

When the dollar dropped sharply in early March, many knockout options were immediately canceled and others appeared likely to be canceled soon thereafter, resulting in gains to the dealers. However, the standard options sold by the dealers to hedge the knockouts went

Chart 3
Value of a Hedged Position as Exchange Rate and Volatility Vary



Source: Author's calculations.

Note: The hedged position in the example consists of a sold \$1.00 down-and-out put, with a DM 1.60 strike, a DM 1.40 outstrike, and a one-month remaining maturity, plus a bought \$1.00 standard DM 1.60 put and a sold \$4.00 standard DM 1.44 put.

in-the-money as a result of the dollar's fall, becoming much more valuable and exposing dealers to losses that greatly outweighed the gains from the cancellation of the knockouts. A vicious circle ensued as dealers scrambled to buy large quantities of standard puts to minimize their losses, driving the prices of the standard puts up even further.

The effect on the option market was extreme because dealers needed to buy a huge volume of standard options at the same time as many other market participants, including customers trying to contain losses arising from canceled down-and-out puts. These customers also sold dollars outright when cancellation of the down-and-out puts left them unprotected against a weaker dollar, but this activity is likely to have added only marginally to the rush to sell dollars already in progress.

We should note that down-and-out calls were also canceled by the dollar's precipitous drop, and dealers who had sold these calls now sold the dollars they held to hedge them. However, because the down-and-out calls were out-of-the-money, the dollar hedges were small and their sale probably accounted for only a small part of the dollar selling. Conversely, down-and-out puts may have accounted for only a small share of outstanding options in early March, but because they were hedged by a far greater volume of standard options, they exerted a disproportionate influence on option prices.

Option Prices as an Indicator of Market Sentiment

This episode in the option market raises another important issue: the usefulness of implied volatilities as an indicator of market sentiment. As we have noted, implied volatilities are often interpreted as an indicator of market uncertainty about future exchange rates. These volatilities may have understated the degree of uncertainty about exchange rates before March, when dealers pumped options into the market, and overstated the degree of uncertainty in early March. Unfortunately,

The cancellation of [down-and-out] puts suddenly unleashed into the option market a large demand for standard put options by former holders of canceled down-and-out puts and, more important, by the dealers who had sold them.

the extent of the distortion caused by changes in option positions cannot be quantified, since there is no way to observe firsthand the degree of market participants' uncertainty.

What we do know is that down-and-out puts concealed customers' desire to protect themselves against a weaker dollar at lower levels. Had the down-and-out puts been unavailable, the holders would have instead sold dollars or bought standard puts, pushing the dollar down and implied volatilities up before March.

Therefore, by observing implied volatilities, market participants may have underestimated their own concerns about the dollar when it began to weaken in January and February, making the move in option prices in early March even more abrupt.

Conclusion

When considering the events leading to March 1995, market observers have emphasized the impact of down-and-out options on exchange rates. Certainly, these knockout options could only have added to the pressure on the dollar. As we have seen, however, down-and-out calls are likely to have played only a minor role in the dollar's drop, since the dollar hedges being liquidated were relatively small. Even dollar sales by customers and dealers resulting from the cancellation of down-and-out puts are likely to have been just a rivulet in the torrent of dollar sales taking place.

Instead, down-and-out puts had a much greater impact on option prices. The cancellation of these puts suddenly unleashed into the option market a large demand for standard put options by former holders of canceled down-and-out puts and, more important, by the dealers who had sold them. Although the down-and-out puts may have represented only a small percentage of outstanding options, they were hedged by a far greater volume of standard options. As a result, these knockout options exerted a disproportionate influence on option prices in early March.

A longer, more detailed version of this paper is available from the author upon request.

About the Author

Allan M. Malz is a trader analyst in the Markets Group.

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